

GNR — A Tribute

When a man comes out with one original idea he is called brilliant. With two he is thought to be extraordinary, but one who comes out with three independent and original ideas is a genius. Einstein, Newton, Pauling and Crick are some examples, and I should like to believe that Gopalasamudram Narayana Iyer Ramachandran, or GNR as he was called by everybody, belonged to this class. He had at least three independent and original ideas to his credit, each of which moved the field that he was engaged in. His first was the elucidation of the structure of collagen. His second was to show what shapes a protein chain can take on, and what it cannot. His third major idea was to show how the three dimensional shape of an object can be reconstructed from a series of flat (or 2-D) pictures using methods of convolution, an idea of value in imaging and tomography.

GNR was born on the 8th of October 1922 in an era in India that was fermenting with ideas, vision and hope for the future. The Independence Movement had gathered momentum, education was valued highly not only for enriching the mind and the soul but also towards enriching the nation itself. There were scholars not only in science and technology but also in literature, arts, politics, law, medicine and engineering. They all had just one common goal for which they worked, namely, an independent, strong and resurgent India. In many ways the family GNR came from represented the *zeitgeist* or the spirit of the times. His father, Narayana Iyer, was a professor of mathematics and later the Principal of the Maharaja's College in Ernakulum. GNR had his early education there and later obtained his BSc Honors in physics at the legendary St. Joseph's College, Trichy. He then went to the Indian Institute of Science at Bangalore, and did

his MSc by research with C V Raman, and continued on with him. In 1947 he won the '1851 Exhibition Scholarship', which took him to England where he spent the years 1947-49 working in the group of Lawrence Bragg. After his PhD from Cambridge, he returned to the Indian Institute of Science, Bangalore where he taught during 1949-1952. It was during this time that the classic review on optics was written by him along with S Ramaseshan.

The Madras Helix

Ramachandran had by this time decided to work on the structure and shape of biological molecules. The late 1940s and early 1950s were a time of great excitement in biology particularly in the newly developed area called biophysics. The elucidation of the spatial disposition of atoms in molecules became possible, thanks to the method called X-ray diffraction. It was becoming increasingly exciting and challenging with the result that people like the Braggs, J D Bernal, W T Astbury and others mounted a programme to analyze the molecular structures and three dimensional architecture of molecules as large as proteins and nucleic acids. Across the continent it was Linus Pauling in California who was also very active in the X-ray structure determination of proteins.

During these eventful years Ramachandran moved from Bangalore to become Professor and Head of the Department of Physics of the University of Madras in 1952, until 1970. It is important to point out here the help and assistance provided to him by A Lakshmanaswamy Mudaliar who was the Vice-Chancellor of Madras University at that time. Ramachandran also had this wonderful proximity

to the Central Leather Research Institute and Y Nayudamma there. When Ramachandran moved to Madras, a ready source of pure animal collagen was made available to him, thanks to Nayudamma. Set with this and armed with excellent colleagues such as Gopinath Kartha and G K Ambadi, Ramachandran set out to meet the challenge of determining the 3-dimensional architecture of the protein collagen. Success came within a few years and the prototype of the currently accepted structure of collagen was first put forward in 1954 by Ramachandran and Kartha in a paper published in the journal *Nature*. If the alpha helix were the California helix and if the double helix were the British helix, the collagen helix came to be known as the Madras helix.

The Ramachandran Diagram

Many people would have felt a sense of fulfillment after such a major discovery but not Ramachandran. What factors go to govern the myriad shapes that protein and polypeptide chains adopt was a question that enticed him. To this end, he asked his students, notably V Sasisekharan and C Ramakrishnan, to analyze all X-ray diffraction pictures published until then on amino acids, peptides and proteins and to find out what sets of bond angles and shapes they most often take. They were soon able to write out the entire conformational space that a polypeptide chain can occupy. It was done in much the same manner that cartographers do when they write out maps, based on two coordinates. These two coordinates in proteins are referred to as dihedral angles, and named after the Greek letters *phi* and *psi*. This analysis has come to be known in protein science as the celebrated Ramachandran map or the Ramachandran diagram. It is indeed a tribute to Ramachandran that each one of the over 10,000 protein structures that

has been so far solved obeys the principles and the allowances of the Ramachandran map. Ramachandran was thus able to give a conformational grammar to protein structure. This was his second achievement. Sasisekharan extended the conformational map to DNA chains, and V S R Rao did so for sugar chains. The folding rules of these three biopolymer chains had thus been established by the GNR school.

His mentor C V Raman immortalized himself in physics through the Raman effect, and GNR has immortalized himself in biophysics and biochemistry with the Ramachandran diagram. Indeed when one looks at contemporary scientists of India, no one else has had such recognition in professional literature and textbooks as Raman and Ramachandran. Many people in the profession have felt that these two achievements, namely the elucidation of the structure of collagen and providing a grammatical basis for the three dimensional shapes that a biopolymer chain can adopt, would suffice for award of the Nobel Prize. They both have stood the test of time, have helped us advance our knowledge not only in structure but also in the function of protein chains, and have opened up newer ways of designing molecules. It is indeed a pity that Ramachandran was not awarded the Prize, and never will be, now that he is no more. Nobel Prizes in biology have been given for lesser achievements, and it will remain a sour point, at least in my mind, that Ramachandran was not. It may justifiably be said that in this case that it is the Prize who missed the master.

The 18-year period that Ramachandran spent at the University of Madras was a golden era. Together with Alladi, who was a Reader, he brought forth a department that produced gems as students, excellence breeding excellence. It is worth re-



ARTICLE-IN-A-BOX

flecting on what made this magic possible. First is surely the man behind it and the passion that he had for academic brilliance (despite a slowly debilitating illness that started affecting him already). Second is the ability to choose students and colleagues, and the freedom to recruit them. Third is understanding and appreciation by the administrators, and their willingness to enable this to happen. It was here that Vice-Chancellors with vision such as Mudaliar and neighbours with ready help such as Nayudamma become vital. How I wish we find modes to make their tribe increase!

Mudaliar left the University and the anchor of support to GNR weakened. Rule books were thrown at him, and he left the University in a huff. Here that we must record our appreciation to two other men of vision and foresight namely Satish Dhawan and S Ramaseshan, who invited GNR to return to Bangalore and start the Molecular Biophysics Unit (MBU) at the Indian Institute of

Science, Bangalore. Sasisekharan, Ramakrishnan and V S R Rao went along with him to the MBU, added more people and helped the MBU become a globally respected centre in biophysics.

Despite his progressively weakening illness (later identified as Parkinson's), GNR continued to be active, this time in area of mathematical logic. Having handed MBU over to able hands, he switched to this field and published a series of papers on what he called as *Syad* and *Nyaya* logic, reminiscent of and akin to what today is called fuzzy logic. But, alas, his illness weakened him and he suffered for over a decade before he passed away.

D Balasubramanian
Hyderabad Eye Research Foundation,
L V Prasad Eye Institute
Hyderabad 500034, India.



*G N Ramachandran with
his wife Rajalakshmi*