THE WORK OF L. H. C. TIPPETT

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1. A Reminiscence.

Many years ago, when I was a graduate student, I took my first job (at the munificent salary of fifty dollars a month) as a research assistant to the late Lionel Penrose. Penrose, in addition to being one of the world's great authorities on the genetics of human defect, was also an expert statistician, and I first learned all of my elementary statistics while working for him. It was Penrose who recommended Tippettt's text [3] on statistics to me, and it was almost the first statistical work that I studied. Several years later, when I had a little bit more money, I was able to purchase one of Tippett's books [4], and it is sitting in front of me as I write this tribute; it is an interesting comment on changing times that the price of this "hard-cover" volume was only $3.50.

The jacket blurb on **Technological Applications of Statistics** is worth recalling, in part, since it catches very well the flavour of Tippett's work and his dedication to practicality. The publisher describes the book as "an introduction to statistical methods applied to technological problems", and continues with the following description.

> After presenting the logic of the statistical methods to be employed, the author emphasizes and illustrates the practical points that arise in applying statistics to problems in industry and technology. Throughout the work, he stresses the practical importance of the mathematical assumptions involved. The exposition is based on particular examples ...[to] help the reader attain the necessary "feel" for the subject. He also cites the working through of the examples - which are treated

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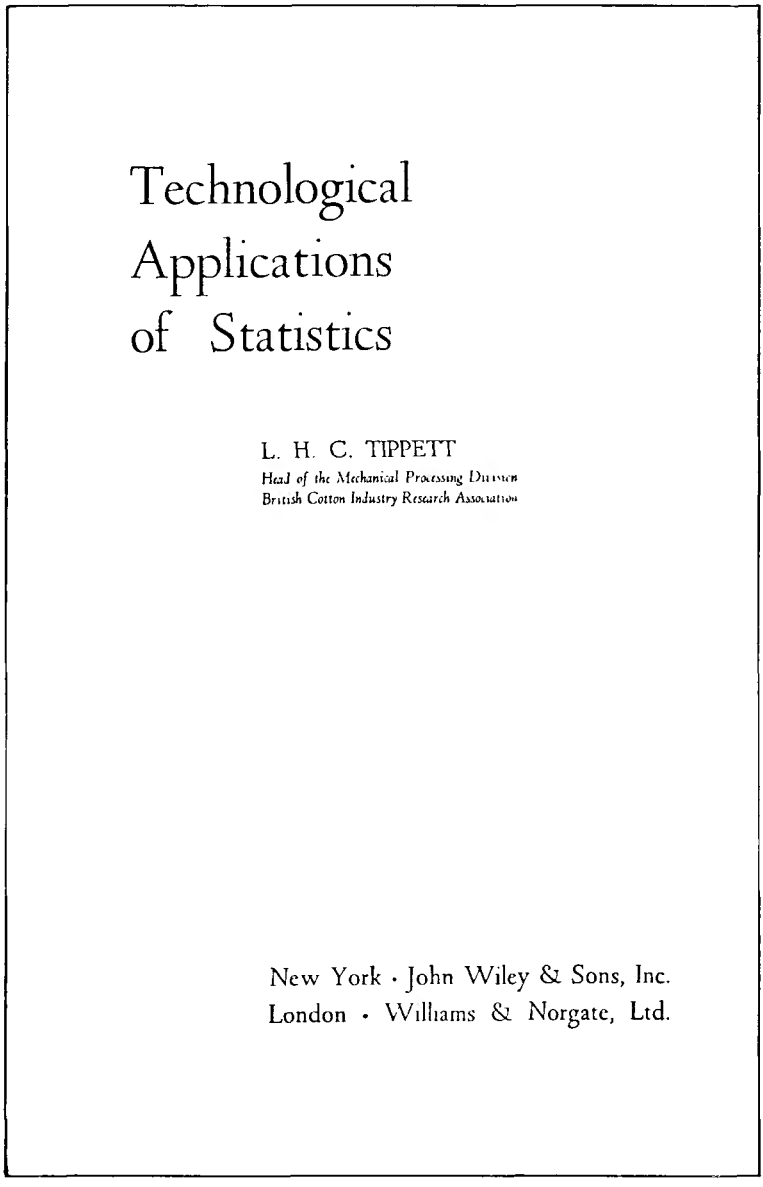
Technological
Applications
of Statistics

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Figure 1.
Title-page of the first edition of Tippett's
Technological Applications of Statistics

as problems in technology as well as statistics - as necessary to obtain a thorough understanding of the subject.

The reader is now probably wondering why an account of the work of a statistician should be appearing in **Ars Textrina**, and succeeding sections of this paper will certainly justify the inclusion. Tippett was no ordinary statistician; he devoted his entire working life to technological applications in the British textile industry, and that industry owes him a very great deal. Statistics is a very general subject; the same scientific methods can be applied to a wide spectrum of different problems. But, if you wish biologists to use statistical methods, the examples need to be drawn from biology; if you wish psychologists to use statistical methods, the examples should involve familiar situations, such as drug-testing experiments. And, if you want to introduce statistical procedures into the textile industry, the examples and illustrations need to involve familiar textile situations. This was a pedagogic principle that Tippett exploited to the full, and we shall later include a few cases showing his down-to-earth approach to practical problems in the textile industry.

2. Some Brief Biographical Details.

Leonard Henry Caleb Tippett (1902-1985) was born in London, England, and was educated at the St. Austell County School, Cornwall, and at Imperial College, London. After graduating from Imperial College in 1923, he was awarded a studentship by the British Cotton Industry Research Association (the Shirley Institute) to study statistics under Professor Karl Pearson at University College, London; later, he also worked with the great Sir Ronald Fisher. In his biographical article [2], he admits that his first statistical book [3] was an attempt "to present a unified system of statistics, uniting the approaches of Pearson and Fisher".

