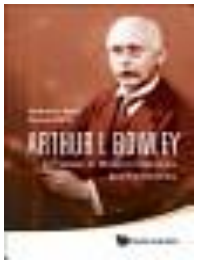


Arthur Bowley: the dog that did NOT bark in the night.

JOHN BIBBY, York

Note: This long-forgotten review-article was written in 2011 and emerged recently from a pile of digital dust. It is based on reading Dale and Kotz ('DK'), namely:

Arthur L Bowley: A Pioneer in Modern Statistics and Economics by Andrew I. Dale and Samuel Kotz (World Scientific Press 2011; 525 pp.).

Throughout my career I have felt the shadow of Sir Arthur Bowley (1869-1957) stalking my path. In the 1960s when I was at LSE, his spirit still permeated the walls in the *personae* of Sir Roy (R.G.D.) Allen, Alan Stuart, David (D.V.) Glass and their ilk. More recently, while planning large health surveys, Bowley's practical ideas resonated for me in the writings of Leslie Kish and Graham Kalton (who, coincidentally, were also there at LSE when I was there in '68-'69).

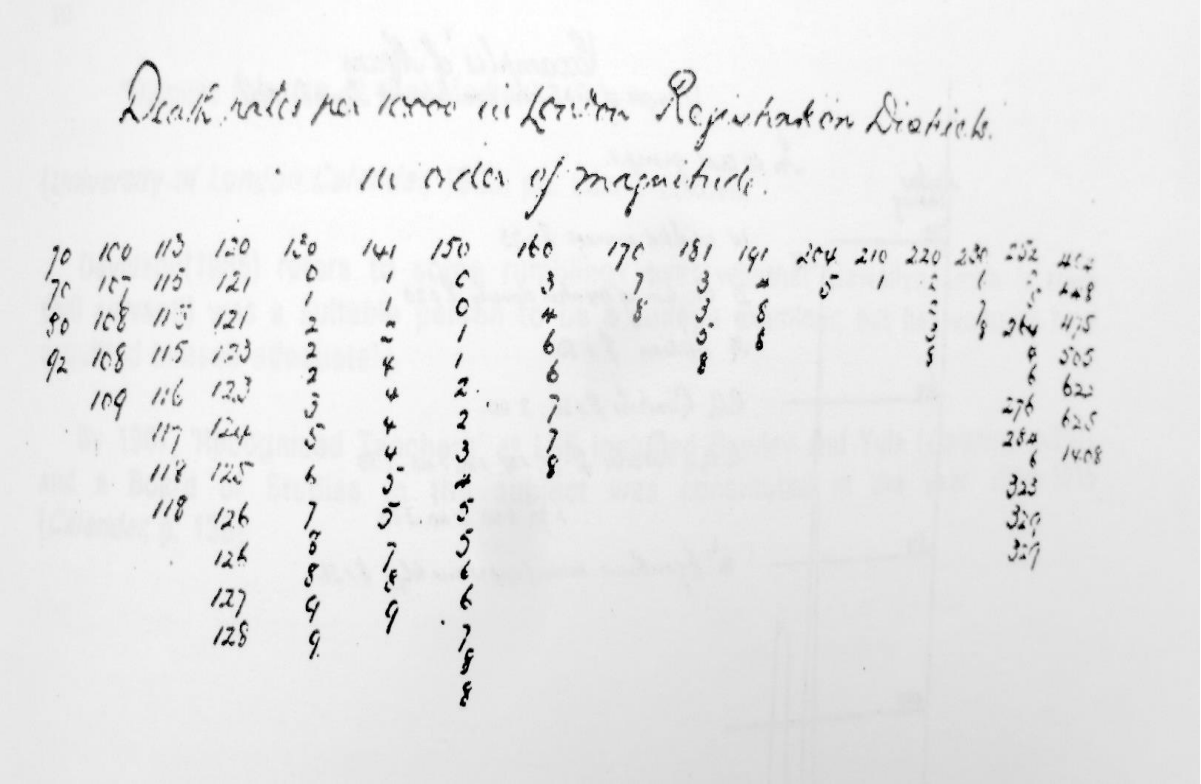
Bowley stalked me too in the 1980s when I was briefly at Huddersfield Polytechnic. It was then, while writing my *History of Teaching Statistics* book that I realised how well Bowley had anticipated John Tukey's *Exploratory Data Analysis* (EDA) ideas. The Polytechic had recently received the papers of George Henry Wood (1874-1945), late Secretary of the Huddersfield and District Woollen Manufacturers and Spinners Association, who had studied under Bowley at LSE. They wrote 6 papers together. However the most important thing for me was

