James (Jim) Hardy Wilkinson

Born 1919; died October 5, 1986, London, UK- numerical analyst, developer of the so-called "backward" error analysis, and believer in the ability to work with large matrices.

Education: Graduated with first-class honors, Cambridge University, 1939.

Professional Experience: National Physical Laboratory (NPL), 1947-1980; professor, Computer Science Department, Stanford University, 1977-1984.

Honors and Awards: DSc, Cambridge University, 1963; fellow, Royal Society of London, 1969; A.M. Turing Award, Association for Computing Machinery (ACM), 1970; John von Neumann Award, Society for Industrial and Applied Mathematics (SIAM), 1970; honorary fellow, (British) Institute for Mathematics and Its Applications, 1977.

When he was 16 years old, Jim Wilkinson won an open competition scholarship in mathematics to Trinity College, Cambridge. He won two coveted prizes (the Pemberton and the Mathison) while he was an undergraduate there, and graduated with first-class honors before he was 20 years old. Throughout World War II he worked as a mathematician for the Ministry of Supply, and it was there that he met and married his wife, Heather. In 1946 he joined the recently formed group of numerical analysts at the National Physical Laboratory (NPL). He was to stay there until his retirement in 1980. Soon after his arrival he began to work with Alan Turing on the design of an electronic computer, in addition to his work with the numerical analysts using mechanical computing machines. That work led to the Pilot ACE machine, which executed its first scientific calculations in 1953.[1] Wilkinson designed the multiplication unit for ACE and its successor DEUCE.

One could say that the decade 1947-1957 was the exciting *learning* period in which Wilkinson and his colleagues at NPL discovered how automatic computation differed from human computation assisted by desktop calculating machines. By dint of trying every method that they could conceive and watching the progress of their computations on punched cards, paper tape, or even lights on the computer console, these pioneers won an invaluable practical understanding of how algorithms behave when implemented on computers.

Some algorithms that are guaranteed to deliver the solution after a fixed number of primitive arithmetic operations *in exact arithmetic* can produce, on some problems, completely wrong yet plausible output on a digital computer. That is the fundamental challenge of the branch of numerical analysis of which Wilkinson became the leader: matrix computations. He was the first to see the pattern in the bewildering mass of output.

The period 1958-1973 saw the development, articulation, and dissemination of this understanding of dense matrix computations. It was in 1958 that Wilkinson began giving short courses at the University of Michigan Summer College of Engineering. The notes served as the preliminary version of his first two books. The lectures themselves introduced his work to an audience broader than the small group of specialists who had been brought together in 1957 by Wallace Givens at Wayne State University, Michigan, for the first of a

[1] See also the biographies of Harry Huskey and Edward Newman.

sequence of workshops that came to be called the “Gatlinburg” meetings. The year 1973 saw the beginning of the NATS project (at the Argonne National Laboratory), whose goal was to translate into Fortran and test in a most exigent manner the Algol algorithms collected in the celebrated *Handbook* of 1971. That book, written essentially by Wilkinson and Reinsch, embodied most of what had been learned about matrix transformations.

Wilkinson was honored for achieving an understanding of the effect of rounding errors during the execution of procedures that are used for solving matrix problems and finding zeros of polynomials. He managed to share his grasp of the subject with others by making error analysis intelligible, in particular by his systematic use of the “backward,” or inverse, point of view. This approach asks whether there is a tiny perturbation of the data such that execution of the algorithm in exact arithmetic using the perturbed data would terminate with the actual computed output derived from the original data. Wilkinson did not invent backward analysis but he put it to its best use. In spite of its apparent simplicity, the *significance* of backward error analysis did not occur to either Alan Turing or John von Neumann, despite the fact that both of them were thinking about related matters.

By 1973 Wilkinson had received the most illustrious awards of his career. He was awarded a doctor of science degree at Cambridge in 1963; he was elected to the Royal Society of London in 1969; in 1970 he was awarded the A.M. Turing Award by the Association for Computing Machinery, and the John von Neumann award of the Society for Industrial and Applied Mathematics. It was not until 1977 that he-was made an honorary fellow of the (British) Institute for Mathematics and Its Applications.

The final period, 1974-1986, may be marked by Wilkinson's promotion to the Council of the Royal Society. He accepted a professorship in the Computer Science Department at Stanford University (1977-1984). He was able only to be resident for the winter quarters, and then not every year.[1]

The obituary the *Annals of the History of Computing*[2] published for Jim Wilkinson was one of the most interesting ever created. On Sunday, October 5, 1986, Gene Golub (golub@ score.stanford.edu) sent out a message over the Internet, which announced:

> I'm sorry to tell you that our dear colleague Jim Wilkinson died today. He was in the garden and had a massive heart attack.... Let me invite you to send messages ... giving your thoughts on Jim and retelling any encounters that you may have had with him.

The Numerical Analysis distribution list on the Internet then received a number of stories about Wilkinson of such interest that the *Annals* published the obituary as a part of its “Anecdotes” department rather than the usual place for obituaries-the “Biographies” department:

> Even after a glass or two, he still had an incredibly strong insight into people's motives-in their mathematical work and in other aspects of life. [He delivered conference talks] in the best English tradition, underplaying his own contribution.

> He made you want to take him home with you.

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[1] Based on Parlett 1990.

[2] Anon. 1987.

> I always looked forward to his lectures. The image I remember is of his lecturing in shirt sleeves-sleeves held up by garters to achieve the correct length. Nevertheless, his lectures were always both interesting and informative. He had a great knack for working in an interesting historical anecdote that illuminated what he was trying to say.

QUOTATION

"Did I understand von Neumann? I could verify that each line was deduced from the one above, but if asked what he did, I couldn't answer. And when I probed my colleagues, I found I was losing friends fast."[1]

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UPDATES

Portrait added (MRW, 2013)

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[1] Parlett 1990.