Jacob Wolfowitz (1910-1981)

DURING THE LAST YEAR the world has lost three of its leading statisticians, among them being Jacob Wolfowitz who died on July 16, 1981, in Tampa, FL, after suffering a heart attack.

His ideas and inspiration will continue to live in his work and in the hearts and minds of those who knew him.

He was born on March 19, 1910, in Warsaw, Poland. He received the B.S. degree from the City College of New York, New York, NY, in 1931, the M.S. degree from Columbia University, New York, NY, in 1933, and the Ph.D. degree from New York University, New York, NY, in 1942.

In 1938 Wolfowitz met Abraham Wald at Columbia; thus began a very fruitful and almost unique collaboration which produced some fundamental results in theoretical statistics, particularly in the areas of decision theory and sequential analysis. Unfortunately, this first and seemingly most decisive period in Wolfowitz's research activity ended tragically in 1950 with Wald's untimely death in an airplane crash in India.

Shortly thereafter, in 1951, Wolfowitz moved to Cornell University, Ithaca, NY, where he had his longest tenure and perhaps also his most productive period. At Cornell his great love of discussing new ideas and problems resulted in collaboration with several mathematicians and also with his students. Most outstanding of these was J. Kiefer (another of the three statisticians we lost last year, the third being J. Neyman). Besides extending the frontiers opened up by Wald in the areas of decision theory and sequential analysis, Kiefer and Wolfowitz also either pioneered or made important early contributions in new fields such as stochastic approximation, many server queuing systems, and the design of experiments. (An extensive discussion of these contributions can be found in *Jacob Wolfowitz: Selected Papers*, J. Kiefer Ed. New York: Springer Verlag, 1980.)

Wolfowitz had an exceptional ability to recognize new phenomena in science and engineering. He judged innovations by the highest standards; once he was convinced that something had substance he quickly accepted and propagated it, even at the price of having to relinquish a long-held position. On the other hand, he could not get excited by complicated formalism or by abstractions made for their own sake. One of his favorite sayings was "Let us look at what happens in Euclidean n-space; this was good enough for my grandfather and therefore also for me." For him mathematical research could not be separated from reflection about mathematics, its meaning or its use in the "real" world, but at the same time he was hesitant to get carried away by philosophical speculation. Here his position might be termed that of an agnostic.

As a typical example of his feeling for new developments it should be mentioned that he was one of the first mathematicians to recognize and appreciate Shannon's foundation of information theory; this was at a time when a number of mathematicians had doubts about whether Shannon had really anything new and, if so, whether it was true. Furthermore, in 1957 Wolfowitz presented in "The coding of messages subject to chance errors," his own approach to coding theory. This can be considered as one of the very basic contributions to the subject and has had a lasting influence. The main merits of this paper are the following.

a) A simple and precise mathematical terminology, which made the subject accessible and attractive to a larger scientific community.
b) A rigorous definition of "typical sequences," which Shannon had used in a more intuitive way. Thus the basically combinatorial nature of probabilistic coding theory became apparent.
c) The proof of the strong converse to the coding theorem. Even though this result has little immediate use in applications, a number of clever mathematical techniques have since been developed in order to extend this result to various sources and channels, and these techniques have turned out to be helpful in treating problems of practical importance.

Wolfowitz wrote more than twenty papers and survey articles on coding theory (one coauthored with J. Kiefer and four with R. Ahlswede). His more important contributions are included in his book: *Coding Theorems of Information Theory* (Springer Verlag, 1st ed. 1961, 2nd ed. 1964, and 3rd ed. 1978). This is one of the most frequently quoted "classics" in information theory and is largely responsible for the fact that quite a number of mathematicians are now competing with theoretical engineers for the advancement of the subject. Space does not allow a discussion of these papers. Almost all of them are witness to Wolfowitz's firm belief in the power of the "typical sequence" approach. He stuck to this with tenacity even when more elegant analytical techniques turned out to be better suited, as was the case with problems involving feedback and for nonstationary and infinite alphabet channels. However, the progress in multi-user information theory during the last decade is hard to imagine without the use of "typical sequences," thus finally confirming that he indeed had the right insight.

Still adventurous at the age of sixty, Wolfowitz joined the faculty of the University of Illinois, Urbana, in 1970. Upon his retirement there in 1978 he became Distinguished Professor at the University of South Florida, Tampa, where he continued to be active in teaching and research. During the final decade of his life he (together with L. Weiss) added the method of maximum probability estimators to the asymptotic theory of estimation, this growing out of his criticism of the maximum liklihood method. He also closely followed the new directions in multi-user information the-

ory, and with admirable energy and devotion to science he struggled to the end with some of the hardest problems to arise in this subject.

His lucid lectures always moved straight to the heart of a matter, even occasionally at the price of oversimplification. He was very entertaining and won over every audience with a seemingly never-ending series of jokes. He had wit, knew how to use irony, but was never cynical about life: his simple reason for this being "It doesn't make sense to be cynical about life because there's nothing better to take its place." Understandably he was invited to be the banquet speaker on various occasions. At one time he came into serious conflict with his principle of "never lecturing without having a new result;" his wife Lilian, who assisted him in many ways, offered the solution "Jack, why don't you tell one of your two jokes?"

He took a passionate interest in political developments all over the world and visited many countries in connection with meetings or lectures. Somewhat longer periods were spent teaching at the University of Paris, France, the Technion in Haifa, Israel, and at the University of Heidelberg, Germany.

Wolfowitz received almost all the academic accolades one might wish for. His honors include election to the National Academy of Sciences of the USA and the American Academy of Arts and Sciences as well as fellowships of the Econometric Society, the International Statistics Institute, and the Institute of Mathematical Statistics (IMS). The Technion awarded him an Honorary Doctorate in 1975, and he has been both the Rietz Lecturer and the Wald Lecturer of the IMS. In 1979 he was the Shannon Lecturer of the IEEE Information Theory Group; sadly this was for many people the last occasion on which they could enjoy him speaking on a subject to which he contributed so much.

RUDOLPH AHLSWEDE

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