

Sir CV Raman and the Story of the Nobel Prize

Authors

Abstract: In 1930, Sir C.V. Raman was the first 'non-white', Asian and Indian to receive the Nobel Prize in Physics due to his work on scattering of light and the discovery of the Raman effect. In the past, the questions have been raised about the sharing of the Prize either among his colleagues or the Russian scientists. It will be shown here that these objections are not fair, as the unpublished report of the (Royal) Swedish Academy of Sciences reveals. He received the Nobel Prize in a record time of two year after the discovery. The reasons for it are also elaborated.

Keywords: Nobel Prize, Raman effect,

Introduction

The Nobel Prize is one of the only prizes known by name to a great part of the non-scientific public and is considered as the highest honour for scientists. A short view about the founder and the foundation of the Nobel Prize is given. The Statutes of the Nobel Foundation (abbreviated as SNF) which was approved by the Crown on June 29, 1900 had been decreed by the Swedish Government on April 27, 1995. The rules and regulations quoted are taken from these Statutes.

In his wonderful book „Raman and His Effect“ Keswani wrote, „*Raman was a great teacher and beloved of his pupils but he could have given more credit to K.S. Krishnan who contributed no less to the discovery of the effect now known as the Raman effect*“¹; and further, „*Many have felt that K.S. Krishnan should have been acknowledged as the co-discoverer of the effect now bearing Raman's name exclusively*“². As far, as the coining of the term Raman effect (in English and German speaking areas) or Smekal-Raman effect is concerned, a detailed description has been given in a separate article³. The term was not coined by Raman himself, it was a product of others. In the same book he has raised some interesting questions, such as „*Why did the Nobel Committee for physics not vote for the sharing of the prize by the Indian (s) and Russians?*“⁴. The writer has given a brief idea, why the Russians were excluded.

In this article, we can put the question the other way round, i.e. why did he not share the prize with Indian and Russian scientists? It will be shown here that it was not in Raman's hand to take this decision. Also, it will be shown, why he received it in such a short time whereas persons like A Einstein (1879-1955) and M Planck (1858-1947) had to wait for a long time. Did Raman's contacts in the western world play a role? What was the opinion of the western scientists about his scientific work? The unpublished report of the (Royal) Swedish Academy of Science reveals some of the secrets about Raman and the Nobel Prize.

Chandrasekhara Venkata Raman (1888-1970)

India's only Nobel Laureate and the first Asian to get the Nobel Prize for physics, Sir CV Raman was born on November 8, 1888 in Madras. Later, the family moved to Visakhapatnam, where his father had been appointed lecturer. Raman was a brilliant student throughout his studies. In order to get a job in the Indian Civil Services he had to go to England to appear in the examinations, which was ruled out on health grounds. The next best bet for him was the Financial Civil Services, where he was posted as an Assistant Accountant-General in Calcutta. He went there in 1907.

In his spare time, he started working on some problems in the fields of acoustics at the Indian Association for the Cultivation of Science which was founded by Mahendra Lal Sarcar (1833-1904) on the model of the Royal Institution in London. For nearly ten years, he worked independently and established his reputation as a scientist not only in India but also in Europe. In 1917, he was appointed professor at the University of Calcutta. He went to Oxford in 1921 to represent this university. It was his first trip abroad.

During his voyage, he did some experiments and soon sent a note to the „Nature“ entitled 'The colour of the Sea'⁵. It was a general belief that the blue colour of the Sea is due to the reflected sky-light and apart from it if there is another factor at all responsible for it, it is the absorption of the light by the suspended matter in the water. Raman had shown that the blue colour of the Sea is independent of sky-reflection and absorption, but is due to the molecular diffraction. These initial experiments opened a new field of research in Calcutta. Further work on the scattering of light led to the discovery of the Raman effect in 1928. The effect deals with the change in the frequency of the monochromatic light after scattering. The spectrum of the scattered light gives clues about the molecular structure and thus helps to understand the properties of material.

The list of honours bestowed on Raman for his scientific activities is long. Because the Nobel Prize is something very special and questions have been raised only about it, so it is the main point of discussion.

