



S C Sirkar – The witness of the discovery of the Raman effect

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On Feb 28, 1928, the Raman effect was discovered by C V Raman and his students. Raman received the Nobel Prize in 1930 for his work on light scattering and the effect named after him. Russian physicists, who discovered the same effect nearly at the same time, were ignored. These details are explored in the previous two articles published in “*Asian J Physics*” [1,2].

According to the record of the Nobel Foundation, Raman is the only one Indian Nobel Laureate in the field of Physics. Not surprisingly there are a number of biographies, which deal with various aspects of his life [3-14]. However, to the best of my knowledge, none of the authors has discussed Sukumar Chandra Sirkar’s view about the discovery of Raman Effect. In those days S C Sirkar (Photo 1) was Raman’s research scholar at the University of Calcutta. The present article is intended to fulfill the gap.



Photo 1. S C Sirkar (1898-1983). Credit: IACS.

In May 1926, Raman wrote a letter to S C Sirkar (SCS) and offered Palit Scholarship for three years [15]. SCS recalled about his duties as follows:

“I was first assigned the experimental investigation on penetration of light in the second medium during total reflection. This work was completed in a month and I was next asked to determine the permanent electric moment of a few simple organic molecules by Debye’s method. I set up the apparatus required for the heterodyne null method in the laboratory of the Association and got results for three simple organic molecules.” [15]

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S C Sirkar and the Raman effect

In 1928, Raman and his students discovered that when monochromatic light is scattered by a transparent medium, the scattered light contains not only the original but also other frequencies; which help to determine the structure of scattering medium. This discovery later on came to known as the Raman effect.

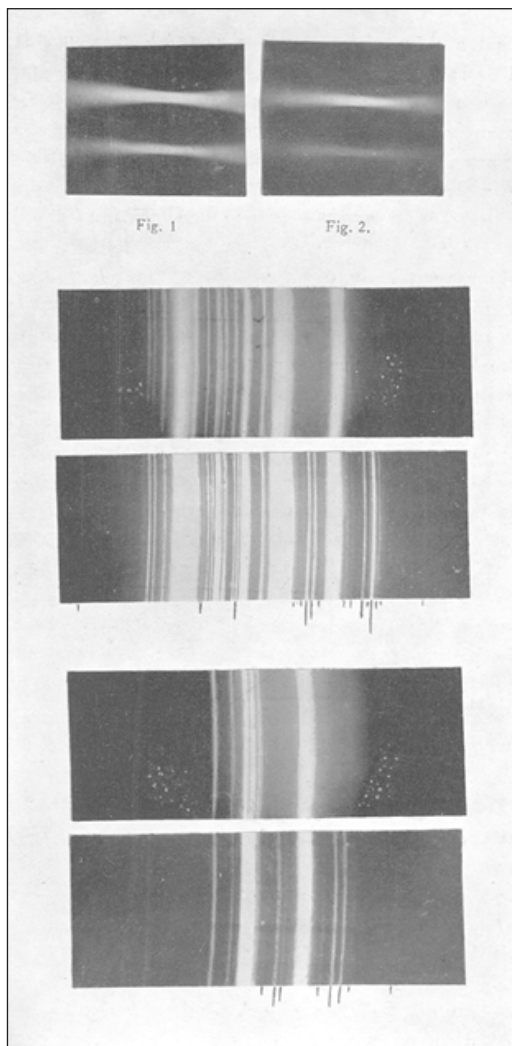


Fig 1. Top: Polarisation of scattered light in toluene: (i) Unmodified and (ii) Modified. Middle-upper: Mercury arc light filtered through a blue glass with transmission range from 350 to 440 Nanometer. Middle-lower: Scattered spectrum of benzene with additional lines. Bottom-upper: Mercury arc incident light filtered with potassium permanganate solution. Bottom-lower: Scattered spectrum of benzene with additional lines. (Courtesy IACS. *Indian Journal of Physics.*)

During the year 1928, at the IACS, under Raman's guidance 32 research scholars were working [16]. As far as the discovery of the Raman effect is concerned, only K S Krishnan and S C Sirkar left written record about the discovery. K S Krishnan in his private diary; which covers only a very limited period of time that is, from Feb 5-28, 1928. During his lifetime Krishnan never disclosed the diary. Only after his

death, parts of diary started appearing in articles. Parts of the authentic diary are published by Professor D CV Mallik [17,18]. In the following, we shall see – What SCS recalled about the discovery at the occasion of the 25th and 50th anniversaries of the Raman effect. As stated above, his views are important, as none of Raman’s biographs have dealt with the issue.

In the 1928-1929, SCS was working on Kerr effect in liquids; and Laue pattern in crystals. SCS recalled: “one day Prof Raman was showing a plate to some of the workers in the laboratory and he hurriedly came to my seat also and after showing me the plate said ‘Krishnan has made half the discovery.’” [15]. The lesser known fact is that SCS was the first person to be asked by Raman to evaluate the first ever taken “Raman spectrum” of benzene (Fig 1). Sircar recalled that Professor Raman came to him with glass plates containing benzene and mercury lamp spectra and asked him to measure the wavelength of new lines with Adam Hilger comparator. He also told me that one of the spectra was due to the direct light from mercury arc and the other was due to the same light scattered by benzene. As the standard iron spectrum for comparison was not available, and the distance between the lines was too low (35 Å), he was unable to measure it accurately. When Professor Raman came back from the lecture, S C Sircar informed him about the difficulty. Raman told him (SCS) that there is not time to take (reference) spectrogram from iron arc as he (CV Raman) has to leave for Bangalore to announce the discovery [15].

