

Sir. C.V. Raman's Contribution to Physics Literature: A Study Using SAO/NASA Astrophysics Data System

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ABSTRACT

C.V. Raman has contributed many classic papers in Physical sciences during his years at the Indian Association for the Cultivation of Science, Indian Institute of Science and the Raman Research Institute. In this paper we would like to emphasis on his scientific contributions in Physics domain. In this study NASA\ADS has been used to analyze citation pattern of the research papers published by C.V Raman. Since NASA/ADS covers only Astronomy & Astrophysics, Physics and Geophysics, the present study was restricted to papers published in the field of Physics. The analysis includes year wise distribution of publications; authorship pattern, collaboration; and journal preferences for the publication. In his entire career as a scientist he has collaborated with 27 eminent scientists and students and has published a total of 144 papers during the years 1907–1963.

1. INTRODUCTION

Scientometrics is a study concerned with the quantitative features and characteristics of science and scientific research. It is a technique used for the documenting works of eminent scientists and researchers. In this study an attempt has been made to analyze the communication and collaboration pattern of C.V. Raman in physical sciences domain as reflected through NASA\ADS.

Chandrasekhara Venkata Raman (C. V. Raman) was born at Trichinopoly in Southern India

on November 7th, 1888. His father was a lecturer in mathematics and physics so that from the first he was immersed in an academic atmosphere. He entered Presidency College, Madras, in 1902, and in 1904 passed his B.A. examination, winning the first place and the gold medal in physics; in 1907 he gained his M.A. degree, obtaining the highest distinctions. His earliest researches in optics and acoustics - the two fields of investigation to which he has dedicated his entire career - were carried out while he was a student.

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Since at that time a scientific career did not appear to present the best possibilities, Raman joined the Indian Finance Department in 1907; though the duties of his office took most of his time, Raman found opportunities for carrying on experimental research in the laboratory of the Indian Association for the Cultivation of Science at Calcutta (of which he became Honorary Secretary in 1919). In 1917 he was offered the newly endowed Palit Chair of Physics at Calcutta University, and decided to accept it. After 15 years at Calcutta he became Professor at the Indian Institute of Science at Bangalore (1933-1948), and since 1948 he was Director of the Raman Institute of Research at Bangalore, established and endowed by him. He also founded the *Indian Journal of Physics* in 1926, of which he is the Editor. Raman sponsored the establishment of the Indian Academy of Sciences and has served as President since its inception. He also initiated the *Proceedings* of that academy, in which much of his work has been published, and is President of the Current Science Association, Bangalore, which publishes *Current Science (India)*.

In 1922 he published his work on the "Molecular Diffraction of Light", the first of a series of investigations with his collaborators which ultimately led to his discovery, on the 28th of February, 1928, of the radiation effect which bears his name ("A new radiation", *Indian J. Phys.*, 2 (1928) 387), and which gained him the 1930 Nobel Prize in Physics. Sir Chandrasekhara Venkata Raman died on November 21, 1970. (Venkataraman, G.)

2. NASA/ASTROPHYSICS DATASYSTEM

The NASA Astrophysics Data System is a popular citation database widely known as ADS. The NASA Astrophysics Data System Abstract Service resides at the centre of URANIA, the most sophisticated discipline centered bibliographic system ever developed. The typical astronomer, on average, uses

the ADS every day; It offers time-cited data of papers published in journals, conference proceedings, book chapters, etc. This is a comprehensive database in the field of astronomy and astrophysics containing more than 9.6 million bibliographic records. (Meera and Manjunath). ADS provides bibliographic information to the majority of astronomical researchers worldwide. It contains abstracts, full-text scans of journal articles, links to articles and data online at other data centers, and reference/citation information available for free to users all over the world.

This service provides access to three databases: Astronomy and Astrophysics, Physics and Geophysics, and the arXiv.org preprints in Astronomy. Users can use one of the obtainable query forms to submit queries by author, object name, date range, words in the title, and words in the abstract text. ADS has highly customizable query forms (Figure 8), and full-text scans of much of the astronomical literature which can be browsed or searched via their full-text search interface. (Meera and Manjunath)

3. METHODOLOGY

We have used NASA/ADS database to retrieve time-cited data for the papers published by C.V. Raman. A search for the author, "Raman C.V", may retrieve many articles of the other authors with the same name. We have carefully selected articles published by him by going through each retrieved record. Bibliographic records selected accordingly are posted into a "Private Library" - a facility provided by the system. The private library thus created for C V Raman is given below in Figure 10. (The SAO/NASA Astrophysics Data System)

4. OBJECTIVES

- To know the authorship pattern, collaborative research pattern of Sir. C.V. Raman
- To identify the Core Channels of Communication and distribution of publications

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- To compare the research output, in terms of the number of citation received, and how far his top cited works have importance in present study.