Before starting with the case of Raman, it will not be out of place to give a short biography of the founder of the Nobel Prize.

Dr. Alfred Bernhard Nobel (1833-1896)

Alfred Nobel was born on October 21, 1833 in Stockholm, Sweden. His father Emmanuel Nobel was an engineer who built bridges and buildings. During these activities, he experimented with different techniques of blasting rocks. In 1837, he was forced into bankruptcy. He left Stockholm and moved to Russia, where he started a new enterprise in St. Petersburg. In his new workshop he started producing the equipment for the Russian army. Soon, he was a pioneer in arms manufacturing. In 1842, the rest of family joined him in St. Petersburg; where Alfred and his brothers were tutored privately till 1850. After the Crimean War (1853-1856), the new Russian Government cancelled all delivery agreements; Emmanuel Nobel had to declare bankruptcy once again, and returned to Sweden in 1859.

In Paris, Alfred Nobel worked in the private laboratory of a famous chemist Professor TJ Pelouze, and came in contact with an Italian scientist A Sobrero, who had invented highly explosive nitro-glycerine, a mixture of glycerine, sulphuric and nitric acid. This idea was extended further by Alfred Nobel to make explosions under controlled conditions. After a long period of experimentation he was able to turn liquid nitro-glycerine into a ductile explosive and patented this material as dynamite in the year 1867. He also invented a detonator which could be ignited with a fuse. These inventions helped to reduce the costs for drilling tunnels, building canals and other construction works.

He was a scientist as well as a successful businessman. He founded many factories and laboratories in different countries. He focused not only on explosive technology but also other materials such as synthetic rubber, leather etc. His later work covered electrochemistry, optics, biology and physiology. At the end of his life, he had as many as 355 patents. Some of his industrial enterprises still exist e.g. Imperial Chemical Industries, UK; Dyno Industries Norway and AB Bofors in Sweden.

At the age of 43, he fell in love with Sophie Hess, who was 20 years old and a clerk in a flower shop. The relationship ended around 1891, as she became financially demanding. For his house keeping and secretary work he engaged an Austrian woman Countess Bertha Kinsky, who left Paris after a few weeks due to home sickness. She was engaged in the peace movement. Most probably, it was due to her influence that the Nobel Prize for peace is one of the five Prizes, whereas the sixth Nobel Prize for economic sciences has been established by the Swedish Riksbank since 1968. The other version about the Nobel Prize for peace is that *“Evidence suggests that the award for peace may well have been the fruition of the inventor’s long standing aversion to violence. Early in 1886, for example, he told a British acquaintance that he had ‘a more and more earnest wish to see a rose red peace sprout in this explosive world’”*⁶.

Through his skill as industrialist, and his number of patents he became one of the wealthiest men in the World. Alfred Bernhard Nobel died in Italy on December 10, 1896. This day is taken as the Nobel Prize ceremony day to honour the testator.

The Last Will - The Foundation of the Nobel Prize

“The Nobel Foundation is established under the terms of the will of Dr. Alfred Bernhard Nobel, drawn up on the 27 of November, 1895, which in its relevant parts runs as follows: § 1 „the whole of my remaining realizable estate shall be dealt with in the following way: the capital, invested in safe securities by my executors, shall constitute a fund, the interest on which shall be annually distributed in the form of prizes to those who, during the preceding year, shall have conferred the greatest benefit to mankind. The said interest shall be divided into five equal parts, which shall be apportioned as follows: one part to the person who shall have made the most important discovery or invention within the field of physics; one part to the person who shall have made the most important chemical discovery or improvement; one part to the person who shall have made the most important discovery within the domain of physiology or medicine; one part to the person who shall have produced in the field of literature the most outstanding work of an idealistic tendency; and one part to the person who shall have done the most or the best work for fraternity between nations, for the abolition or

reduction of standing armies and for the holding and promotion of peace congresses. The prize for physics and chemistry shall be awarded by the (Royal) Swedish Academy of Sciences; that for physiological or medical works by the Karolinska Institute in Stockholm; that for literature by the (Swedish) Academy in Stockholm; and that for champions of peace by a committee of the persons to be elected by the Norwegian Storting (Parliament). It is my express wish that in awarding the prizes no consideration whatever shall be given to the nationality of the candidates, but that the most worthy shall receive the prize, whether he be a Scandinavian or not⁷.