The other important statement by SCS to be underlined is that Raman in his paper to “*Nature*” (2, 387, 1928) in which he was single author, he wrote: :

“This new secondary radiation was analogous to Compton effect. It was also stated that each of the prominent mercury lines produced a single new line. These statements were made only because the complete spectrum of the light scattered by benzene had not been investigated and the difference between the new effect and Compton effect was not realised at that time.” [15].

SCS further noted that even in the middle of 1928, neither Raman nor his students made effort to investigate the theory of the effect. The effect was being called ‘modified scattering’.

In Berlin, Peter Pringsheim, performed experiments successfully, and in a letter of June 20, 1928 he coined the term “the Raman effect” (Fig 2).

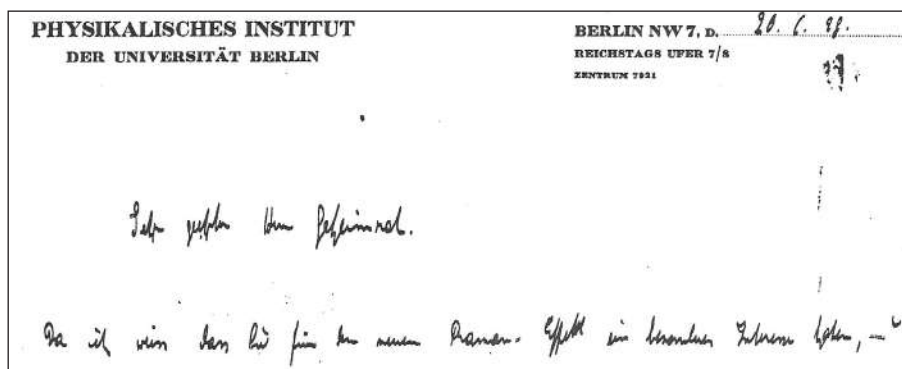


Fig 2. Use of the term “Raman effect” by P Pringsheim in a letter to A Sommerfeld. Credit: “Deutsches Museum, München”

In the same letter Pringsheim sent the Raman spectra of Benzol, Toluene and CCl₄ to A Sommerfeld (Fig 3). Later he (Pringsheim) published “Der Ramaneffekt, ein neuer von C V Raman entdeckter Strahlungseffekt” in the German journal “*Naturwissenschaften*”[19].

Raman was aware that in Russia and France scientists were working on the same topic. Russian physicists L I Mandelstam and G S Landsberg observed the same effect nearly at the same time, in crystals [20]. Also the effect was theoretically predicted by Adolf Smekal [21]. Due to these reasons the effect was later called under different names, such as Landsberg-Mandelstam effect, Combination Scattering, Raman-Landsberg-Mandelstam effect, Smekal effect and Smekal-Raman effect [22]. According to SCS, P Pringsheim relieved Raman from the stress of the priority of the discovery; because he coined the term Raman effect. In S C Sirkar's words:

“One day Prof. Raman was seen moving about hurriedly in the halls of the Association with a copy of “*Naturwissenschaften*” in his hand. He showed every one of us present in the laboratory an article entitled ‘der Raman Effekt’ on page 597 of the issue written by Pringsheim. Prof. Pringsheim was an acknowledged authority in fluorescence and therefore Prof Raman's joy knew no bounds when he came across the article. He told us that the controversy about the priority of the discovery of this new phenomenon was settled when the effect was named after him alone.” [15]



Fig 3: Spectra sent by P Pringsheim to A Sommerfeld. From top to bottom: Hg-Benzol, Toluol and Hg-CCl₄. Credit: “Deutsche Museum München”.

In 1953, under the guidance of M N Saha, Director IACS, the 25th anniversary of the discovery of Raman effect was celebrated [23]. The British journal “*Nature*” reported about it. Therein we read that S C Sirkar narrated briefly the sequence of events which led to the discovery. According to “*Nature*”:

“Prof Saha then pointed out that the discovery was one of the most important in science of this country and that not only the Association but also the whole of India took pride in the fact that such a discovery was made in the laboratories of the Association. A resolution congratulating Prof C V Raman on the anniversary was passed and forwarded to him” [24].

SCS lived long enough to celebrate the 50th anniversary of the *Raman Effect*. At the occasion he wrote: “Reminiscences of my association with Prof C V Raman” [15], which was quite critical.

However, before that in the 1940s SCS came in conflict with Raman due to the interpretation of diffuse Laue spots which were discovered by Raman in crystal. These details are explored elsewhere. Raman and SCS did not have a cordial relation. One of SCS’s associates, G S Kastha, wrote: “Prof Raman did not encourage him and casually pointed out that only a scientist who was born as a genius could make any important fundamental discovery. At that time, for some reasons, Prof Raman was disgusted with Bengali research workers”[25].



Photo 2. Prof Wolfgang Kiefer (left) and Prof S C Sircar (right)

Thus this article described Sukumar Chandra Sircar’s (SCS) view about the discovery of Raman Effect. In Photo 2 Prof W Kiefer (University of Würzburg, Institute for Physical and Theoretical Chemistry, Am Hubland, D-97074 Würzburg, Germany and Eisingen Laboratory for Applied Raman Spectroscopy, (ELARS), 97249 Eisingen, Germany) and Prof S C Sircar are seen with Raman's Spectrograph. As mentioned on the photograph, the first Raman Spectrum was recorded with this spectrograph in 1928. The photo was taken during the Conference celebrating the 50th anniversary of the discovery of the Raman effect in 1978, which took place at the Indian Association for the Cultivation of Science (IACS) in Calcutta, India. Prof Kiefer occupied "Smekal chair" at Karl-Franzens-University in Graz, Austria, from 1985 to 1988.

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