

# Raman Effect: A Giant Leap for Science in India

Sir CV Raman's Nobel Prize was not just a historic achievement but a veritable morale booster for India's scientific community and its research



■ Ayan Datta

**C**handrasekhara Venkata Raman (7 November, 1888 - 21 November, 1970), more well-known as Sir CV Raman, was a stalwart of modern Indian Science. He was the first Indian and Asian to receive a Nobel Prize in science.

He was a great supporter of science without artificial boundaries or confinements of subjects. In fact, throughout his long and active scientific career he worked on several diverse subjects like astronomy, meteorology and physiology. He made many scientific discoveries in acoustics, optics, magnetism, and crystal physics. Raman also made significant contributions towards understanding of the physics of Indian musical instruments and clearly established the rich acoustical knowledge of ancient India.

Raman is, of course, most well-known for the discovery of a phenomenon named after him, the Raman Effect, on 28 February, 1928 — the day is now celebrated in India as National Science Day every year. Raman was, at that time, Sir Tarakanath Palit chair professor at Calcutta University, which, even though a highly respectable academic position, gave a salary at least five times less than what he was earning from his extremely well-paid job in the financial



Sir Chandrasekhara Venkata Raman

Image Courtesy: Raman Research Institute, Bengaluru

civil services. Yet, he resigned from that job to join as the Palit professor in Calcutta University.

The fact that Raman showed scant regard to material prospects and did not hesitate to quit a lucrative position clearly shows the deep commitment he had for science. He would reach Indian Association for Cultivation of Science (IACS) at six in the morning and for this he chose a residence just behind the back door entrance of IACS so that he could enter and work in the laboratory any time, day or night. After carrying

on experiments till 9.30 am, he quickly returned home, took a bath, had his breakfast on the run and reached the Calcutta University, which was four miles away. After finishing his lectures and other academic duties, he would again come back to IACS at around six in the evening and work in the laboratory till midnight. Such was the course and tempo of his life throughout his fruitful scientific career.

In the afternoon of February 28, 1928, Raman and his extremely brilliant student, KS Krishnan examined



From top: Snapshots from the illustrious life of Sir CV Raman

All Images Courtesy: Raman Research Institute, Bengaluru

the influence of wavelength of the incident light on the “weak fluorescence” observed in several organic liquids and vapours. Raman had, in the last two months, already verified this phenomenon for 80 different aromatic, aliphatic and inorganic liquids and this effect was observed in all of them, furnishing a conclusion that it was a completely new and universal phenomenon. This effect — distinctly different from the usual fluorescence — is now known to us as the Raman Effect.

On February 28, using incident radiation of a narrower range of wavelengths, Raman examined the scattered track through a direct vision spectroscopy. To his great surprise, he found that the modified scattering was separated from the scattering corresponding to the incident light. He immediately used a monochromatic light source to further verify. When the light from the monochromatic light source was passed through a tube of the liquid, he found two additional bright lines in the blue and green region of the spectrum which were not present in the spectrum of the incident light. Clearly, these lines emerged from the interaction of light with the molecules of the liquid in the tube. In the given image, one can also see the first Raman spectrum for benzene as recorded by Raman on this eventful day.

Recognition came almost immediately. Professor A. Sommerfeld, a great physicist of the time known even now for his work on an improved model of a hydrogen atom with an electron, recommended him for the Nobel Prize in 1929. In fact, after receiving the Nobel Prize when Raman visited Munich, Sommerfeld introduced him as not only a great scientist but as a representative of a great ancient culture. He said: “We welcome our guest (Raman) not only as a successful scientist and discoverer but also as a representative of the age-old and now rejuvenated culture of the Orient which trustfully cooperates with Occidental culture and strives for the same ends.” Raman was proposed for the Nobel Prize in Physics in 1930 by E Bloch, N Bohr, L and M de Broglie, O Khvolson, J Perrin, R Pfeiffer, J Stark

and CTR Wilson. The readers will realise that these physicists represented the best minds that the subject had ever produced. Raman was awarded the Nobel Prize in physics in 1930 and received it on December 10 the same year. He was only 42 years of age when he became the first Nobel laureate in science from Asia.

There is an interesting story that his biographer, A Jayaraman, writes in *C. V. Raman — A Memoir* (Indian Academy of Science, 2017). Nobel awards were declared around November mid-week and Raman only had less than a month’s time to reach Stockholm. It was impossible for him to arrive on time if he had booked his and Lady Raman’s tickets in steamship after receiving the telegram. It is now a historical fact, however, that Raman had booked tickets for his wife and himself in July 1930 which enabled them to reach Stockholm in early December. That was the level of confidence Raman had on himself and his science.

