



C V Raman at the Nobel Prize winner meeting 1956 in Lindau, Germany

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C.V. Raman, India's only Nobel Prize Winner in the field of science, had close contacts with the German scientific community. The present short communication explores his last visit to Germany, but first visit to Lindau in 1956, to take part in the 6th Nobel Laureate Meeting. © Anita Publications. All rights reserved.

Chandrasekhara Venkata Raman (CVR), better known as C.V. Raman, the founder of the Raman spectroscopy, is known for the discovery of the effect, named after him. For the discovery and work on light scattering, he was awarded the Physics Nobel Prize in 1930 [1]. Till today, he remains India's only Nobel Prize winner in science. Not surprisingly, there are a number of books, which explore different aspects of his life. However, his visit to Lindau, Germany, in 1956, remains unexplored. The present article intends to fill the gap.

To start with we give a very brief history of the beginning of the Lindau Nobel Laureate Meeting.

The beginning of the Lindau Nobel Laureate Meeting

After World War II, the German scientific community was isolated. In order to reestablish contacts, a careful step was taken by two men of medicine from Lindau, Prof. Gustav Parade and Dr. Franz Karl Hein [2]. They decided to hold a meeting of the Medicine and Physiology Nobel Laureates under the motto "Educate, inspire, and connect" [3]. The initial difficulties faced by the initiators, and the history of the institution is explored by the author R. Burmester in "Science at First Hand - 65 Years Lindau Nobel Laureate Meetings" [4]. The first meeting was held in 1951, in which Medicine and Physiology Nobel Laureates were invited. In the second and third annual meeting the Chemistry and Physics Nobel Laureate were invited alternatively. The circle of Medicine and Physiology, Chemistry and Physics Nobel Laureate Meeting continued in the following years [5]. CVR took part in the Physics Nobel Laureate meeting in 1956. Nobel Laureates who delivered lectures were Patrick M.S. Blackett, Max Born, John D. Cockcroft, Paul A.M. Dirac, Werner Heisenberg, Gustav L. Hertz, Max von Laue, Chandrasekhara V. Raman, Hideki Yukawa, and Frits Zernike. CVR and Japanese Hideki Yukawa were two Asian physicists. The latter had already attended the meeting in 1953 [6].

Report by Indian media on CVR's visit

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Background: In the beginning of the 1940s CVR and his students observed diffuse spots in Laue photographs. To explain them, CVR and associates gave a theory. The study of vibrational spectra of diamonds and other crystals led them to believe that old theories of lattice dynamics by Peter Debye and Max Born are not correct as they predict a continuous spectrum, whereas the experimental studies showed only a line spectrum. In the beginning the communication between Raman and Born was friendly, as the latter was invited by Raman to visit the Indian Institute of Sciences, Bangalore. Raman wanted to create a permanent chair of theoretical physics for Born, but failed due to internal conflicts. Max Born had no explanation for the observed line frequencies. He asked Erwin Schrödinger and other theoretical physicists and mathematicians to write articles in favour, to show the cyclic boundary condition hypothesis is reasonable. Erwin Schrödinger wrote to Born that lines observed by Raman are reality, thus people will believe, even though his theory has mistakes. Born went so far as to write to the editor of “Nature” to check Raman’s manuscripts carefully. Raman on the other hand, did not allow to publish R.E. Peierls article in the journals of the Indian Academy of Sciences. The dirty games played by the two great men of science was explored in detail, elsewhere [7]. In the following we give a short review of the situation, before CVR went to Lindau to deliver a lecture, and the content of his lecture.

Indian media: In 1955, on the annual meeting of the Indian Academy of Sciences in Bangalore, in his lecture, CVR stated that today physicists were taught to believe Peter Debye’s forty years old theory - “namely, that the heat energy of a solid is identifiable with the energy of sound waves of high frequencies spontaneously present in its interior. The Bangalore investigations have, however, shown that the Debye theory is untenable” [8].