As stated above, the Nobel prize for physics and chemistry is awarded by the Swedish Academy of Science. Here, the discussion has been limited to the field of physics only. In general, the "Nobel Committee" consisting of three, four or five members is elected for a period of three years for each Swedish Prize section by the Academy.. (Later the number of members for the Physics and Chemistry groups had been fixed to 5 for each group⁸). The Nobel Committee sends invitations during the month of September to the competent persons to put forward proposals, which had to be submitted with evidences before the first of February of the following year. The following persons are competent to submit proposals⁹: "

- 1. Swedish and foreign members of the Academy of Sciences;*
- 2. Members of the Nobel Committees for Physics and Chemistry;*
- 3. Scientists who have been awarded the Prize by the Academy of Sciences;*
- 4. Permanent and assistant professors in the sciences of Physics and Chemistry at the universities and institutes of technology of Sweden, Denmark, Finland, Iceland and Norway, and the Karolinska Institute;*
- 5. Holders of corresponding chairs in at least six universities or university colleges selected by the Academy of Sciences with a view to ensuring the appropriate distribution of the commission over the different countries and their seats of learning; and*
- 6. Other scientists from whom the Academy may see fit to invite proposals. Decisions as to the selection of the teachers and scientists referred to in paragraphs 5 (Expert's scrutiny) and 6 (Opinion of 3-5 members of the Nobel Committee) above shall be taken each year before the end of the month September."*

According to Nobel's will, the prize should have international character. It has been observed that between the years 1901-1929; 28.6%, 20.0%, 20.0%, 8.6% and 8.6% Nobel Laureates belonged to Germany, France, England, USA and Scandinavian countries respectively; whereas the nominators who made proposals from the above countries were 25.9%, 13.9%, 7.6%, 11.0% and 13.4% respectively¹⁰. As most of the nominators and proposed candidates come from these countries, the chances for others such as Russians were not good. On the other hand, these circumstances make the case study of Raman more interesting. It is in itself a proof of his pioneer work and his reputation among the scientists of these countries.

CV Raman and the Nobel Prize Proposals

In 1929, two persons proposed Raman. C Fabry from Paris recommended J Cabannes (Montpellier) and CV Raman (Calcutta), whereas N Bohr's proposal was that either RW Wood or RW Wood and Raman should get the Nobel Prize for physics. In that year 48 nominators sent 97 proposals and proposed 29 persons¹¹. Out of these 29 persons, L de

Brogie, Cabannes, Raman and Wood were declared by the Committee as “the persons who fundamentally deserve the prize”; but L de Broglie was recommended by the Committee to the Academy, thus he got the prize for this year¹².

Now ” for the year 1930, 39 competent persons were asked to make proposals. Out of them 37 persons sent proposals. There were 21 valid recommendations for a full or shared Prize. ... Most of the recommendations were concerned with atomic theory and atomic physics. The atomic theory proposals have been worked out by Oseen¹³ (Translated from Swedish).

Out of 21 nominations Raman was the most suitable person as he was proposed 10 times either as single candidate for the Prize or with other persons (see table 1).

Proposed by	The Candidate/s
E Bloch (Paris)	WR Wood* & CV Raman
N Bohr (Copenhagen)	Wood or Wood & Raman
O Chwolson (Leningrad)	Half for Raman and the rest for Landsberg & Mandelstam
J Perrin (Paris)	Raman or Raman & Heisenberg
FL de Broglie (Paris)	Raman
HM de Broglie (Paris)	Raman
R Pfeiffer (Breslau)	Raman
J Stark (Grosshesselohe)	Raman
E Rutherford (Cambridge)	Raman
CTR Wilson (Cambridge)	Raman

Table 1: *WR Wood (1868-1955) who was famous for his work on fluorescence and resonance radiation, “... was recommended 24 times since 1914¹⁴. Names of the persons who recommended Raman alone or Raman with others for the Nobel Prize for the year 1930. (Reference, the report of the Nobel Committee, pages 5-6; and also page 1 of the report submitted by Erik Hulthen to the Academy of Science, dated May 26, 1930).