that Wood had retained Bowley's original lecture-notes from his course at LSE during the 1890s. This was almost contemporary with Karl Pearson's famous Gresham Lectures, which subsequently had far more influence: one wonders why.

Bowley's lecture-notes were fascinating in form as well as in content. Their form was Gestetner-type mimeography, as used (according to Wikipedia) in school and university teaching for nearly a century starting in the 1880s. I still recall the distinctive odours of solvents and wax emitted by my mother's class-preparations in the 1950s and in my first teaching job in Ghana. (Is there a history of smells - an archive or a library I can refer to, or even a vocabulary and syntax that I can use to describe them? I have since learned via Alain Desrosières that such reproduction processes may be far, far older even than Bowley – going back e.g. to the 1790s lecture notes of Cauchy and others. But did Cauchy have the same smells? !!)

Apart from their form, the *content* of Bowley's lecture notes was also fascinating for me – an ardent Tukeyite. Bowley had followed the Galton-Edgeworth-Weldon school, using order statistics rather than moments (*pace* Pearson, whose moment-infatuated dominance came later). Remarkably, Bowley anticipated by nearly a century at least two innovations later attributed to Tukey – stem-and-leaf diagrams and "the five-figure summary" (see Figures 1 and 2). I showed these to Tukey in 1981 but he was unfazed, commenting that Bowley had "lost courage in the tails" of his stem-and-leaf precursor, as he had truncated the stem rather than list lots of empty leaves. (Personally, I prefer Bowley's truncated-stem idea rather than Tukey's untruncated and unruly vine.)

