



A Virtual Exhibition on Life Journey of
Sir Chandrasekhara Venkata Raman
(C. V. Raman)





Dr.CV Raman – Remembering the Nobel Laureate



Dr. C.V Raman full name is Dr. Chandrasekhara Venkata Raman. On 28 February, 1928, he discovered the Raman Effect and win Nobel Prize in Physics for the discovery. Every year on 28 February, National Science Day is celebrated to pay tribute to the Nobel Laureate Dr. C.V. Raman.

Dr. C.V Raman's contribution to science and his innovative research helped India and the World. He was born on 7 November, 1888 in Tiruchirappalli, Tamil Nadu. His father was a lecturer in Mathematics and Physics and so at a young age, he was exposed to an academic environment.

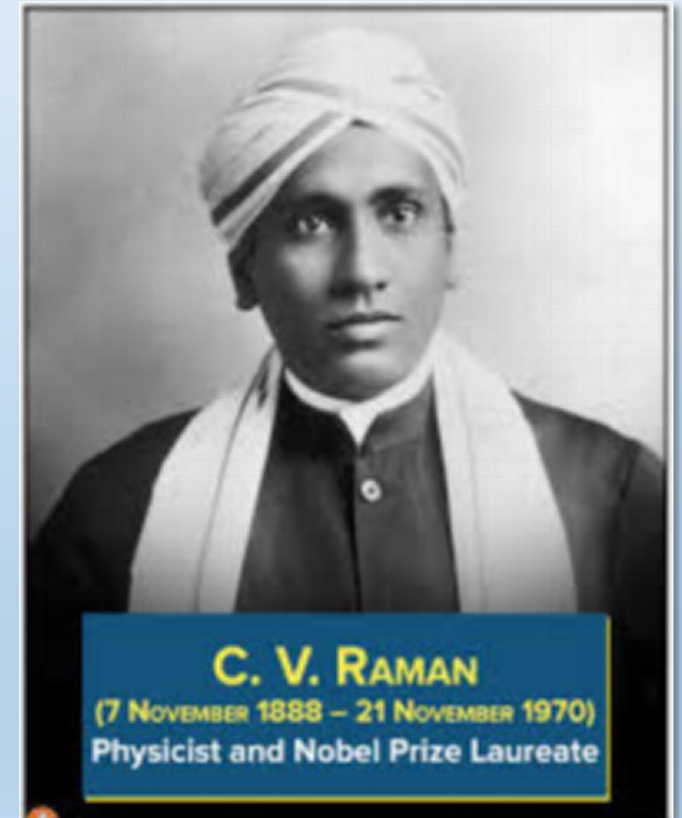




C.V. Raman : Introduction



- **Name:** Dr. Chandrashekhra Venkataraman or C.V. Raman
- **Born on:** 7 November, 1888
- **Place of Birth:** Tiruchirappalli, Tamil Nadu
- **Father's Name:** R. Chandrashekhara Aiyer
- **Mother's Name:** Parvathi Ammal
- **Spouse Name:** Lokasundari Ammal
- **Died on:** 21st November, 1970
- **Place of Death:** Bangalore, Mysore State, India
- **Discovery:** Raman Effect
- **Awards:** Matteucci Medal, Knight Bachelor, Hughes Medal, Nobel Prize in Physics, Bharat Ratna, Lenin Peace Prize, Fellow of the Royal Society
- **Institutions -** Indian Finance Department, Rajabazar Science College (University of Calcutta), Indian Association for the Cultivation of Science, Indian Institute of Science, Raman Research Institute
- **Doctoral students -** G. N. Ramachandran, Vikram Ambalal Sarabhai, Shivaramakrishnan Pancharatnam
- **Other notable students -** Kariamanickam Srinivasa Krishnan, K. R. Ramanathan