For the same year, there were some other famous persons proposed, such as M Born, A Sommerfeld, E Schroedinger, W Heisenberg, HF Osborn and MN Saha, who also belonged to India and was famous for his work on astrophysics.

CV Raman and the Nobel Prize in Record Time

A very interesting factor in the case of Raman is that he got the Prize in record time, as is clear from table 2 which has been compiled for the physicists from the German speaking area who got the Prize before 1930. However there will be one exception, if we take into consideration all the Nobel Laureates of Physics before that, that is in the year 1915 Sir WH Bragg and his son Sir WL Bragg jointly received the Prize in 1915 for their services in the analysis of crystal structure by means of x-rays during 1912 and 1914.

Scientist/s	Invention	Year of Invention	Year of Nobel Prize
WC Roentgen	The discovery of the X-rays	1895	1901
PEA von Lenard	For his work on cathode rays	1893/1902	1905
KF Braun*	Contribution to the development of wireless telegraphy	1897	1909
W Wien	The laws governing the radiation of heat	1893	1911
M von Laue	The discovery of the diffraction of X-rays by crystals	1893	1914
M Planck	For the services he rendered to the advancement of physics by his discovery of energy quanta	1900	1918
J Stark	For his discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields	1905/1913	1919
A Einstein	For his services to theoretical physics, and specially for his discovery of the laws of the photoelectric effect	1905	1921
J Franck & GL Hertz	For their discovery of the laws governing the impact of an electron upon an atom	1913	1925
CV Raman	The Raman effect	1928	1930

Table 2: *Braun had to share the prize with the Italian scientist Marconi G. This is the list of Nobel Laureates from German speaking area who got the Nobel Prize before CV Raman. Also the name of Raman is given in the end to show the record time he needed to get the Nobel Prize.

According to the will of Nobel: "... the annual award of prizes shall be intended for works 'during the preceding year' shall be understood in the sense that awards shall be made for the most recent achievements in the fields of culture referred to in the will and for older works only if their significance has not become apparent until recently"¹⁵.

The application and significance of the Raman effect becomes clear from the number of papers published in a period of one and half year after its discovery. "By August 1929, Ganesan was

able to compile a bibliography of 150 papers!"¹⁶. The last date of sending the proposal is the first of February (in our case Feb. 1930); and the list of original literature on the Raman effect compiled by Kohlrausch¹⁷ contains 225 entries till January 31, 1930, starting from the first publication of Raman and Krishnan in „Nature“¹⁸ on the discovery. Another evidence to show the importance of the discovery.

The importance of the discovery for the quantum mechanics can be judged from the statement given by RW Wood, who stated *“It appears to me that this very beautiful discovery which resulted from Raman’s long and patient study of the phenomenon of light scattering is one of the best convincing proofs of the quantum theory (emphasis added)”*¹⁹.

As shown in above examples, the applications of the discovery in the field of experimental and theoretical physics, qualified Raman for the Prize in such a short period of time. Whereas in most of the cases, the significance of the discoveries becomes clear after a long time and the scientists have to wait for many years.

Raman’s Contacts and the Opinion of the Experts about his Scientific Work

Raman’s work on musical instruments was well known abroad before he started working in the University of Calcutta as a professor. He began his work on light scattering in 1921 and soon established his reputation in this field. In 1924 he was invited by the British Association for the Advancement of Science in Toronto to open a discussion meeting on the scattering of light. As a scientist, he established good contacts in the western world. Persons like Sommerfeld believed in his experimental work and regarded him as „correct and important“. It was his scientific work and his personality which made him popular in the west. However, the next paragraphs show that the contacts only would not have helped him to win the Nobel Prize, it was his scientific work for which he got the Prize.