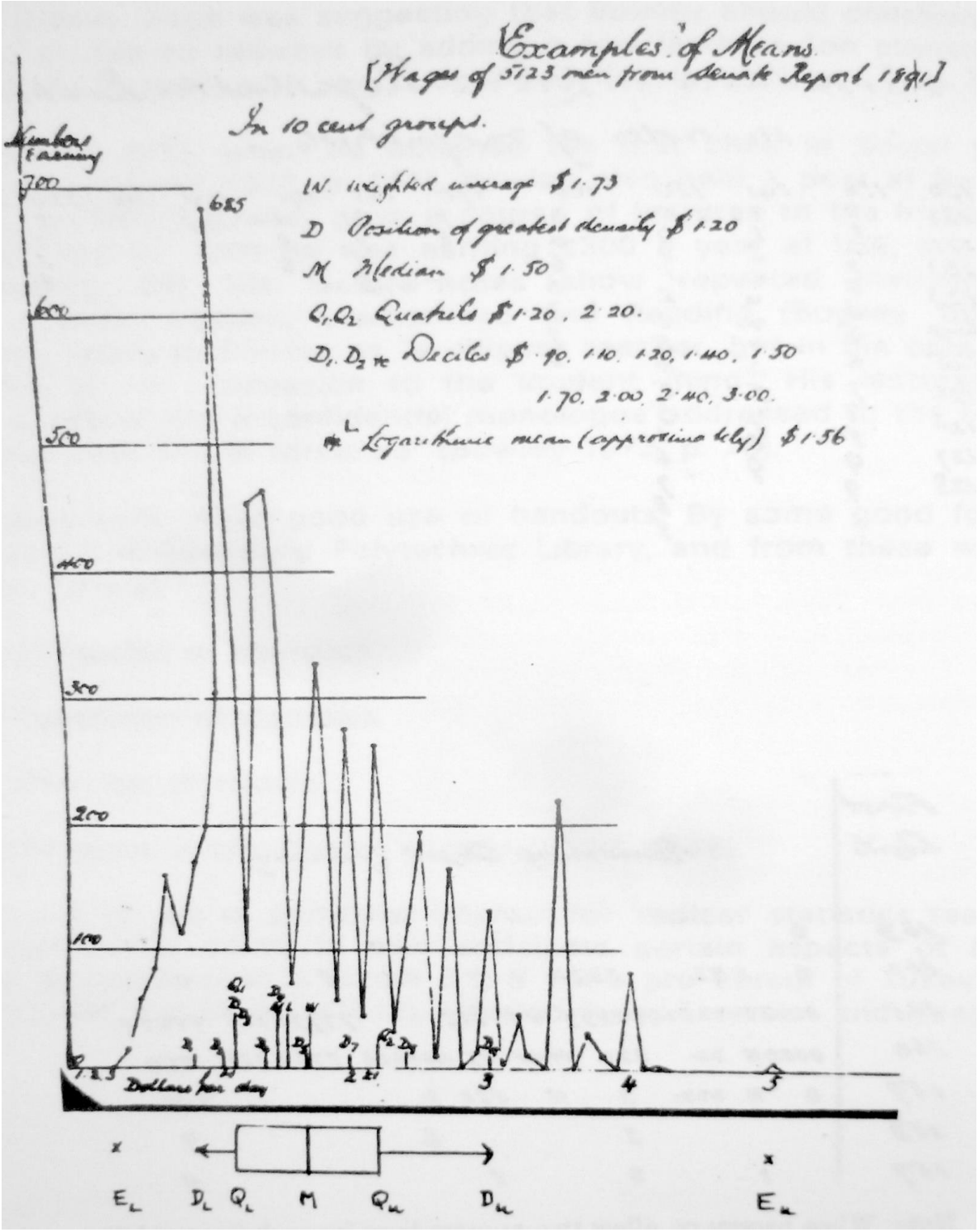
Tukey's five-figure summary (extremes, quartiles and median) was also insufficient for Bowley, who added deciles to give more information about the tails. His "seven positions" lead to robust, intuitive measures of average, variability and skewness – thus obviating the first three moments of Karl Pearson's later scheme of moments. (Measures of kurtosis are also possible, and comparing median with mid-extreme, mid-decile and mid-quartile can be particularly illuminating regarding symmetry.) Pearson had the advantage of mathematical tractability (more important in those pre-computer days than it is today), but Bowley's measures based on order-statistics are more intuitive, more calculable, and more robust.



Bowley: "Death rates per 10,000 in London Registration Districts in order of magnitude"

A precursor of Tukey's stemplot idea. Taken from Bowley's 1890s LSE lecture-notes, via G H Wood and Bibby (1986) "Notes towards a History of Teaching Statistics (HOTS)", p.55.

Recently I have studied some London statisticians of the 1890s, including not only Florence Nightingale, but also Karl Pearson, Francis Galton and Raphael Wheldon who were based around University College, the “old lady of Gower Street”. At the same time, just a mile further south, Arthur Bowley beavered away at LSE in apparently a quite separate world. (He was one of the first appointees, starting in October 1895.) Despite searching, I have found no evidence of any contact between Bowley and Pearson, although they were both so active in similar areas, and so physically close for so long. This I find remarkable. Was it because Bowley was active in the RSS, while Pearson notoriously was not - or was there some other reason? Pearson claimed to have been a radical and a socialist, yet ignored LSE, that hot-bed of radicalism. (I recall that Beatrice Webb made some acidic remarks about Pearson – or was it the other way round? Perhaps umbrage was taken and Bowley got caught in its fallout. It is reported that in 1927-28, Bowley's Newmarch Lectures at University College “drew members of Karl Pearson's department” (DK26). Yet on



