

SIR C.V. RAMAN

Text by Dr. N.R. Srinivasan



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The Diamond Jubilee of the discovery of the "Raman Effect" falls this year, which coincides with the birth centenary of Sir C.V. Raman. He was a rare phenomenon in the annals of Indian science and his contribution shines forever like the pole star in the firmament of world physics. Raman had not only the confidence but the daring to tell his mentor, Sir Asutosh Mukherjee, then Vice Chancellor of the University of Calcutta, "I will bring the Nobel prize east of the Suez." And he DID IT! The highest accolade of world acclaim in physics came to him in 1930.

Raman's passion for physics was inborn, his zeal for work contagious, his support for his students unflinching and his love of nature amazing. He was honoured by the then British Government in

1929, with a Knighthood. The Princely State of Mysore, not to be outdone, bestowed on him the honorific of 'Rajasabha Bhushana'. The Government of a free India, much later, in fit recognition of his mettle, donned him with the title of 'Bharat Ratna.' Raman's life and work is a fascinating, colourful and unforgettable page in the history of Indian science.

Raman's experimental equipment was as elementary as a flask of benzene, a ray of light and a camera! Yet, he discovered a truth, which has stood the test of time and will continue to do so for as long as mankind and physics thrive on this planet.

Chandrasekhara Venkata Raman, known as Sir C.V. was born on November 7, 1888, in Tiruvanaikkaval, a hamlet in

Tiruchirapalli, in Tamil Nadu. The place is religiously famous for the *Jambu Linga*, or one of the primordial states of Lord Shiva as water. Here, the Lord in the form of a *linga* is always seen submerged in water. Little did the small village dream then that it had given birth to a future Nobel Laureate and it would have a berth on the map of world science. His father, R. Chandrasekhara Iyer, was a lecturer in mathematics and physics at the SPG College, Tiruchirapalli. He later moved over to the AVN College at Visakhapatnam, which was then in the undivided Madras Presidency and which today is in Andhra Pradesh. Raman had his early schooling there and as a Tamil adage goes that the emerging sprout is indicative of the vigour of the sapling, his performance at school



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was brilliant. He went over to the then prestigious Presidency College, Madras. He obtained the Bachelor and Master degrees in physics in 1903 and 1906 respectively, and topped the university, receiving coveted gold medals. Raman once told me casually, while showing me the medals, that he was informed that they were made of the purest yellow metal but he did not bother to have the fact verified.

Though mentally a giant, physically he was a puny boy. It is learnt that when he first entered the portals of the college, with a typical coat and a cap, which were a wont in days past, the professor mistook him for a schoolboy and cynically enquired, if Raman had strayed into the college classroom by mistake. It was not long before the professor realised the enormous mental structure of Raman, though his physical stature was small and deceptive.

Even at college, Raman exhibited a flair for original thinking and experimental verification. His maiden effort on diffraction of light bands from a prism was published in the Philosophical Magazine,

London. It was really a feat, while at the same time a treat to the new entrant into the vast vista of physics and consequent world attention. It might be interesting to record here that when Raman approached the Professor of Physics, an Englishman, to forward his paper, he kept it with him for quite some time, perhaps not being sure of the credibility of the work. After considerable waiting, Raman went up to the professor and told him that he had got some new results and would like to incorporate them in the paper. The unsuspecting professor returned the paper but Raman quietly sent it directly for publication. When the Philosophical Magazine came out with Raman's paper, it was a shock to the poor professor but a shot in the arm to the young Raman!

In those days, jobs even for double graduates were few and far between. A Government job then was held as the acme of achievement, and society attached great awe and importance to a Government servant. Advised by his professors, Raman appeared for the Audit and Accounts Service

Above: Raman demonstrating an effect to an observant Nehru and Mrs. Gandhi looks on. This picture was taken at the Raman Research Institute, 1949.

examination conducted by the Government. He topped the list of candidates, was appointed Assistant Accountant General and took up the post at Calcutta in June 1907. Can one imagine that he was hardly 18 then? The discharge of official duties for the next few years took him to Rangoon and Nagpur. Though saddled with official routine as a quill driver, he never gave up his love for physics. In Rangoon, his residence became a laboratory and he was experimenting with stringed and percussion instruments and the sound of music. In 1911, he was

In the wake of Raman's fame, he was invited in 1933, to become the Director of the Indian Institute of Science, Bangalore. It needs mention that this tower of research rose due to the vision of Jamsetji Nusserwanji Tata in 1911 and it was the only centre in the country devoted to advanced learning and research. Raman came in with high hopes and wanted to elevate the Institute to a centre of world rank. In essence, he wanted to establish a Chair in Mathematics, set up a central workshop where instruments and apparatus could be made and repaired and he also wanted Nobel laureates in different disciplines to head the various departments to give lead to first rate research. He continued to work with young talent. But his new ideas attracted a lot of opposition. The country was not ready for his ventures and he had to pay dearly for it!