Dr. C.V. Raman : Early Life and Family



Dr. C.V. Raman was born on 7 November, 1888 in an orthodox South Indian Brahmin family in Tiruchirappalli, Tamil Nadu. His father's name was Chandra Shekhara Aiyer who was a lecturer in Mathematics and Physics in a college in Vishakhapatnam. His mother's name was Parvathi Ammal. C. V. Raman was an intelligent and brilliant student since his early childhood. At the age of 11, he passed his matriculation and 12th class at the age of 13 with a scholarship. In 1902, he joined the Presidency College and received his graduate degree in 1904. That time, he was the only student who received the first division. He has done his Master's in Physics from the same college and broke all the previous records. In 1907, he married to Lokasundari Ammal and had two sons namely Chandrasekhar and Radhakrishnan.





Dr. C.V.Raman : Career



- Because of his father's interest, he appeared for the Financial Civil Services (FCS) examination and topped it. In 1907, he went to Calcutta (now Kolkata) and joined as Assistant Accountant General. But in the spare time, he went to the laboratory for doing research at the Indian Association for Cultivation of Sciences. Let us tell you that, his job was very hectic then also he continued his research work in night due to his core interest in science.
- Though the facilities available in the laboratory were very limited, he continued his research and published his findings in leading international journals including 'Nature', 'The Philosophical Magazine', 'Physics Review', etc. At that time, his researches were focused on the areas of vibrations and acoustics.
- He got an opportunity to join the University of Calcutta in 1917, as the first Palit Professor of Physics. After 15 years at Calcutta, he became the Professor at the Indian Institute of Science at Bangalore from 1933-1948 and since 1948, he became the Director of the Raman Institute of Research at Bangalore which was established and endowed by him only.



Dr. C.V. Raman : Awards and Honours



- In 1924, he was elected as a Fellow of the Royal Society early in his career and was knighted in 1929.
- He won the Nobel Prize in Physics in 1930.
- He was awarded the Franklin Medal in 1941.
- He was awarded the Bharat Ratna in 1954, the highest civilian award in India.
- In 1957, he was awarded the Lenin Peace Prize.
- The American Chemical Society and the Indian Association for the Cultivation of Science in 1998 recognised Raman's discovery as an International Historic Chemical Landmark.
- On 28 February every year, India celebrates National Science Day to commemorate the discovery of the Raman Effect in 1928 in his honour.
- In 1970, he received a major heart attack while working in the laboratory. He took his last breath in the Raman Research Institute on 21st November, 1970.
- Dr. C.V. Raman was one of the great legends from India whose hard work and determination made India proud and became the first Indian to receive Nobel Prize in Physics. He proved that, if a person really wants to pursue his/her desires nobody can stop. His interest in science and dedication towards research works made him discovered the Raman Effect. He will always be remembered as a great Scientist, Physicist and a Nobel laureate.