Bowley: "Examples of Means. (Wages of 5123 men from Senate Report 1891.)"
This shows Bowley's "seven positions" (median, quartiles, deciles and extremes): an extension of Tukey's boxplot and "5-figure summary". Taken from Bowley's 1890s LSE lecture-notes, via G H Wood and Bibby (1986): "Notes towards a History of Teaching Statistics (HOTS)", p.56.
Bowley's representations of deciles etc are shown by the symbols D_1, D_2, Q_1 etc. along the horizontal axis, below which is a "decile boxplot" as used in the Open University course "MDST242: Statistics in Society".

one occasion the only attendees were Bowley's mother and a friend! Bowley does make passing reference to Pearson (who was twelve years older) in some of his writings, but I have seen none in the opposite direction. Historians must be detectives: is this a case of a dog that did NOT bark in the night?

More recently while re-reading Leslie Kish – whose writings can answer all survey statisticians' prayers – I came to realise how crucial Bowley was – along with Kiaer - in getting the notion of random sampling established in place of the contending "representative method". (This latter involved selecting a range of 'typical' subgroups, and then analysing them in their entirety – see DK324. This method has some merit in design if combined with random methods e.g. in selecting subgroups to sample, but is unable to provide numerical estimates of uncertainty.) History's verdict on Bowley may identify this as the most important of his many contributions.

At the risk of these comments on a book about Bowley becoming an auto-biography of myself (JB), I should also comment that not only has Bowley's influence followed me for many decades but so too has *this book* followed me. In the 1990s I had a small publishing house, QED Books, which specialised in popularising mathematics. One day, I received out of the blue a large parcel from Samuel Kotz containing an early manuscript of this book. He wanted me to publish it, and was prepared to cover much of the costs. I was of course overwhelmingly flattered that such an eminent statistician should consider publishing *via* my very minor press. I was sure I was not his first choice, and I recall a sense of deep disappointment on reading the manuscript, along with the certainty that it needed to be drastically re-written if I was to publish it. QED books did specialise in *popular* mathematics after all!

The upshot was that Kotz went his separate way; he found an established co-author in Andrew Dale, and this book is the result. (Unfortunately, Sam has died in the interim, and I am saddened that may have been partly due to my delay that he did not live to see this book published.)

Thus for many reasons, this book has a particular interest for me. However, it still suffers from many of the weaknesses that I sensed when I first saw Kotz's manuscript some decades ago. It lists some

300 of Bowley's publications (DK469-488) and provides rather pedestrian summaries of many of them. These will be extremely useful to those who need them, but they contain few sparkles – there is no "big picture". Only rarely are links made to Bowley's life-environment or character. He comes out as a one-dimensional man. [Maybe this is where professional historians can help: I got more 'life' out of the 4-page description of Bowley and Wood in Davidson (1985:120-124) than I did out of all of DK's biography section, particularly regarding the interplay between their statistical work and their political beliefs.]

DK reminds me of comments made about Pearson's monumental biography of Galton – that it "buried the man beneath the monument". But at least Pearson *enthused* about his subject – indeed *worshipped* him. Pearson gives us 'big picture' as well as detail. I get no sense of this from Dale and Kotz. There is no passion. It is as though after starting the task, they were *damned well going to finish it*. I for one am glad they did: it is a fine monument, but it is far from being the 'definitive' biography. Indeed, it is barely a biography at all. Most life-details come in the first thirty pages, and much of this uses the warm monograph written by Bowley's daughter Agatha (A.H. Bowley 1972; another daughter was the housing economist Marion Bowley, whom I have heard blamed for the worst excesses of 1960s social housing's brutalistic architecture). Agatha clearly adored both parents – her mother was a leading wood-carver, teaching at Reading College when she met Arthur (DK13). At this time he was already examining "the socialist's statement that the rich were getting richer and the poor poorer". This question, he said, "led to a great part of my statistical work after 1892" (DK8). Did it ever cease to be relevant? Bowley was one of LSE's first lecturers when it opened in October 1895, and much of his subsequent work involved constructing methodologies and data which together could illuminate social and labour issues.

