

A front-rank mathematician

An obituary of K. G. Ramanathan

Professor Kollagunta Gopalaiyer Ramanathan who passed away in Bombay on 10 May 1992 at the age of 72, weighed down during his last few years with serious illness involving cerebral surgery coupled with Parkinson's disease after his retirement in December 1985 from the Tata Institute of Fundamental Research, was a front-rank mathematician of international reputation with distinguished and well-recognized achievements in number theory and especially the analytic and arithmetic theory of quadratic forms over involutorial division algebras. He had contributed in no small measure to the emergence of a new generation of elite high-calibre mathematicians as well as to the general development of mathematical research and teaching in India.

After getting his B.A. degree in mathematics from Osmania University and M. A. degree from the University of Madras, he worked for some time as a research scholar in the latter, coming into contact with a genial Rev. Fr. Racine as well as with eminent mathematicians like Vaidyanathaswamy and Vijayaraghavan. He also taught for a while in the South, before proceeding to Princeton for further study at the Institute for Advanced Study, where he came under the influence of the great mathematician Carl L. Siegel even while functioning as Assistant to Hermann Weyl. Soon after obtaining his Ph D degree from Princeton University with Emil Artin for his guide, he returned to India to team up with K. Chandrasekharan at the Tata Institute of Fundamental Research, Bombay in 1951. With extraordinary dedication and zeal, he joined Chandrasekharan in the magnificent efforts for the steady evolution of the School of Mathematics of the TIFR into an enviable centre for mathematical research with excellence of international level. With his remarkable expertise and all-consuming passion for number theory, he built up the Number Theory School at TIFR. His polished and meticulously delivered lectures reinforced by informal discussions unfolded for many a budding scholar enthralling vistas of the exciting

mathematical world of Fermat, Euler, Lagrange, Gauss, Abel, Jacobi, Dirichlet, Kummer, Galois, Eisenstein, Kronecker, Riemann, Dedekind, Minkowski, Siegel, Hilbert, Hecke, Artin, Weil, Chevalley and so on. His abiding enthusiasm for the propagation of good mathematics and the spread of wholesome mathematical culture has been much instrumental in the moulding and flowering of several fine mathematicians and further for the betterment of teaching of mathematics and its further pursuit in many of our universities.

The earlier papers of Ramanathan deal, for the most part, with congruence



properties of some arithmetical functions, Ramanujan's trigonometric sums and certain identities of Ramanujan type. From Siegel's famous work on quadratic forms and P. Humbert's reduction theory, he studied in two of his papers (*American Journal of Mathematics*, 1951 and *Annals of Mathematics*, 1952) the properties of unit groups of quadratic and hermitian forms over algebraic number fields such as their finite generation or volume co-finiteness. In a paper in *Acta Arithmetica*, 1959, he has used a general formula of Siegel's concerning lattice points in symmetric

bounded convex euclidean domains to obtain a formula for the discriminant of a division algebra yielding, as a nice consequence, the Hasse-Brauer local-global splitting theorem for the case of quaternion algebras over the rationals.

In an ensuing series of papers, he made a systematic study of the equivalence of, and representation by, quadratic forms over division algebras with involution and of the unit groups and theta series associated with such quadratic forms as a prelude to an analytic theory (on the lines of Siegel's fundamental papers on the analytic theory of quadratic forms) for this general set-up. (The famous *Acta Mathematica* papers of Weil in this context appeared later — in fact, during 1964–65.) Using the foregoing results of his own, along with certain methods of Siegel and some theorems due to Selberg and Borel, he solved in his important paper (in *Göttingen Nachrichten*, 1963) the problem of constructing infinitely many classes of mutually incommensurable discrete groups of the first kind in classical semi-simple groups. This was followed by a beautiful paper of his (in *Göttingen Nachrichten*, 1964) wherein he settled the question of maximality of discrete subgroups of arithmetically defined classical groups, generalizing certain results of Hecke and Maass. He has also made interesting (joint) work establishing the 'dense' nature of the set of values at integral algebraic arguments, of 'irrational indefinite' quadratic forms representing zero non-trivially (over an algebraic number field), generalizing an earlier result of A. Oppenheim whose well-known conjecture on the values of irrational indefinite quadratic forms at integral arguments was settled only recently by Margulis using various ideas and techniques from Ergodic Theory, Lie Groups, Algebraic Groups, etc.