Turbulence in the campus and canvassing against Raman were the sordid features of 1937 and a move was afoot to remove him. When word reached the Maharaja of

Mysore, he sent a stern warning through the Dewan, Sir Mirza Ismail, that if Raman was disturbed, he would not hesitate to close the Institute. Anyway, a compromise was arranged and Raman was only to be the Head of the Department of Physics. It was no doubt humiliating but Raman's love for work prevailed. Had he gone to the U.S.A, at least a dozen universities would have come down on their knees, begging to honour their campuses with his presence. But Raman was a patriot par excellence, and he chose to remain on the soil of his birth, whatever the trials and tribulations. He retired from the Institute in 1948 and set up the Raman Research Institute in Hebbal, Bangalore. He refused to accept any grant or aid from the Government.

Raman once told me, when he was in a pensive mood, "I made three mistakes in life. The first was to come to Bangalore as Director of the Institute. The second was that I tried to improve the calibre of research at the Institute to world

Below: Raman showing his diamonds to Nehru. A smiling Mrs. Indira Gandhi at the rear. This picture was taken at the Raman Research Institute, Bangalore 1949. Opposite page: At the academy meet at Annamalai University 1959. Seated: Raja Sir M.A.Muthiah Cettiar, Pro Chancellor Lady Lokasundari Raman and Prof. S.Bhagwantam.

standard. The third was that I tried to please others. I am now doing what I want. I am at peace with myself."

Raman's 60th birthday came in November 1948. It was celebrated as a grand occasion by the large gathering of his distinguished students with the presentation of papers and so on. In the morning, there was a private religious ceremony at home. Raman was seated in front of the sacred fire, with his wife. While the *Vedic*

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hymns were being chanted, his erstwhile students, who were then stalwarts to reckon with, were assembled in an adjoining room. It was truly a galaxy of talent. The group included Sir K.S. Krishnan, Dewan Bahadur K.R. Ramanathan, Dr. L.A. Ramdas, Dr. R.S. Krishnan and a few others. I was too insignificant and stood quietly in a corner. Sir K.S. Krishnan in his typical humorous style was regaling everyone with jokes and anecdotes. Suddenly, there was a rustle in the air. All eyes turned to the doorstep. And standing there was Sir C.V. Raman, wearing a *dhoti* in the orthodox fashion, his bare chest sporting the sacred thread and his forehead shining with a bright white caste mark. All his students rose and stood in absolute silence. The professor took one look at the scene, sensed the mood and quietly withdrew. It appeared to me that, after the holy rites, Raman wanted to bless his 'boys', which he did with a silent and gentle nod of the head. It was a drama, enacted to perfection, the actors having been in true wavelength with one another. It was an unforgettable experience for me and a vivid example of the *guru-shishya* system.

Raman's main field of interest was light or optics but the range of materials and areas of work chosen by him was amazingly vast. He published a string of papers on the colour of diamonds. In the process, he acquired quite a few rare gems, some as gifts from Maharajas for his experiments. He was fascinated by colour. He delved deep to find out how and why the human eye is able to distinguish the 250 odd shades of colour in the myriad manifestations of nature. His classic papers on the physiology of vision came as a treat not only to physicists but to physiologists as well. Again, his rationale on the perception of smell is equally astounding. It is difficult to catalogue his decades of dedicated work or areas of absorption in a brief article, when heavy tomes of his papers adorn the shelves of libraries all over the world. Suffice it to say that the 'Raman Effect' has taken a new turn, since the discovery of laser. Various laboratories in the world are now engaged in the 'Raman Effect' work using laser and this has immense



Photography courtesy of Indian Academy of Sciences, Golden Jubilee Volume.

potential for the future.

A lasting contribution which Raman made to Indian science was the founding of the Indian Academy of Sciences, in 1934, as a foremost professional body, for the promotion and advancement of knowledge. It attracted rich talent and began publishing the results of research in physical and biological sciences. Annual meetings of the Academy were characterised by a business-like atmosphere. He also brought out *Current Science* a journal devoted to the quick publication of research, on the lines of the well established *Nature* of London.

Raman was a prolific reader and his spectrum of interest covered everything under the sun. He had a photographic memory and could recall in a flash even a small note which he had read years ago. An instance might be quoted of his critical eye. Once a dissertation for a doctorate in science came to him for evaluation. He was seen flipping through the pages quickly once, twice and thrice. And then he called me to attention and thundered in his flamboyant style: "Look! the most important reference, which is the basis for the candidate's work, is missing. I have searched for it high and low. It is not there. If the author thinks he is clever in suppressing the fact, he is dishonest and doesn't deserve the degree. If he is ignorant of it, he does not merit the degree either. So, I am going to reject his thesis." And that is precisely what he did.