In many ways Bowley straddles Victorian and modern traditions. History has undervalued him, and as the authors comment: "while hundreds of articles and books have been written on Karl Pearson, those on Arthur Bowley amount to a dozen or less". Recent revivals in poverty studies have led to renewed interest in Bowley's legacy, which is actually far broader than this, as DK well illustrates. Apart from his poverty surveys in the styles of Booth and Rowntree, the authors also discuss Bowley's work in the following areas:

- national and official statistics
- wages and incomes
- foreign trade
- India
- housing
- index numbers
- sampling
- pure mathematics.
- aspects of statistical methodology – goodness of fit, inference, averages and the double median.

After his work on sampling, Bowley's greatest legacy lies in his textbooks, which extend to many editions. I hope to discuss his "Elements of Statistics" (1901 *et seq.*, six editions) and "Elementary Manual of Statistics" (1910 *et seq.*, five editions) elsewhere; these and "Mathematical Groundwork of Economics" were all pioneers in their field. If, as Kuhn and Agassi have claimed, the true nature of a discipline is defined by its leading textbooks, then Bowley was instrumental in constructing two modern disciplines – statistics and economics. Yet he seems to have been written out of our Whiggist intellectual history. [By "Whiggist" I mean a history which presents the past as a progression leading inevitably to the present. By contrast, a Darwinian history would also consider apparent dead-ends representing less 'fit' memes and ideas such as Bowley's that did not survive.]

Bowley's friend Alfred Marshall supported him in writing "Mathematical Groundwork". It was the first to bring together the works of Cournot, Jevons, Pareto, Edgeworth, Marshall and Pigou using a uniform notation (DK358-384). From utility-based Edgeworth-box type analyses of 2-commodity exchange, it develops elasticities of demand and the marginalist result that "the greatest satisfaction is obtained when the transference of a trifling sum from one purchase to another would have an insignificant effect on satisfaction" (DK362). Then follow supply curves and analyses of consumer- and producer-surplus, all enveloped in a discourse of simple equations and diagrams as in Lipsey's *Positive Economics* or any standard undergraduate text. It all looks very modern, and was quite different

from what went before.

Thus Bowley used a mathematical and diagrammatic discourse to provide one of the first coherent introductions to positive economics. His book was well-received, but was not an easy read – as indicated by two eminent reviewers:

- "(The book is) clear, concise and correct …. The maturer student will be edified by it …" (Edgeworth 1924:430)
- "Bowley belongs to those who love conciseness more than is desirable for the average reader" (Wicksell 1925:209).

The concept of "positive economics" is of course deeply flawed, especially when it purports to be 'value-free'. Two weaknesses are that it is intrinsically a-historical, and it also ignores the crucial role of access to social power – especially the role of asymmetric information. Nevertheless, positive economics provides a template of discourse which is useful even for radical economists, and Bowley founded some of this discourse.

Despite this, we may claim Bowley as a "radical economist" and a "radical statistician" for his times. He had no illusions that his work was 'value-free', and he was well aware of the importance of information and social power. Thus one might say that Bowley provided one of the first pedagogic constructions of positive economics but also was on the threshold of its deconstruction. (I have also wondered whether his use of the rather peculiar word "Groundwork" in his book-title was intended in any way to resonate with Marx's use of "Grundrisse", but have no evidence for this.)