The report prepared by the Nobel Committee had been signed by H Pleijel, Manne Siegbahn, V. Carlheim-Gyllensköld, Erik Hulthen and CW Oseen. Out of them some were known to Raman. For example, M Siegbahn (1886-1978) who got Nobel Prize in 1924 due to his discovery and research in the field of X-rays; had contact with Raman as one of his colleagues BB Ray had, who became famous for his work on X-rays in India „*was in Siegbahn laboratory in the year 1925*“ (Kai Siegbahn 1918- , Nobel Laureate since 1981; Private commun.). Also Prof. CW Oseen (1879-1944) who held the chair of theoretical physics at the University of Uppsala and later the director of the Nobel Institute for theoretical physics, was known to Raman as a letter shows, in which he wrote, „... *Several months ago, you had the great kindness to send me a copy of your German pamphlet ‘Fortschritte der Chemie etc.’ on anisotropic fluids. During the sea-voyage now nearing its termination, I have spent my time very pleasantly and profitably studying your exposition of this subject. I had not written to you earlier acknowledging your presentation, so I am taking this opportunity of expressing my gratitude to you for sending me this publication. It has deeply interested me, and the explanation you have given are so clear and masterly that their perusal has made a deep impression on my mind. I hope this will bear fruit before long*“ (dated Dec. 16, 1929). The content of the letter shows that the contact was normal like between two scientists who exchange their publications and ideas.

Niels Bohr (1885-1962) who received the Nobel Prize in 1922 for the investigation of the structure of atoms and the radiation emanating from them; with him Raman had contact since 1923 as his letter dated March 21, 1923 shows in which he wrote, "I hope you will pardon the liberty I am taking in writing to you concerning Dr. Bidhubhusan Ray, who is on the staff of this college and is one of the promising young physicists of the Calcutta School. ... I have suggested to Dr. Ray that he might follow a different course (not to go to England and Germany like most Indians were doing) and that he cannot do better than spend a greater part of his period of deputation at Copenhagen working under your direction". Bohr suggested them to postpone this stay for sometime as he had planned to go to United States of America for a few months. In the middle of August 1929 Raman wrote another letter which shows that Bohr received as presentation a set of bound volumes of the Indian Journal of Physics (Vols. VI to XII). Raman visited Copenhagen during one of his visits to Europe about which Bohr states, „We often think of your visit here some years ago, and I hope very much that I shall have the pleasure of meeting you again before too long“ (dated September 18, 1929). About the discovery of the effect he wrote in the same letter, „I take this opportunity to express my most cordial congratulations to you to your great discovery of the new radiation phenomenon which has added so immensely to our knowledge of optics and atomic physics.“

Again Raman wrote to him, "The great kindness you have shown me in the past encourages me to make a request of a personal character. As you know, my work on the new radiation effect has been received with enthusiasm in scientific circles, and I feel sure that if you give your influential support, the Nobel Committee for Physics may recommend that the award for 1930 may go to India for the first time. The proposal for the award has to reach the Nobel Committee before 31st January 1930. I have greatly hesitated in writing to you about this, and it is only because I felt sure that you sympathise with the scientific aspirations of India that I have ventured to do so. With many apologies. I am, your sincerely" (letter dated December 6, 1929). Raman was not aware that he had been already nominated by Bohr for the year 1929. He repeated this decision for the year 1930.

Opinion of the Nominators about Raman's Scientific Work

Some of the persons who nominated Raman gave the following comments about his work and the discovery.

CTR Wilson (1869-1959) who received the Nobel Prize in the year 1927 and E Rutherford (1871-1937) both wrote, " „... There seems to be no doubt that a study of the change of frequency in liquid and solid media provides valuable information on the natural frequencies associated with the molecules - information which is difficult to obtain by other methods - and will prove of great service in increasing our knowledge. ... We are both of (the) opinion that Raman is a physicist of exceptional ability, who in the difficult conditions in his own country has built up a successful school of research which has already produced work of high quality. He is a man strong both on the theoretical and experimental side and this is well illustrated by many of his papers. We are of the opinion that his work is of the outstanding quality required for this great honour" (Rutherford and Wilson to the Chairman Nobel Committee, Jan. 25, 1930).