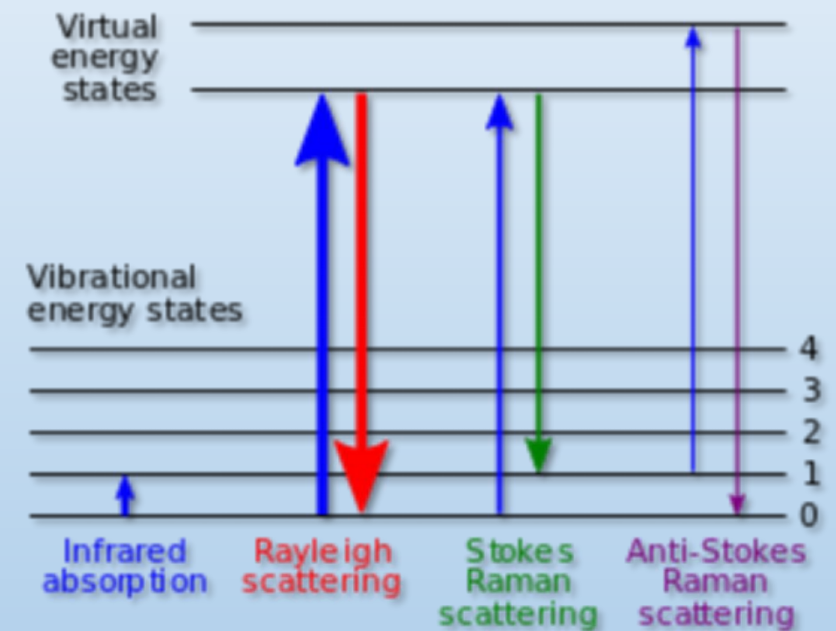


Scientific contributions Musical Sound



One of Raman's interests was understanding the physics of musical sounds. He was inspired by Hermann von Helmholtz's *The Sensations of Tone*, the book he came across when he joined IACS. He studied and published his findings quite prolifically between 1916 and 1921. He worked out the theory of transverse vibration of bowed string instruments, on the basis of superposition of velocities. One of his earliest studies was on the wolf tone in violins and cellos. He studied the acoustics of various violin and related instruments, including Indian stringed instruments, and water splashes. He even performed "Experiments with mechanically-played violins."

Raman also studied the uniqueness of Indian drums. His analyses of the harmonic nature of the sound of tabla and mridangam were the first scientific studies on Indian percussion. He wrote a critical research on Kaufmann's theory on vibrations of the pianoforte string. During his brief visit of England in 1921, he managed to study how sound travels in the Whispering Gallery of the dome of St Paul's Cathedral in London that produces unusual sound effects. His work on acoustics was an important prelude, both experimentally and conceptually, to his later works on optics and quantum mechanics.





Scientific contributions BLUE COLOUR OF THE SEA



Fascinated by the blue color of the sea, C.V. Raman believed the color was caused by more than just a reflection of the sky. Using a pocket-sized spectroscope and a prism, he examined the water and was convinced the water molecules could scatter light just as air molecules could. Raman discovered the scattered light was polarized, which distinguished the new scattering effect from fluorescence, in February 1928.

It is proposed in this paper to urge an entirely different view, that in this phenomenon, as in the parallel case of the colour of the sky, molecular diffraction determines the observed luminosity and in great measure also its colour. As a necessary preliminary to the discussion, a theoretical calculation and experimental observations of the intensity of molecular scattering in water will be presented.

Ramanathan published an elaborate experimental finding in 1923. The subsequent study in the Bay of Bengal in 1924 provided the full evidence



28 February: National Science Day

To commemorate the discovery of the Raman Effect



In 1928 an Indian Scientist Sir Chandrasekhara Venkata Raman discovered a phenomenon known as Raman Effect and for his remarkable discovery in 1930, he got Nobel Prize, which was the first Nobel Prize in India in the field of Science and to mark this discovery every year National Science Day is celebrated.

It is a phenomenon in which change in the wavelength of light occurs when a beam of light is deflected by molecules. When a beam of light travels from a dust-free transparent sample of a chemical compound, then a small fraction of the light emerges in the direction other than that of the incident light. Most of the scattered light wavelength is unchanged and in small part, if the wavelength is different from that of incident light it is due to Raman Effect.

Do you know that from **2013**, the “**Raman Effect**” has been designated as an International Historic Chemical Landmark by The American Chemical Society?