Two crucial tensions in Bowley's work gave him the means to cross this threshold i.e. to deconstruct the paradigm of positive economics that he had himself constructed. First, his neo-classical analyses of the *theory* of economic exchange conflicted with his *practical* work on poverty and the labour market, which showed the limitations of these analyses. Second, despite his pioneering work on probabilistic survey sampling, these did not cohere with his visionary statement concerning the crucial role of information:

> *"It is because of the immediate and pressing need of information before we commit ourselves to dangerous remedies on an erroneous diagnosis that I have spent my allotted time in pressing the importance of scientific method in statistical research* (DK357;

Bowley 1906:558)

Thus the value of information was centre-stage in Bowley's work's rationale; he is barely one step away from the important notion that information's value can be weighed against the costs of "dangerous remedies" and "erroneous diagnoses" - thus presaging today's ideas of cost-benefit analysis and "evidence-based policy". Yet Bowley ultimately disappoints, as his work on random sampling – in common with all nearly all the works that have followed him – rarely mentions information in this common, everyday sense.

When 'information' is mentioned today in discussions of survey sampling theory, it is generally in the narrow Fisherian sense. We have rushed down the dead-end of Type I and Type II errors with few considerations of how these relate to the *value* of information being collected. **An alternative paradigm is needed.** This would start from Bowley's assertion (above), and would compare the costs of collecting information against the value that the information can provide. This includes, but is not limited to, the value due to improved decision-making.

The required 'alternative paradigm' could include the following features:

- if information (e.g. estimates of a particular parameter or variable) increases the value of decisions made, then this increased value is part of the 'value' of that information
- the value of any decision using a particular estimate (piece of information) is a decreasing function of its bias and uncertainty
- with knowledge of the above, the optimal expenditure on e.g. sample size is to increase the sample size until the incremental cost exceeds the incremental gain in value due to reducing bias and uncertainty.

This paradigm contrasts with current cost-optimisation models for surveys which generally assume fixed budgets, and totally ignore the value of information.

To illustrate the proposed new paradigm (and at the risk of over-circularity) let me ask: What is the value of this book by Dale and Kotz? At the very least, its literature reviews may assist readers in deciding which of Bowley's works to read. Can we estimate how many readers it will thus assist, and how many hours on average it will save

them? Will it save on inter-library loans? If so, we are some way towards estimating this part of the book's value.

In addition, such books may enhance culture – of groups or individuals; they may help us avoid repeating last year's mistakes; they may enrich our understanding of today's history and/or raise alternative visions of the future's potential; they may reinforce or challenge stereotypes; or they may just be a damn good 'story'. In my estimation, Dale and Kotz score less highly on these dimensions than on the strict "literature-guide" dimension.

Equally - to continue the infinite regress - what is the value of this review? Nothing – unless it leads some to explore or avoid the writings of this important figure who worked largely outside the hegemonic paradigm (even if this was not clear in his day), and as a result has been neglected by subsequent authors until now.

One of my several helpful reviewers commented that he disapproved of my "ranting about the need for a new information paradigm" and said "I can't see that it is fair to moan at Bowley so". In response I have modified my "ranting, and if I am "moaning" at Bowley at all, I would only say in mitigation that this is one of the things that reviewers do; my assessment of Bowley is that he merits considerable further study – especially the links between his technical work and the political current of the times - and Dale and Kotz's book is but a first step towards this.

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Author's note: JB thanks Ludi Simpson and Andrew Dale among others for their comments, and apologises for the narcissistic ramblings!

Comment from Editor

Most bespoke surveys in the UK (as distinct from Government Censuses and Surveys) are carried out in response to a tender and so cost-benefit rather than cost-optimisation is the criterion.

Also one useful way to enhance the value of surveys is to establish the extent to which they are really representing their declared population. For example most (all?) household surveys exclude those who are not in households – perhaps as much as 10% of the world population and about 2.5% of the UK population – nearly all of whom are the poorest of the poor; so the survey results underestimate the impact of poverty on the outcome(s) they are examining. This would be one way of assessing the value of a survey.