J Stark (1874-1957), who also got the Nobel Prize in 1919 for his discovery of the Doppler effect in canal rays and the splitting of the spectral lines in electric field, his statement is short

and remarkable, as it shows the practical side of the discovery. He observed, "*Answering your invitation I present to you a proposal for the Nobel prize in physics for the year 1930, and to be precise I propose: Professor C. V. R a m a n in Calcutta for the discovery of the effect of the change in the frequency of light when scattered which was named after him. This discovery means - independent of the transience of theories - a permanent progress in the knowledge of physical reality*" (J Stark to Nobel Committee, dated January 7, 1930; Translated from German).

Pfeiffer R from Breslau praised not only the discovery of the effect but also the earlier research work of Raman. He stated, "*I propose the professor of physics at the University of Calcutta Sir Venkata R a m a n (Fellow of the Royal Society) for this year's Nobel prize for physics. Professor Raman has developed a fruitful research work since several decades from which I want to mention only his extensive investigations about the acoustics of Indian musical instruments and those about the diffraction of light in molecules (Tyndall phenomenon). These latter investigations led him to his great discovery namely the establishment of the effect which was named after him (Raman effect); as a result Raman moved up to the very front of those physicists studying the problems of modern atomic physics. The Raman effect provides inner eigenfrequencies of the molecules that means a property of them due to their inner constitution, that means it (the effect) provides a powerful method for the exploration of molecules. It is of particular interest that the eigenfrequencies determined by this method which are situated in the spectral range of ultra-red frequently cannot be found by the help of spectroscopic methods. Therefore ultra-red research and Raman effect have a stimulating influence upon one another so that everyday surprises us with fresh evidence. In summary, I have to express my conviction that the Raman effect is one of the most important und most fruitful discoveries of the last years*" (Pfeiffer R to the Nobel Committee, January 22, 1930. Translated from German).

The above evidences also show that experts recognised his work, which qualified him for the Nobel Prize.

Why did Raman Not Share the Nobel Prize with His Co-Workers?

The names of the collaborators were known to the Committee as well as to the expert who prepared the report. The name of candidates given in the report of the Nobel Committee shows that not a single collaborator of Raman was nominated by the competent persons. Also according to 'the SNF § 7 „... *Personal applications for an award shall not be considered*' (emphasis added). Thus it was not possible for Raman to put *his name* or any of his co-workers for the nomination. The prize was awarded not only for the discovery but for "his work on light scattering and the discovery of the Raman effect". Thus the discussion that the Committee did not include co-workers is not correct, as the committee has to react to the proposals and the opinions of the experts. In case there was a controversy among the members of the Committee, whether co-workers should get the prize, it will never come to light because under the rules of SFN § 10, "*Proposals received for the award of a prize, and investigations and opinions concerning the award of a prize may not be divulged. Should divergent opinions have been expressed in connection with the decision of a prize-awarding body concerning the award of prize, these may not be included in the record or otherwise divulged*".

Why did Raman Not Share the Nobel Prize with Russian Scientists?

It had already been a point of controversy between Raman and his Russian colleagues on the priority of discovery as a letter written by Raman in „Nature“ shows. He wrote, *“The Russian physicists, to whose observation on the effect in quartz Prof. Darwin refers, made their first communication on the subject after the publication of the notes in ‘Nature’ of May 31 and April 27. Their papers appeared in print after sixteen other printed on the effect, by various authors, had appeared in recognized scientific periodicals”*²⁰. Most probably, there was more one sided correspondence between Raman and the Mandelstam school, as Prof. IL Fabelinskii’s who was a co-worker of Mandelstam states, *„... due to its impudent and domineering nature it has been left without reply and no correspondence has been kept“* (IL Fabelinskii, private commun.).

Perhaps it was due to the publicly known controversy that the Committee had to give special attention to this issue although the Russian scientists were recommended only twice i.e. Prof. Papalexis of Leningrad (now St. Petersburg) proposed that the Prize should go to Mandelstam (1879-1944) alone, whereas Prof. Chwolson stated that Raman should get half of it and the rest should go to Landsberg (1890-1957) and Mandelstam.

