Comment

Ingram Olkin

History tends to emphasize and document the research accomplishments of an individual more than personal characteristics, and this has been the case with respect to Harold Hotelling. His name in the index of a book or in an encyclopedia of statistics will bring forth Hotelling's T^2, canonical correlations, principal components, transforms of the correlation coefficient, etc. Much less is known of Hotelling's role in the development of statistics as a profession. He was very much concerned with the training of statisticians, with the teaching of statistics, with the role of statisticians in cross-disciplinary research and with the general welfare of the statistical profession.

Hotelling's doctoral dissertation was in topology and was written under the direction of Oswald Veblen at Princeton. After receiving his doctorate in 1924 he accepted a position in the Food Research Institute at Stanford University. It is hard to imagine such a career sequence today. But Hotelling was always interested in applying mathematics to statistics and economics, and this position provided an opportunity to develop theory from practical problems. Hotelling's teaching load at Stanford reflects his background and interests; in 1927 he taught three courses—mathematical statistics, differential geometry and analysis situs (topology)!

Hotelling wrote a number of articles on statistics as a profession. An IMS committee on the teaching of statistics was established with Hotelling as chair. The other members of the committee were Walter Bartky, then Dean of Arts and Science, University of Chicago; W. Edwards Deming, then Director, Division of Statistical Standards, Bureau of the Budget; Milton Friedman, then Associate Professor of Statistics, School of Business, University of Chicago; and Paul Hoel, then Associate Professor of Mathematics, University of California, Los Angeles. The committee issued a report, published in *The Annals of Mathematical Statistics* **19** (1948) 95–115, that addressed a number of issues which still plague the profession, and offered a program for action in the future.

The committee conclusions addressed the following issues:

1. Who are the prospective students of statistics? (1a) college students, (1b) future consumers of statistics, (1c) future users of statistical methods, (1d) future producers and teachers of statistical methods.
2. What should they be taught?
3. Who should teach statistics?
4. How should the teaching of statistics be organized?
5. What should be done about adult education?

The second part of the report reflects Hotelling's views and provides a more intensive discussion of the general problem on the teaching of statistics. Much of this portion of the report is discussed in Hotelling's 1949 paper that is reproduced.

One of Hotelling's central themes is that the teacher of statistics must have a thorough knowledge of the subject. He may touch a raw nerve when he states "... the teaching of statistics cannot be appreciably better by mathematicians ignorant of the subject than by psychologists or agricultural experimenters ignorant of the subject." However, he does note that the mathematician has an advantage in more easily being able to study the field. It would be a serious mistake for us today to deny the mathematical roots of the statistical sciences, and indeed some areas of the field may be viewed as branches of the mathematical sciences. But by the same token it would be a serious mistake for us to deny that many of the fundamental aspects of the statistical sciences differ radically from mathematics. The description by John Tukey that statistics is part mathematics is most apt. Acceptance of this description has implications in the way that statistics is taught, in the choice of teachers of statistics and in the role of a statistics department in a university. But it also has implications for governmental and industrial organizations. For example, should statistics be part of a mathematical division, or part of a behavioral, social or economic sciences division. Perhaps statistics should not be relegated to any single division but should be part of every division. Is research in statistical methodology as applied to the social sciences, say, to be viewed as social science research or as statistical research? At one level it does not matter as long as the needed research is completed. However, there is a hidden difficulty in that the research may not be supported if statistical methodology as applied to the social sciences has the requirement of advancing the social sciences per se. Thus, many of Hotelling's concerns are as alive today as they were 40 years ago when he wrote these articles.

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I would like to add some personal reminiscences of my association with Hotelling at the University of North Carolina in Chapel Hill from 1948–1951. During that period I took some of his classes and had numerous discussions with him at his Sunday teas (appropriately called Hotellings' T). The class lectures were quite lofty and generally not fully appreciated by many of the students. We knew that a book was in the offing, but I do not recall reading any of the chapters. The teas were much more memorable. Susannah Hotelling was a marvellous hostess and tried to make each student feel comfortable. The table of goodies helped the graduate students through many a Sunday. Hotelling wrote and spoke in verse—one could feel the punctuation in his long encyclopedic discourses. What came through to me was an individual for whom science and the scientific method was paramount. This removed prejudice and politics from his arena—everyone was equal and what mattered was the result of one's research. I never had the feeling that priority of publication was essential to him, but only that the results be made available to the research community.

On a personal level he had a profound effect on my development. In addition to Hotelling, in 1948 the Chapel Hill faculty consisted of R. C. Bose, W. Hoeffding, P. L. Hsu, W. G. Madow, G. Nicholson and H. E. Robbins. S. N. Roy joined shortly thereafter and E. J. G. Pitman was a visitor. P. L. Hsu normally taught multivariate analysis, but was on leave in China never to return to the United States. The multivariate course was taught by Wassily Hoeffding, who in his characteristic way prepared a beautifully developed course. After completing this course, Walter Deemer, who was a postdoctoral visitor and I were interested in pursuing multivariate analysis, and we approached Hotelling with the suggestion that we take a reading course. He suggested that we study Hsu's notes as taken by several of the former students, and present a lecture at the end of the term. Walter and I delved into the material on Jacobians and were able to develop a calculus for dealing with matrix transformations. We were also able to extend some of Hsu's results. After our presentation to the faculty Hotelling suggested that we prepare the work for publication, which he would submit to *Biometrika* on our behalf—after obtaining Hsu's approval. At that time the United States and China did not have diplomatic relations, so Hotelling wrote to Egon Pearson requesting that he transmit a letter of explanation of how this paper came to be and a copy of the paper to Hsu. We intended the authorship to include all three names, but Hsu indicated that we had sufficiently extended the methodology and that his name should not be included. Hsu was most gracious in making laudatory comments and asked us to include some material that he was working on. In all of these negotiations Hotelling was tenacious in pressing us to publish the results and in helping this come about.

Hotelling, together with a faculty who were the leaders in the field, created a research atmosphere that produced a generation of future research leaders.