For several years now, Ramanathan has been actively interested in the study of published and unpublished work of Srinivasa Ramanujan, expounding, elucidating and extending Ramanujan's beautiful work on singular values of certain modular functions, Rogers-

Ramanujan continued fractions and hypergeometric series. Since the mathematicians in the West had already made a tremendous advance in respect of many aspects of Ramanujan's unpublished work, it was only natural that he strongly urged many colleagues in India to take seriously to this fascinating domain, even if such activity might be cold-shouldered by 'peers' from within. Actually, during the last few months of his life when his right arm was virtually disabled due to Parkinson's disease, he continued to forge ahead in preparing a 'monograph on continued fractions' with their two aspects—one relating to the hypergeometric series and the other related to basic hypergeometric series.

Realizing the need to establish a good school in applications of mathematics, he mooted, in 1975, the idea of a joint TIFR-IISc Programme to be operated at Bangalore on the campus of the Indian Institute of Science. This programme has now come of age, with the emergence of a viable group of competent mathematicians specializing in differential equations and numerical analysis, thanks to his efforts and vision.

Although quite attached to his base in Bombay throughout his 34-year tenure with the TIFR, Ramanathan visited many centres of learning on research and teaching assignments—the Institute for Advanced Study, the Mathe-

matisches Institut der Universität Göttingen, the University of Missouri at St. Louis, the University of Alberta at Edmonton, etc. He has around 50 research publications to his credit. He was a Fellow of the Indian National Science Academy and of the Indian Academy of Sciences and a Founder-Fellow of the Maharashtra Academy of Sciences. He had served as President of the Indian Mathematical Society and as Life-President of the Bombay Mathematics Colloquium. As the Editor of the *Journal of the Indian Mathematical Society* for more than 10 years, he scrupulously maintained a high standard for that journal. He was a member of the Editorial Board for *Acta Arithmetica* for nearly three decades. He was a recipient of many national awards—the Shanti Swarup Bhatnagar Prize, the Jawaharlal Nehru Fellowship, the Homi Bhabha Medal (from INSA) and the Padma Bhushan.

His interests in English, Telugu and Tamil literature with his unfailing knack for pulling out apt quotations were just as remarkable as his erudition in music. He has been heard to remark a couple of times in his later years that the reason for his company being sought was probably that he was considered to be 'well-rounded'. However, his occasional quips could have put off a few. He shunned publicity as much as he

abhorred those who craved for power and ephemeral glory through the media; those who happened to know him somewhat closely could not have failed to note his simplicity and inner humility. For one whose health was indifferent most of the time, he was generally friendly to those who came to him and generous with help if solicited, unmindful of antecedents; he was a firm believer in 'sharanaagatharakshanam', in tune with Valmiki's phrase: dosho mahaa-nathra prapannaanaamarakshane. He did not believe in 'grabbing' or 'snatching' students. He often exhorted fellow-number-theorists to pursue their own mathematical objectives diligently without being overawed by glamour or jargon but truly in the 'anaashrithah karmapalam' spirit. If he was perhaps heart-broken that his hopes for a flourishing number theory school had not entirely been fulfilled, it is for the rest to look for the reasons. In any case, to sum up, his was an illustrious and colourful life and he will be greatly missed not only by his surviving wife and two sons to whom he was deeply attached but also by his countless friends, admirers and former colleagues.

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Mathematics conference

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mathe-matians and astronomers. Is there any reason why such an epoch should not recur? None that I can see. At the present time a young Indian student, Mr S. Ramanujan—(cheers)—is studying at Cambridge and his career we in Southern India are watching with keen interest and high anticipations. You know the story of the discovery of his unusual talent, and all here will be glad to hear how entirely he is justifying the efforts which were made to give it full scope. I shall quote merely one sentence

from a letter written from Cambridge by one of the most distinguished mathematicians of the present day: "In him," he says, "India now possesses a pure mathematician of the first order whose achievements suggest the brightest hopes for its scientific future." Gentlemen, not a few Indians have earned high distinctions in the Cambridge schools. Some of them, I believe, are members of the Society, and they will be able to realise what is required to earn an encomium of this nature. We may be sure,

however, that if India is to make permanent contributions to this the most international of all sciences the creation of a favourable environment is essential. By the provision of post-graduate scholarships and of opportunities for post-graduate research, Madras University is, I am glad to say, doing something to secure this.

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