Opinion of the Nobel Committee: The arguments put forward by Prof. Chwolson from Leningrad in his proposal follows: *“that Raman shares the honour of his discovery with Landsberg and Mandelstam; because undoubtedly, they discovered the named phenomenon in quartz crystals at the same time and independently from Raman. Only due to the external circumstances and the negligence of the Russian researchers in publishing their discovery is according to Chwolson the cause that the effect has been named as the ‘Raman effect’. Raman’s discovery was made on February 16 and Landsberg and Mandelstam’s on February 21, 1928. Raman’s and Krishnan’s letters to Nature were published in Nature on March 31, 1928, whereas Landsberg and Mandelstam’s first publication in Naturwissenschaften on July 13. By giving Raman alone the Prize the Russian scientists would be severely punished due to this negligence, said Chwolson. Also he gives the reference of M. Born from Goettingen, who was said to know the exact situation and to have given his opinion publicly. Chwolson obviously refers to Born’s article in Naturwissenschaften 16, 741, 1928, on the Fourth Russian Physicists Conference, where Born was a guest. Born mentions in his lecture that the phenomenon was discovered in Moscow and Calcutta at the same time and the Russian Physicists should share the honour with Raman”*²¹ (Translated from Swedish).

About the proposal of Prof. Papalexis from Leningrad the Committee observed, *“An even stronger impression of this opinion we find in the proposal of Prof. Papalexi, Leningrad in which he writes that Prof. Mandelstam alone should get the prize. He supports his proposal as follows: Prof. Mandelstam has been working since 1907 on the theoretical and experimental aspects of the diffusion light. Since 1918 through his theoretical interpretations he came to the idea of the existence of the scattering light, which corresponds to the Raman effect. Prof. Papalexi refers to an article of Mandelstam in Journal of Russian Physical Society (Journal d. russ. phys. Gesellschaft) 58, p. 831, 1926 (in Russian language)”*²² (Translated from Swedish). The committee was of the opinion that Smekal in 1923; and Kramers and Heisenberg in 1925 had already given this explanation.

In order to make the position of the Committee about it more clear, it will not be out of place to quote the comments of it, which stated, "*If we see Mandelstam's and Landsberg's first publication in Naturwissenschaften 16, 557, 1928; we get a different picture. The short note had been dated 6th of May and explains the discovery of combination lines of the diffuse light in crystalline quartz. The existence of these lines has been shown experimentally, but about the interpretation of the lines the authors say, 'We consider it to be premature at this moment to give a definite interpretation of the phenomenon in question. One of the theoretical interpretations which are possible consists of the following ...'* (Translated from German), in which the authors gave the same statement as Raman. And further they said, '*Whether and in what way the phenomenon observed by us is connected with the one which was recently described by Raman cannot be judged at the moment because of its rather summary description'* (Translated from German). However, Raman's and Krishnan's letters of 31 March as well as that of 21 April gave a very clear explanation of the nature of the phenomenon, (both cited by Mandelstam and Landsberg). Under these conditions, Mandelstam and Landsberg cannot argue to have obtained their experimental results independently"²³ (Translated from Swedish).

Opinion of an Expert: According to § 5 of the SNF, "*A work may not be awarded a prize, unless it by experience or expert scrutiny has been found to be of such outstanding importance as is manifestly intended by the will*". The expert who gave report was Erik Hulthen (1891-?) a spectroscopist, who was professor and the director of the Physical Institute and also the member of the Nobel Committee from 1929 to 1962. He prepared the report on the Raman effect under the title "The complete explanation of the Raman-Effect". The report is in favour of Raman and cites work done by different scientists on the topic in the past years. The conclusion of the report²⁴ (Translated from Swedish) follows:

"1. The proposal by Prof. Chwolson that the Nobel Prize should be divided between Raman and Landesberg-Mandelstam had been rejected because they did not come to an independent interpretation of their discovery..

2. For the same reasons, the proposal of Prof. Papalexis in favour of Mandelstam had not been taken into account.

3. The uncertainties concerning the explanation of the intensity of Raman- and Infrared lines in the spectrum, could be explained during the last year.