Posthumous recognition and contemporary references



- India celebrates National Science Day on 28 February of every year to commemorate the discovery of the Raman effect in 1928.
- Postal stamps featuring Raman were issued in 1971 and 2009.
- A road in India's capital, New Delhi, is named C. V. Raman Marg.
- An area in eastern Bangalore is called CV Raman Nagar.
- The road running north of the national seminar complex in Bangalore is named C. V. Raman Road.
- A building at the Indian Institute of Science in Bangalore is named the Raman Building.
- A hospital in eastern Bangalore on 80 Ft. Rd. is named the Sir C. V. Raman Hospital.
- There is also CV Raman Nagar in Trichy, his birthplace.
- Raman, a lunar crater is named after C. V. Raman.
- C. V. Raman Global University was established in 1997.
- In 1998, the American Chemical Society and Indian Association for the Cultivation of Science recognised Raman's discovery as an International Historic Chemical Landmark at the Indian Association for the Cultivation of Science in Jadavpur, Calcutta, India.
- Dr. C.V. Raman University was established in Chhattisgarh in 2006.
- On 7 November 2013, a Google Doodle honoured Raman on the 125th anniversary of his birthday.
- Raman Science Centre in Nagpur is named after Sir C. V. Raman.
- Dr. C.V. Raman University, Bihar was established in 2018.
- Dr. C.V. Raman University, Khandwa was established in 2018.



Dr. C.V. Raman : Works and Discovery



- He established the Indian Journal of Physics in 1926 where he was the Editor. He also sponsored the establishment of the Indian Academy of Sciences and served as the President since its inception. He was the President of the Current Science Association in Bangalore, which publishes Current Science (India).
- In 1928, he wrote an article on the theory of musical instruments to the 8th Volume of the Handbuch der Physik. He published his work on the "Molecular Diffraction of Light" in 1922 which led to his ultimate discovery of the radiation effect on the 28th February 1928 and gained him to receive Nobel Prize in Physics in 1930. He became the first Indian to receive a Nobel Prize.
- Other researches carried out by Dr. C.V. Raman were: Diffraction of light by acoustic waves of ultrasonic and hypersonic frequencies and effects produced by X-rays on infrared vibrations in crystals exposed to an ordinary light.
- In 1948, he also studied the fundamental problems of crystal dynamics. His laboratory has been dealing with the structure and properties of diamond, and the structure and optical behaviour of numerous iridescent substances like pearls, agate, opal, etc.
- He was also interested in the optics of colloids, electrical and magnetic anisotropy and the physiology of human vision.
- No doubt, he was honoured with a large number of doctorates and memberships of scientific societies. In 1924, he was also elected as a Fellow of the Royal Society early in his career and was knighted in 1929.
- As briefly described that he is best known for discovering the 'Raman Effect' or the theory related to the scattering of light. He showed that when light traverses a transparent material, some of the deflected light changes its wavelength.



Some Facts of C.V Raman



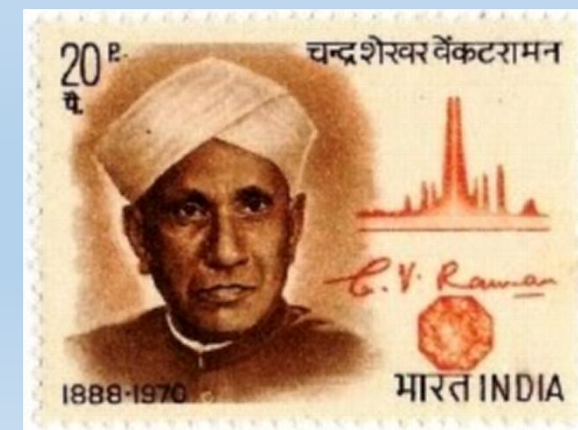
- C.V. Raman passed the matriculation from St. Aloysius Anglo-Indian High School when he was just 11 years old.
- While CV Raman was teaching at the University of Calcutta, he continued his research at the Indian Association for the Cultivation of Science (IACS) in Calcutta. He later became an honorary scholar at the association
- Raman went on to serve as the first Indian director of the Indian Institute of Science in Bangalore in 1933. He retired 15 years later and established the Raman Research Institute, which he led till the end of his days.
- In 1927, Arthur Holly Compton was awarded the Nobel for demonstrating the light scattering effect in x-rays. Raman was convinced he could show the same in visible light, and he did.
- The father of nuclear physics, Dr Ernest Rutherford referred to Raman spectroscopy in his presidential address to the Royal Society in 1929. Raman was acknowledged by the society and was also presented with a knighthood.
- When asked about his inspiration behind the Nobel Prize winning optical theory, Raman said he was inspired by the “wonderful blue opalescence of the Mediterranean Sea” while he was going to Europe in 1921.
- Raman was not only an expert on light, he also experimented with acoustics. In fact, he was the first person to investigate the harmonic nature of the sound of the Indian drums such as tabla and mridangam.