The journalist wrote that to explain the specific heat of solids, CVR outlined his own theory, which explains the observed experimental results.

The Deccan Herald of June 17, 1956, reported that CVR delivered a lecture and talked about: why volume of a solid changes on heating; why its elasticity falls off in the same circumstances; and why heat energy moves very slow, while sound travels faster than a bullet in the same solid. He stated that scientists are taught to believe P. Debye’s 40 years old specific heat theory of solids. He has outlined his own theory. Raman’s criticism was: (i) Born’s theory contains the *ad hoc* hypothesis of cyclic boundary condition. (ii) It predicts a continuous vibrational spectrum, while the experimental results show a line spectrum.

CVR’s simple specific heat theory was able to explain his results. After presenting his results in India, he decided to propagate his new theory in Europe. The chance came due to a special conference in Lindau, Germany. On June 17, 1956, two newspapers reported that CVR is leaving India to attend a World Conference of Nobel Prize Winners on June 25, 1956. *The Dacca Herald* of June 17, 1956, reported that he would deliver a lecture on the “Physics of crystals” to give a ‘fresh orientation to the subject of crystal physics.’ His theory is based on Einstein’s classic papers of 1907. According to it, “**a crystal is an assembly of an immense number of individual oscillators distributed over its volume which could be grouped into sets, each set comprising a great many oscillators characterized by a common frequency of vibration** (emphasis in original)”.

CVR’s lecture on the physics of crystals

Nobel Laureates are free to choose the topic of their lecture. CVR did not talk on it, but the physics of crystals, a topic, due to which he had controversy with Max Born.

The meeting was held from June 25 to 29, 1956. One of us Heinz W. Schrötter (abb. HWS) took part in the conference as a young student. He had just begun to work on his diploma thesis in the Physics Institute of Professor Walther Gerlach at the Ludwig-Maximilians-University in Munich. Under the supervision of Gerlach’s assistant Josef Brandmüller he had the task to convert a Raman spectrometer with photographic

recording to photoelectric detection with photomultipliers and to measure Raman intensities of liquid carbon tetrachloride. At that time a high pressure mercury lamp was used as light source.

Of course the presence of CVR as the discoverer of the Raman effect was of supreme interest for HWS. However, he had only limited knowledge of solid state physics and could not make any judgement of the controversy between CVR and Max Born.

In the session M. Born was the first speaker on “Bemerkungen über die Grundlagen der kinetischen Gastheorie“ (Comments on the basics of kinetic gas theory). He repeated the lecture in English and therefore used much more time than provided by the program.

The German text of CVR’s lecture “Die Physik der Kristalle“ (The Physics of Crystals) was distributed before session. CVR started to lecture in German but after 20 minutes he realized that he needed too much time and he switched to English in free speech in his lively manner. Whenever it read “die Theorien von Debye und Born” in German text, he said “the theories of Debye and others.”

Quite interesting, CVR’s talk in German, was recorded, and is available on the “Lindau Nobel Laureate Meetings”[6]. He told the aim of the talk is to discuss the relevant theories, and apply them to answer: “What is the nature of the thermal agitation in crystals? What is the character of their vibration spectra?” CVR stated that according to Einstein’s theory of specific heat, the atomic vibration spectrum of a crystal consists of discrete monochromatic frequencies. “However, the theory as it stands gives no precise indication of how the oscillators in each set are to be enumerated and how their respective frequencies of vibration are to be determined. Neither is any indication given whether the modes of vibration of the solid recognised by the classical theory of elasticity have any place in the picture”[9].

CVR presented his own theory, which successfully explained the observed frequencies. Also with it, it was possible to determine the specific heat of crystals. He observed: “The ideas underlying the specific-heat theories of Debye and Born are irreconcilable with the observed spectroscopic behaviour of crystals and especially with the effects exhibited in their second-order spectra of light-scattering” [9].