4. The Raman method has been applied with great success in different fields of molecular physics.

5. The Raman effect has effectively helped to check the actual problems of the symmetry - properties of molecules thus the problems concerning the nuclear-spin in the atomic physics"

The Nobel Committee said that "*the Raman effect is useful for the study of atomic physics and the constituents of compound. It also gives valuable information to prove modern theories in atomic physics. The Committee finds Raman's discovery on diffusion light is worth the Nobel Prize for physics*"²⁵ (Translated from Swedish).

We have seen that the expert as well as the Nobel Committee had given their award-adjudication in favour of Raman and he was not in the position to take any influence, thus he cannot be made responsible for the sharing of the Prize. The Committee as well as the experts have to work under certain rules and regulations of the foundation.

The Nobel Dream

According to the regulations the Nobel Committee submitted its report with proposal and opinion to the Swedish Academy of Science on September 20, 1930 (the regulation says - 'by the end of September) with the conclusion, „*The Committee has decided to ask the Academy to award the Nobel Prize for physics for the year 1930 to Sir Chandrasekhra Venkata Raman, Calcutta, for his work on the diffusion of light and for the effect named after him*”²⁶ (Translated from Swedish).

According to the regulations „*the Committee shall take up the matter for a final decision before the middle of the following November*”²⁷. The next decision giving committee is named “Physic-class” in the case of the Nobel Prize for physics; which consists of about 25 members. Once again, it controls all the proposals, recommendations and other documents concerning the Nobel Prize. It gives its opinion and decision to the Academy about the selection of the Nobel Laureate. According to the Special rules of SNF § 7, “... *The Academy shall take the matter for a final decision before the middle of the following November*”. “*The laureate is immediately notified of the decisions, which are then announced internationally at a press conference held in Stockholm and attended by representatives of the international news media. The messages contain the names of the laureates and a short statement describing the reason for award*”²⁸. Raman would not have had the chance to attend the Nobel ceremony on December 10, 1930; if he would have been informed by proper channels. „...*Two months before he knew he was awarded the Nobel Prize, he had the supreme audacity of booking his steamer passage to be in time for the ceremony at Stockholm. That not only did he take such a step but went further and declared publicly that he did so are both interesting facts of his life*”²⁹. It seems somehow, he had already been informed about the decision. Whatever might be his source of information, on December 10, 1930 he and Lady Raman were in Stockholm to receive the Prize.

According to SFN rules under § 9 „... *It shall be incumbent on a prize-winner, whenever this is possible, to give a lecture on a subject relevant to the work for which the prize has been awarded. Such lecture should be given within six months of the Festival Day in Stockholm, or, in the case of the Peace Prize, in Oslo*”. Raman delivered his Nobel lecture on December 11, 1930, entitled: “The Molecular Scattering of Light” in which he gave the point of motivation of his research i.e. the blue colour of the Sea and further extension of his work on the scattering of light which lead to the discovery of the effect.

After receiving the prize he stayed there for five days more. On December 17, 1930 he was in the Grand Hotel Oslo from there he wrote a letter to Bohr which dictates, „... *We next proceed to Goeteborg and then to Copenhagen which we reach on the night of the 19th Dec. Or perhaps the 20th Dec. ... It is my hope to (be) able to meet you and your group of investigators and to spend three or four days in Copenhagen much to the advantage of my knowledge of physics*” (dated December 17, '30). The telegram which he sent from Goeteborg shows that in

Copenhagen he delivered a lecture on „*Scattering of light in crystals*“. Raman also went to Munich to meet A Sommerfeld , with whom he had close contact after his visit in India. After this tour through Europe he came back to India. Now he was enjoying the hours of glory and was at the top his scientific career. Mother India and especially Calcutta was proud of him.

Conclusion: It has been concluded here Raman received the Nobel Prize “for his work on diffusion of light and for the effect named after him”. The objections raised by some historian that Raman did not share the Nobel Prize with others or the Committee ignored Raman’s collaborators and Russian colleagues is not correct; as he got the Prize not only for the effect but also for other work in this field. The Nobel Committee had to take the decision according to certain rules and regulations imposed on it by the Nobel Foundation. Raman was nominated 10 times and the nominators wrote convincing recommendations in favour of him; thus the Committee decided for Raman. He received the Nobel Prize in record time due the practical significance of the discovery and the good opinion of the famous contemporary scientists about his work.

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