Raman was a staunch patriot. It is worthwhile to quote Raman describing his impression on receiving the Nobel Prize: “When the Nobel award was announced I saw it as a personal triumph, an achievement for me and my collaborators — recognition for a very remarkable discovery, for reaching the goal I had pursued for seven years. But when I sat in that crowded hall I saw a sea of western faces surrounded me and I, the only Indian in my turban and closed coat, it dawned on me that I was representing my people and my country. I felt truly humble when I received the Prize from King Gustav; it was a moment of great emotion, but I could restrain myself. Then I turned around and saw the British Union Jack under which I had been sitting. It was then that I realised that my poor country, India, did not even have a flag of her own — and it was this that triggered off my complete breakdown.”

Raman was a great supporter of self-reliance and national education based on our own wisdom rather than importing ideas and instruments from abroad. His Raman apparatus was completely a home-built instrument and therein lay his success. In his convocation address at IIT Madras on July 30, 1966, he said:

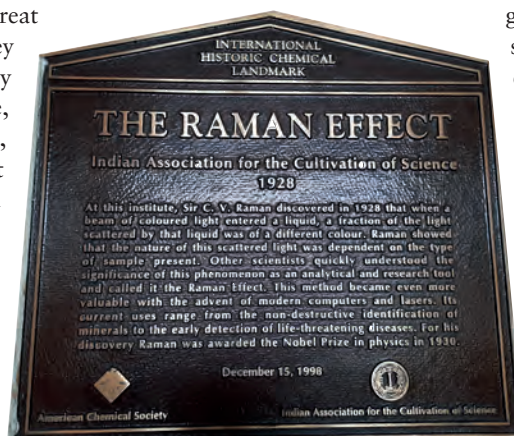


Sir Chandrasekhara Venkata Raman

Above: The spectrograph used to record the first Raman Spectrum  
Below: The Raman Effect honored as the International Historic Chemical Landmark by the American Chemical Society in 1998

“If you think that you can build a great industrial nation, make tons of money and pay off all these awful debts by pursuing so called technology alone, you are doomed to complete failure, let me say this without hesitation. It is only when we set our houses in order and build powerful schools of thinking in every field, electricity, chemistry, metallurgy and so on, only then we will have the solid basis of knowledge from which can come forth men who will teach technologists what to do.”

Apart from his towering contribution in physics of optics, Raman was extremely passionate about improving the scientific ambience in India. As the Director of the Indian Institute of Science (1933-1937), Raman was instrumental in making it the citadel of world-class experimental research. In 1934, he had also founded the Indian Academy of Sciences (IAS) in Bangalore, which grouped authoritative scientists coming from different parts of India to promote interdisciplinary scientific research in the country. Raman was actively involved in the activities of the academy as its president from its establishment till his death in 1970. He also started a new research institute in 1948 which is now well-known for fundamental work of liquid crystals and soft-condensed



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matter as the Raman Research Institute.

Raman's legacy lies in the large number of PhD scholars and researchers whom he mentored throughout his life. Raman motivated stalwart in biophysics, Prof GN Ramachandran to use methods of X-ray scattering to study the structures of proteins. Raman was a man of

great moral principles and wanted each scholar to be a role model for the society. He was far ahead of his time when he took initiative for funding academic research from industry, something similar to the “PPP model” that many Western countries started following only in this decade. Refusing to collect grant from British government, he requested a noted nationalist industrialist of his time, GD Birla to help him buy a spectrograph for 230 pounds and wrote to him: “Give me the money to buy a spectrograph. And if you give me the money, I promise I will bring the Nobel Prize in one year.”

The supremely confident Raman, indeed, fetched the first Nobel prize in Science in Asia in 1930. Through his work and life, Raman taught us to be patriotic, fiercely independent and to be in eternal pursuit of excellence and never be content with mediocracy. May this great country follow his ideals and vision.

*\* The writer is a Professor of Chemistry at Indian Association for the Cultivation of Science, Kolkata. He was awarded the 2017 BM Birla Science Prize and the distinguished investigator award in 2019 by Science and Engineering Research Board. Recently, he has been incorporated in the list of top 2% scientists in the world by a Stanford University study.*