Some Facts of C.V Raman



- On his first death anniversary, the Indian Postal Service published a commemorative stamp of Sir C V Raman with the reading of his spectroscopy and a diamond in the background.
- Raman was conferred the country's highest civilian award, the Bharat Ratna in 1954 due to his impressive work in the field of Science
- Today, we all celebrate February 28th as the National Science Day, honouring his discovery of the Raman Effect.
- Raman believed that if you ask the right questions 'nature will open the doors to her secrets'. On this day, we hope you find the inspiration to unlock your highest potential and never quench your thirst for knowledge!





Independent discovery



In 1928, Grigory Landsberg and Leonid Mandelstam at the Moscow State University independently discovered the Raman effect. They published their findings in July issue of Naturwissenschaften, and presented their findings at the Sixth Congress of the Russian Association of Physicists held at Saratov from 5 to 16 August. In 1930, they were nominated for the Nobel Prize alongside Raman. According to the Nobel Committee, however: (1) the Russians did not come to an independent interpretation of their discovery as they cited Raman's article; (2) they observed the effect only in crystals, whereas Raman and Krishnan observed it in solids, liquids and gases, and therefore proved the universal nature of the effect; (3) the problems concerning the intensity of Raman and infrared lines in the spectra had been explained during the previous year; (4) the Raman method had been applied with great success in different fields of molecular physics; and (5) the Raman effect had effectively helped to check the symmetry properties of molecules, and thus the problems concerning nuclear spin in atomic physics.

The Nobel Committee proposed only Raman's name to the Royal Swedish Academy of Sciences for the Nobel Prize. Evidence later appeared that the Russians had discovered the phenomenon earlier, a week before Raman and Krishnan's discovery. According to Mandelstam's letter (to Orest Khvolson), the Russian had observed the spectral line on 21 February 1928.



Indian Institute of Sciences



Raman had a great fallout with the authorities at IISc. He was accused of biased development in physics, while ignoring other fields. He lacked diplomatic personality on other colleagues, which S. Ramaseshan, his nephew and later Director of IISc, reminisced, saying, "Raman went in there like a bull in a china shop." He wanted research in physics at the level of those of western institutes, but at the expense of other fields of science. Max Born observed, "Raman found a sleepy place where very little work was being done by a number of extremely well paid people." At the Council meeting Kenneth Aston, professor in the Electrical Technology Department, harshly criticised Raman and Raman's recruitment of Born. Raman had every intention of giving full position of professor to Born. Aston even made personal attack on Born by referring to him as someone "who was rejected by his own country, a renegade and therefore a second-rate scientist unfit to be part of the faculty, much less to be the head of the department of physics."

The Council of IISc constituted a review committee to oversee Raman's conduct in January 1936. The committee, chaired by James Irvine, Principal and Vice Chancellor of the University of St Andrews, reported in March that Raman had misused the funds and entirely shifted the "centre of gravity" in research to physics, and also that the proposal of Born as Professor of Mathematical Physics (which was already approved by the Council in November 1935) was not financially feasible. The Council offered Raman two choices, either to resign from the institute with effect from 1 April or resign as the Director and continue as Professor of physics. If he did not make the choice, he was to be fired. Raman was compelled to make the second choice