Tippett left University College in 1925, and spent the next forty years working at the Shirley Institute. He put statistics to work in a variety of industrial problems such as the problem that looms in

weaving sheds were idle approximately thirty percent of the time (the reasons were then unknown); the problem of yarn breakage rates in weaving; the problem of the relationship between the length of a test specimen of yarn and its strength; the problem of the variation of thickness along the length of a yarn.

Tippett's practical approach can best be illustrated by looking at a few examples that he used in his book on the technological applications of statistics. First, let us look at his approach to control charts. He states that

> all this advice is very general and somewhat vague, but the following particular example may be helpful. The mule is a machine used for spinning cotton yarn ... in Lancashire. It has about 1200 spindles all simultaneously spinning cops of yarn, each cop containing 700 to 2500 yards. For testing purposes, the yarn is divided into lengths of 120 yards, called leas, so that each cop contains from 6 to 20 leas. As a sample of production, cops were taken from 5 spindles of mule 38, and 2 leas were taken from each cop ... The quantity tested was the lea weight.

Tippett then proceeds with an exact account of procedure; the important thing to note is his insistence upon illustration by an arithmetic example, and an example that related to the experience of his colleagues in the Shirley Institute. It is no wonder that he was able to popularize statistical methods among many textile people who might have regarded them suspiciously if they had not been couched in familiar terms.

Another of Tippett's textile examples

> gives the results of a weaving experiment ... There were six lots of warp yarn labelled AL, AM, AH, BL, BM, BH. They were spun from two growths of cotton, A and B, and each cotton was spun to three twists (number of turns in the yarn per inch): low (L), medium (M), and high (H). The combinations of these factors give the six kinds of yarn, which are the experimental treatments. ...

> The number of warp threads that broke during the weaving of each warp was counted and expressed as a rate of so many breaks per unit length of warp.

Having set up this practical model of what statisticians call a factorial experiment, Tippett then showed how to analyse the data collected so as to determine "the weaving quality of each yarn". Again, he couches all of his discussion in practical arithmetic terms.

Finally, let me quote another of Tippetts's examples, this one concerning the use of correlation analysis. He points out that

> in the weaving of cloth, it is important that the weft (or filling) packages should not disintegrate unduly under the forces of weaving, and, in order to control this, a measure of the tendency to disintegrate is required.

He then carries on to present the complicated topic of multiple regression analysis with his usual clear and forthright arithmetic approach.

These three examples surely illustrate the way in which Tippett always kept his feet firmly planted on the ground. He relied on actual mill observations, and his work in improving production efficiency and operative utilization was a forerunner of modern "operational research". Indeed, his "quality control" methods in the textile industry, which led to more looms per weaver, were sufficiently innovative that he received the prestigious Shewhart Medal given by the American Society for Quality Control.

3. Career and Honours.

Tippett moved steadily upwards in the Shirley Institute and became Head of the Mechanical Processing Division in 1945. He served on many professional bodies, was President of the Manchester Statistical Society in 1960, and was later President of the Royal Statistical Society in 1965. He also served in the Textile Institute and in the Association of Managers of Textile Mills. I have already mentioned

the award of the Shewhart Medal to him; he was also awarded the Guy Silver Medal of the Royal Statistical Society.

In the postwar years, Tippett was active in various educational cam - paigns undertaken in Britain for the purpose of introducing quality control and improved productivity into British industry. At one time, he was seconded as a part-time consultant to the Anglo-American Council on Productivity. His book **[4]** was the result of a series of lectures on experimental statistics given at the Massachusetts Institute of Technology in 1938; these lectures were so successful that he gave a repeat performance in 1948, and the second set of lectures was published by John Wiley and Sons.

In addition to various research papers on applications of statistics in the textile industry, Tippett produced three books. The first two of these, **[3]** and **[4]**, have already been cited. The last (1969) was **A Portrait of the Lancashire Textile Industry [5]**. This book, which was written after his retirement, displays his continuing enthusiasm for the industry to which he had devoted his entire working life.

After his retirement in 1965, Tippett went back to live in St. Austell, but remained active as a sort of "emeritus statistician". He served as a **UNIDO** consultant,and was active in India; he also received an honorary degree from the University of Manchester Institute for Science and Technology. Indeed, J.E. Ford **[1]**, in his obituary notice of Tippett for the Royal Statistical Society, points out that Tippett was probably the most internationally distinguished member of the staff of the Shirly Institute; this is no small praise.

Tippett always had a keen interest in books and music, and was still in excellent health at the time of his death (an operation for cataracts had been successful). He belonged to the St. Austell Choral Society, and was walking from his home to sing the St. Matthew Passion at the Choral Society, when he was hit by a van.

Tippett's standing in the statistical world is perhaps best illustrated by the fact that the recent book [2] on **The Making of Statisticians**, edited by J. M. Gani, selected him as the prototype of the industrial statistician. The flavour of the personality of this modest and dedicated man can be obtained by reading his own account of himself (pages 181-187) in that work; his obituary [1] is also instructive. He was a man who had a very full and very productive career, and his work deserves to be remembered for its role both in the development of practical statistical methods and in the quantification of the re - search procedures employed in the textile industry. He spanned two disciplines, and they both benefitted from his labours and his expertise.

REFERENCES

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[5] L.H.C. Tippett, **A Portrait of the Lancashire Textile Industry**, Oxford University Press, 1969.