The programme of the Meeting shows that Max Born, CVR and Patrick Blackett were in the same session. After Raman’s lecture, there was a violent discussion between CVR and M. Born [10].

On Friday, the last day of the meeting, it is the custom to undertake an excursion by boat to the island of Mainau, where the family of earl Bernadotte has created a splendid botanical garden with many beautiful flowers. On the boat CVR was always surrounded by a crowd of students listening to his lecturing, while Max Born was sitting quietly on a bench talking to a colleague. HWS took the opportunity to take many photographs, some of them showing CVR are reproduced in Figs. 1 and 2.



Fig. 1. Left: CVR with young student Heinz W. Schrötter. Right: CVR with a member of Bernadotte family.



Fig 2. Left: CVR with Frits Zernicke, Hans K.A.S. von Euler-Chelpin, Gustav Hertz and Otto Hahn and others. Right: Excursion at Mainau.

“The Deccan Herald” of June 27, 1956, reported that scientists from seven countries attended the conference. The first time, scientists from East Germany took part. Professor Richard Katsch, University of Greifswald proposed the toast. **“Another toast – to friendship among scientists and ever-growing ties between India and East Germany – was proposed by Sir C.V. Raman, Nobel Prize winner from Bangalore”** (emphasis in original). Raman told that he was entitled to bring greetings of Indian Government and public.

End of the controversy

On the official webpage of the “Lindau Nobel Laureate Meeting” Raman’s video is commented by Anders Bárány, a theoretical physics from Sweden. According to him, CVR spoke against Debye’s and Born’s theory. He emphasized Einstein’s theory, but did not mention its drawback at low temperature. “Since the crystal models of Debye and Born have survived and are still taught at universities all over the world, my interpretation is that Raman’s 1956 critique was not completely justified!” [6].

Such statement is misleading, in 1956, there was no proof of the correctness of M. Born’s theory. Max Born could not explain the lines observed by Raman’s school. This was done by Raman’s student K.S. Viswanathan. He showed that the number of frequencies predicted by Raman’s theory “correspond, in Born’s language, to normal mode frequencies for which the group velocity vanishes. Now group velocity can vanish for selected normal modes either for reasons of symmetry or on account of the nature of inter-atomic forces” [11].

Born’s theory found its complete confirmation in 1962, because “Elaborate calculations (...) were needed to predict the simplest of optical and thermal properties from the Born theory. Lacking the notion of singularities in the spectrum, again not to come for a decade, the sharp features seen in the Raman scattering found no explanation” [12]. Complicated calculation done with computers, showed the correctness of Born’s theory.

C.V. Raman and Max Born were great experimental and theoretical physicists, respectively. They themselves were aware of the fact, however, Raman refused to accept Born’s theory as for the time being it did not explain the observed experimental results. In contrast, Born was aware that Raman is a par-excellent experimental physicist, and his observations could not be wrong. Instead of explaining the experimental results, he decided to oppose Raman and sought support from theoretical physicists and mathematicians. Much before his conflict with M. Born, on March 13, 1932, CVR wrote to Niels Bohr: “theories must stand or fall according to as they agree with the facts, and not vice versa (underlined in original).” Here facts means

“experimental results.” The story of the two physicists shows that very often the experimental and theoretical physicists live in their own world, without accepting the “reality”.

CVR could have chosen other topic for his talk as there was no restriction. But he decided to talk on the physics of crystals; in spite of the fact that he was aware that M. Born was taking part, and the scientific community knew the conflict between Raman and Born. This shows that CVR was not a man of forget and forgive, but one to attack his opponents.

The most interesting part of the story is – Raman knew good German. This is not mentioned in any of his biographies or any other article. Finally, we like to emphasize how carefully CVR prepared his lecture is witnessed by the fact that he published the English text of his lecture beforehand (submitted May 31, 1956) and had it translated into German, the distributed manuscript also bearing the date 31. Mai 1956.

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