Indian Academy of Sciences



The Indian Academy of Sciences was born out of conflicts during the procedures of proposal for a national scientific organisation in line with the Royal Society. In 1933, the Indian Science Congress Association (ISCA), at the time the largest scientific organisation, planned to establish a national science body, which would be authorised to advise the government on scientific matters. Sir Richard Gregory, then editor of Nature on his visit to India, had suggested Raman, as editor of Current Science, to establish an Indian Academy of Sciences. Raman was of the opinion that it should be an exclusively Indian membership as opposed to the general consensus that British members should be included. He resolved that "How can India Science prosper under the tutelage of an academy which has its own council of 30, 15 of who are Britishers of whom only two or three are fit enough to be its Fellows." On 1 April 1933 he convened a separate meeting of the south Indian scientists. He and Subba Rao officially resigned from ISCA.

Raman registered the new organisation as Indian Academy of Sciences on 24 April to the Registrar of Societies. It was a provisional name to be changed to the Royal Society of India after approval from the Royal Charter. The Government of India did not recognise it as an official national scientific body, as such the ICSCA created a separate organisation named the National Institute of Sciences of India on 7 January 1935 (but again changed to the Indian National Science Academy in 1970). INSA had been led by the foremost rivals of Raman including Meghnad Saha, Bhabha, Bhatnagar, and Krishan



The Royal Society



Raman never seemed to have thought highly of the Fellowship of the Royal Society. He tendered his resignation as a Fellow on 9 March 1968, which the Council of the Royal Society accepted on 4 April. However, the exact reason was not documented. One reason could be Raman's objection to the designation "British subjects" as one of the categories of the Fellows. Particularly after the Independence of India, the Royal Society had its own disputes on this matter.

According to Subrahmanyan Chandrasekhar, The London Times had once made a list of the Fellows, in which Raman was omitted. Raman wrote to and demanded Patrick Blackett, the then President of the society, for an explanation. He was dejected by Blackett's response that the society had no role in the newspaper. According to Krishnan, it was because of a disapproving review Raman received on a manuscript he had submitted to the Proceedings of the Royal Society. It could have been these cumulative factors as Raman wrote in his resignation letter, and said, "I have taken this decision after careful consideration of all the circumstances of the case. I would request that my resignation be accepted and my name removed from the list of the Fellows of the Society"



Conclusion of C.V Raman



At the end of October 1970, Raman had a cardiac arrest and collapsed in his laboratory. He was moved to the hospital where the doctors diagnosed his condition and declared that Raman would not live more than four hours. He however survived a few days and requested to stay in the gardens of his institute surrounded by his followers.

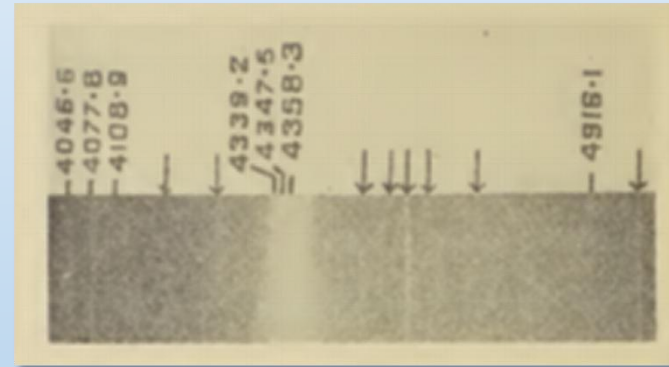
- **Independent discovery**
- **Indian Academy of Sciences**
- **Indian Institute of Sciences**
- **The Royal Society**



Some Glimpse of Dr C.V Raman



Raman at the 1930 Nobel Prize Award Ceremony with other winners, from left C. V. Raman (physics), Hans Fischer (chemistry), Karl Landsteiner (medicine) and Sinclair Lewis (literature)



An early Raman spectrum of benzene published by Raman and Krishnan.



Bust of Chandrasekhara Venkata Raman which is placed in the garden of Birla Industrial & Technological Museum



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