

Editorial*

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Roddam Narasimha (RN), who passed away on 14 December 2020, has left indelible impacts in the field of fluid mechanics and on several individuals and institutions. Born in July 1933, Roddam had his early education in Bangalore, obtaining BE in Mechanical Engineering from the University of Mysore, followed by Diploma and Associateship degrees in Aeronautical Engineering from the Indian Institute of Science (IISc), after which he did his PhD at GALCIT, Caltech, under the guidance of Hans Liepmann. He returned to Bangalore in 1962, where he spent his professional career spanning more than five decades as a teacher, researcher, administrator, and science policy advisor to the Government of India. The articles in this issue by his students and co-workers give glimpses of his research and other contributions, and the articles by Maithreyi, his daughter, and K R Sreenivasan, his student and close associate, reveal his personal side.

A common thread that persisted throughout RN's career was his passion for research and mentoring of students. This is what perhaps he enjoyed most and gave him the much-needed respite from the demanding engagements of administration. RN's research interests spanned a wide range of topics: gas dynamics and kinetic theory, stability and transition, turbulence, drag reduction, cumulus clouds, Indian monsoon, etc. But there was one recurring theme—turbulence. How and when flows become unstable and transition from a laminar state to a turbulent one, is an important question to this date, and one that occupied RN's mind for several decades, starting from his seminal work on turbulent spots as a student at IISc, in association with Satish Dhawan, who besides being his first advisor remained an important mentor in his life. Often transitional flows are more difficult to understand



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and model compared to fully turbulent flows. Rama Govindarajan writes on stability and transition in boundary layers. Another topic on which RN and his co-workers made significant contributions is more intriguing: can turbulent flows become laminar, can they 'relaminarize', and if so, under what conditions. A comprehensive review on this subject ('Relaminarisation of fluid flows', *Advances in Applied Mechanics*) that he co-authored with K R Sreenivasan, describes the various mechanisms (dissipation, density stratification, pressure gradient, curvature) that cause relaminarisation. Almost coincident with the establishment of the Centre for Atmospheric Sciences at IISc, in 1982, RN became interested in the fluid mechanics related to the atmosphere and oceans, and particularly to the Indian monsoon. He conceived and was instrumental in executing 'The Monsoon Trough Boundary Layer Experiment-1990', which was aimed at developing appropriate land-atmosphere flux relations over the Indian subcontinent for use in numerical weather models for monsoon prediction. Another topic he pursued till his very end was laboratory and DNS simulations of cloud-like flows. It seems, though, that RN had an innate interest since a young age in the atmosphere: his meticulous notes on clouds in 1963, reproduced in this issue, show that. Bhat brings out the complex and beautiful world of clouds in his article.

That RN was a visionary, is clear from the influence he had on various initiatives at IISc, NAL and at the national level: the light combat aircraft (LCA), trainer aircraft (Hansa), and 14 seater Light Transport Aircraft (Saras) at NAL; establishment of the hypersonic wind-tunnel and the Centre of Atmospheric Sciences at IISc; the Ministry of Earth Sciences (MES) to oversee the activities related to weather prediction and climate modelling; the flo-solver parallel computer at NAL as early as 1982 for weather prediction. In this issue, Kota Harinarayana has written on the LCA and Rajeevan on the origin and evolution of the MES, and its role in weather prediction. As President of the Indian Academy of Sciences, RN formed a committee to advise on science education in India that finally led to the launch of *Resonance*, the journal



of science education, in 1996. RN has contributed several articles to *Resonance* over the years. Earlier in 1978, the Academy had started *Sādhanā*, the journal of engineering sciences, whose initial years were nurtured by RN as its founding editor.

For his contributions, Roddam has been honoured both in India and internationally. He was a Fellow of all the academies in India, the US National Academy of Sciences and of Engineering, the Royal Society of London, the American Academy of Arts and Science, and The World Academy of Sciences (TWAS). In 2013, he was awarded the Padma Vibhushan, India's second-highest civilian award. Among the visiting positions he held are the Clark B Millikan Professor and Sherman Fairchild Distinguished Scholar, both at Caltech, and the Jawaharlal Nehru Professor of Engineering at Cambridge University in England.

But among the many honours that RN received, the one he perhaps cherished most was for his role as a teacher and advisor—the Lifetime Achievement Award for Mentoring in Science in 2019. His students fondly recollect conversations that they have had with RN on a range of topics. My own interaction with him has been for four decades, starting with when I was a Masters student at IISc. My project work, guided by him, was on the control of turbulent boundary layers. It was an idea way ahead of its time, and which, driven by the miniaturization of sensors and actuators, has become increasingly important in recent years. In one of my early meetings with him, he handed me the review article on relaminarisation that had just come out. As a young uninitiated student, I was struck by the clarity of the writing, which later I came to know was RN's hallmark, and which requires great effort and attention. I am sad that RN could not personally give me a signed copy of the *Encyclopaedia of Classical Indian Sciences* that he had edited with Helaine Selin. Nagaratna, his secretarial assistant for many years, handed it to me when I went to pay my last respects at his home.

It is not enough to have good visionary ideas, but the will, persistence and authority to carry them through. RN had all these attributes in good measure, as evidenced by the success rate he

had in most of his initiatives. The country and indeed the world is undergoing rapid changes and facing unforeseen challenges and an uncertain future, including in the world of education, research and technology. RN bemoans that scientific pursuit is being converted “from a passionate hobby and profession to a cut-throat business, the emphasis on quantity, the lack of appreciation for scientific creativity and deep scholarship, or for tackling tough problems of fundamental importance.” Indeed, we are in a world cluttered with tweets, including those on new scientific findings. On the topic of privatization, I remember RN saying that CSIR laboratories like NAL still have an important role in national development. The repositories of knowledge that publicly funded institutions possess cannot be easily replicated in private settings. The remarkable success of SpaceX is not possible without the highly trained manpower that the American universities produce. The rational, considered opinions of RN, which these times require more than ever before, will be missed.