Pandit Jawaharlal Nehru was an ardent admirer and a great friend

of Raman's. Though there were occasions for them to meet officially and otherwise, there was a unique instance, when they met and chatted for nearly two hours, each regaling the other and both in a deliriously happy mood. It was around 1949 or so, at the Raman Research Institute. Raman had organised his Institute with meticulous attention to every single detail. The library had neat stacks of volumes of research journals, books and magazines. In the centre, stood a bust of Raman on a five-foot tall base of solid polished black stone. The four sides of the base bore inscriptions of the name of the Institute in English, Tamil, Telugu and Kannada. He had explained the significance to me once. Tamil was there because it was his mother-tongue, Telugu since he had spent his early years in Andhra, Kannada because he lived in Mysore and English, as it was the universal language! He had organised a beautiful collection of gems, stones, crystals, and other objects. He used to arrange them with aesthetic finesse and artistic appeal. In front of the building, he had a large rose garden, wherein he had planted selected grafts with great care and devotion. He would take immense pride in presenting, with a dramatic touch, a beautiful red rose to a distinguished lady visitor.

When Panditji arrived, his entourage was asked to leave him alone with Raman. Nehru and Raman had one thing in common. Both were essentially children at heart! Both loved beautiful things!

Raman took Nehru around proudly and explained the varied facets of his work. Nehru would intervene and ask some question and listen attentively like a humble student to a masterly exposition on some topic. After some exchange, they were seen to emerge from one laboratory room, roaring with laughter. They entered the room, where there was a wonderful display of diamonds, crystals and minerals, to the last of which vast collection, I had contributed in a very small way by bringing some rare sphalerite from Australia. I had stationed myself at a vantage point in the crystal room. After a few minutes of narration of the loveliness of some specimens, Raman suddenly went towards the wall and switched off the light. The room was enveloped in darkness. He spoke in the darkness and told Nehru that he would demonstrate a colourful effect. He then switched on a portable ultraviolet lamp, which he had in his hand and played it on the diamonds and the minerals. And the tiny crystals came alive with a vivid display of an array of colours. Some were light yellow, others pink, some green, orange and red! It was a spectacle worth seeing. Nehru was heard to remark whether he was an Alice in Wonderland! Then, Raman, the brilliant showman that he was, explained the scientific basis of the phenomena of fluorescence and phosphorescence. The latter can be seen in the glow worm at night. It was a marvellous experience to witness the two giants, each great and towering in his own way, meet and share the joys of nature.

Raman was a brilliant orator and could explain the most abstruse subject in a lucid way, so as to enable the listener to grasp it. He also had a sanguine sense of humour, yet it was sporting and never taunting. A few instances may be cited here which are quoted from the Diamond Jubilee publication of the Indian Academy of Sciences. During one of the annual business meetings of the academy, presided over by him, there was sharp criticism by the Council Members of the poor quality of the papers published. Raman listened with extreme patience and when everyone finished just said, "Gentlemen, we publish what you produce!" That was the end of it all!

On the occasion of the Academy meeting in Ahmedabad in 1953, greeting his old student Dr. T. Radhakrishnan, who was sporting long hair, Raman playfully tweaked his hair and with a twinkle in his eye remarked that he was not aware "of a shortage of barbers in the famous textile city of Ahmedabad!" It was said in fun and in a playful mood. At the Belgaum Session, Raman congratulated C.V. Subramanian on his election as a Fellow of the Academy. And, then, he also let him into a secret, "don't think all of them, in the Council, supported your election. Some felt you were too young. Well, what is the use of electing someone who is too old?"

The Ahmedabad session of the Academy in 1969 celebrated Raman's 81st birthday, at the Physical Research Laboratory. Eulogies galore were paid to Raman's qualities of head and heart. Raman had this to say of himself: "People may wonder why I wear a turban in this day and age. I will tell you why. The turban is a bandage to prevent me getting a swollen head after hearing your speeches..."

Raman was deeply religious. He once told Gandhiji at Nandi Hills that people took him to be an atheist. But, he said he saw god in nature. In establishing the Raman Research Institute, he had said: "It is my earnest desire to bring into existence a centre of scientific research worthy of our ancient country, where the keenest intellects of the land can probe into the mysteries of the universe and by so doing help us to appreciate the transcendent power that guides its activities. This can only be achieved by divine grace..."

Raman once told me that he "would like to drop dead in the laboratory." And that was pretty nearly what happened. After a brief illness, the end came on November 21, 1970. According to his wishes his mortal remains were consigned to the fire, in the Raman Institute campus and while the flames of the pyre were bright, the world of science was engulfed in darkness!