S. S. Abhyankar (1930–2012)

Shreeram Shankar Abhyankar passed away peacefully in his sleep at his home in USA on 2 November 2012. Just before he went to sleep that day, he was doing what had always given him the greatest happiness: mathematics.

Abhyankar was born in Ujjain on 22 July 1930. His father, Shankar Keshav Abhyankar, was a teacher of mathematics in Ujjain and Gwalior. Inspired by his father, Abhyankar developed a love for mathematics very early in his life. By the time he obtained his B Sc at the Institute of Science (Mumbai) in 1951, his knowledge of mathematics, acquired on his own, was way ahead of what would normally be required for an M Sc degree. He obtained his formal Master's degree in 1952 and a Ph D in 1954, both at Harvard, working with the great mathematician Oscar Zariski. After brief stints at Columbia, Cornell and John Hopkins, Abhyankar joined Purdue University in 1963 to become the first Marshall Distinguished Professor of Mathematics there in 1967. This remained his regular position till the end, but he spent a fair of amount of time as a visiting professor in eminent institutes all over the world, a major part of it in India.

His professional visits to India for brief periods, usually a month or two, were quite regular. But, apart from these short visits, he also spent long years in India in the decade starting 1976. This was when he set up Bhaskaracharya Prathishthana, a research institute for mathematics in Pune, and served as Head of the Department of Mathematics at the University of Pune.

Among the several international awards won by Abhyankar are the Alfred Sloan Research Fellowship, Herbert Newby McCoy Award, Lester Ford Prize, Chauvenet Prize and Vidnyan Sanstha Ratna. He was elected Fellow of the Indian Academy of Sciences in 1988 and of the Indian National Science Academy in 1987.

Abhyankar wrote about 200 research papers and authored several books. He guided 28 students, including 11 from India, for Ph D.

Abhyankar has worked in several areas of mathematics, principal among them being algebraic geometry. The modern language of algebraic geometry has acquired a certain abstraction and most of the literature on the subject appears in this language. However, he preferred to use a classical and more concrete version in his work. His treatment was therefore more amenable to the derivation of constructive and algorithmic methods which engineers and computer scientists need and love. As a result, he acquired a large following among this class of professionals and ended up writing a book *Algebraic Geometry for Scientists and Engineers*, which became phenomenally popular. These developments also led to his appointment as a Professor in the Department of Engineering as well as in the Department of Computer Science at Purdue, in addition to his position in the Department of Mathematics.

There were two distinguishing features of Abhyankar's style of work. One, his work usually started late at night in the spacious study (equipped with a long blackboard) at his home in West Lafayette, going into the early hours of the morning. This could be Abhyankar working alone or surrounded by one or more of his students and colleagues. (He was working in this manner till the very end.) Two, he would usually work thoroughly in one area of algebraic geometry for a few years, mastering it and making substantial and deep contributions to it, and then move on to a different area or return to one of his earlier favourites. Some specific areas encompassed in his vast research work are resolution of singularities, tame coverings and algebraic fundamental groups, affine geometry, enumerative combinatorics of Young tableaux and Galois groups of equations.

Suffice it to discuss two of these areas, namely resolution of singularities and affine geometry, in some detail.

In the 1940s, Zariski had obtained a rigorous proof of resolution of singularities of surfaces and threefolds in characteristic zero. The case of positive characteristic for surfaces was done by Abhyankar in his Ph D thesis. An extension of the result to threefolds required, as a first step, the resolution of singularities of an embedded surface. This he studied over several years, developing in the process highly intricate and powerful algorithms in positive characteristic. As the material grew in size, he found it necessary to write up and update his various results in a book *Resolutions of Singularities of Embedded Algebraic Surfaces*, which appeared in 1966 and which culminated in a proof of resolution of singularities of threefolds in characteristics other than 2,3,5. He once told me that he had about 300 pages of handwritten notes which take care also of characteristics 2,3,5, but that he did not have the energy to translate these into a readable exposition. Apart from positive characteristic, he also solved the equally difficult problem for the arithmetic case, i.e. for surfaces over the ring of integers. For a long time the only significant contributions in positive characteristic or in the arithmetic case were those due to Abhyankar.

In affine geometry, the themes of Abhyankar's work were embeddings and automorphisms. Two well-known terms here are the epimorphism theorem and the Jacobian conjecture. In fact, Abhyankar's focus was on the Jacobian conjecture and epimorphism theorem was just an outcome of his first attempt at solving the Jacobian conjecture. This was in the early 1970s. Soon after, he moved to other areas but then returned to the Jacobian conjecture in about 2002. Then this remained the area of his work in the last decade of his life. Abhyankar was very fond of 'algebraicising' results from other areas, notably analysis and topology, if he thought they were relevant to his current interest. He often succeeded in doing so and this was also one his strengths. It is in this spirit that he developed the algebraic theory of dicritical divisors in the last few years, keeping in view their possible application to a solution of the Jacobian conjecture.

There was a notable contrast between the style of Abhyankar in writing mathematics and his style in speaking it. He wanted his writings to be perfect, logically and notationally, to the extent that perhaps even a computer could read it. This ensured elimination of any errors but also made the reader's task quite hard. However, a few of his writings were exceptions to this rule, notably the book for scientists and engineers mentioned above.

On the other hand, listening to his lecture on mathematics was not only a relaxing experience and a pleasure, but the listener often came away with some rare insights into the subject which would almost never come from reading a book.

Two other passions of Abhyankar were Marathi and Sanskrit languages and Indian mythology. His long stay in India in the 1970s was partly influenced by his desire to have his children learn Marathi language and culture in a genuinely desi environment. His knowledge of Indian mythology was immense and it was not hard to detect his passion for it even during his conversations in mathematics. During a talk by him at Purdue on 'Relationships in *Mahabharata*' the audience was awestruck by his unmistakable and firm grasp on the intricate web of interrelationships among numerous characters in the epic.

Abhyankar is survived by his wife, son, daughter and four grandchildren. His absence will be deeply felt in the world of mathematics.

BALWANT SINGH

UM-DAE Centre for Excellence in Basic Sciences,
Vidyanagari Campus,
Santa Cruz East,
Mumbai 400 098, India
e-mail: balwantbagga@gmail.com

Erratum

E. V. Krishnamurthy (1934–2012)

R. K. Shyamasundar
[*Curr. Sci.*, 2012, **103**, 1473]

Page 1473, 3rd column, lines 24–28

'After his sojourn in New Zealand, he worked at CSIRO, Canberra, Australia as a Professional Fellow from 1991 to 1999 and thereafter as an Emeritus Fellow.'

should read as

'After his sojourn in New Zealand, he worked at the Australian National University, Canberra, Australia as a Professorial Fellow from 1991 to 1999 and thereafter as an Emeritus Fellow.'

Edited by P. Balaram, and printed & published by G. Madhavan for Current Science Association, Bangalore 560 080.
Typeset by WINTECS Typesetters (Ph: 2332 7311), Bangalore and Printed at Lotus Printers, Bangalore (Ph: 2320 9909)