1933	-	1961	-	
1934	-	1962	1	0.69
		Total	144(100%)	

5. DATA ANALYSIS

Based on the ADS private library, an attempt was made to analyze the amount of literature that has been contributed by Sir. C.V. Raman. There were 144 articles indexed in ADS. As shown in Table – 1, in 65 years of publication Sir. C.V. Raman had published on an average of 2-3 articles per year in physics. Highest number of articles have been appeared in the year 1922 (13, 9.2%) followed by 1927 (12, 8.33%) and 1921 (11, 7.63%).

Table - 1: Publication Productivity in Chronological Order

Year	No. of Publications	%	Year	No. of Publications	%
1907	1	0.69	1935	1	0.69
1908	1	0.69	1936	1	0.69
1909	3	2.08	1937	1	0.69
1910	1	0.69	1938	5	3.47
1911	2	1.38	1939	3	2.08
1912	-		1940	5	3.47
1913	-		1941	5	3.47
1914	1	0.69	1942	5	3.47
1915	1	0.69	1943	-	
1916	1	0.69	1944	-	
1917	1	0.69	1945	2	1.38
1918	3	2.08	1946	-	
1919	5	3.47	1947	-	
1920	4	2.77	1948	2	1.38
1921	11	7.63	1949	-	
1922	13	9.02	1950	-	
1923	10	6.94	1951	-	
1924	2	1.38	1952	-	
1925	9	6.25	1953	-	
1926	6	4.16	1954	-	
1927	12	8.33	1955	-	
1928	10	6.94	1956	-	
1929	7	4.86	1957	-	
1930	1	0.69	1958	-	
1931	7	4.86	1959	-	
1932	1	0.69	1960	-	

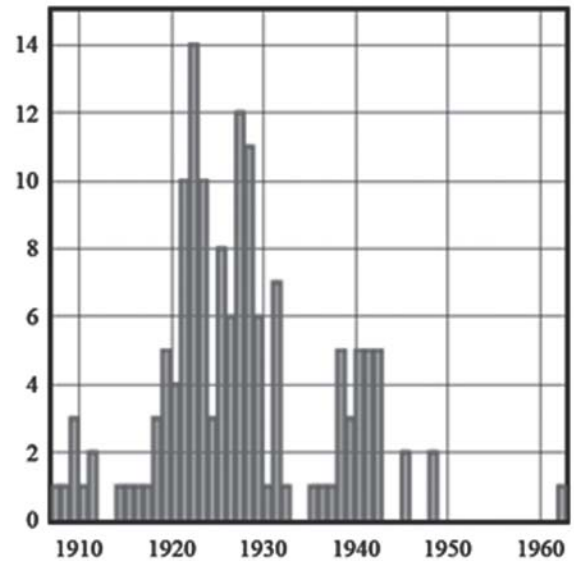


Fig 1: Graphical representation of Table 1

Table – 2: Authorship Pattern

Year	Single and Multi authored Papers			Total
Year	Single	Two	Three	
1907	1	-	-	1
1908	1	-	-	1
1909	3	-	-	3
1910	1	-	-	1
1911	2	-	-	2
1912	-	-	-	-
1913	-	-	-	-
1914	1	-	-	1
1915	1	-	-	1
1916	1	-	-	1
1917	1	-	-	1
1918	2	1	-	3
1919	4	1	-	5
1920	2	2	-	4
1921	8	3	-	11
1922	13	-	-	13
1923	8	2	-	10
1924	1	1	-	2
1925	2	7	-	9
1926	4	2	-	6

1927	4	8	-	12
1928	1	9	-	10
1929	5	2	-	7
1930	1	-	-	1
1931	4	3	-	7
1932	-	1	-	1
1933	-	-	-	-
1934	-	-	-	-
1935	-	1	-	1
1936	-	1	-	1
1937	-	1	-	1
1938	-	5	-	5
1939	-	3	-	3
1940	-	5	-	5
1941	1	2	2	5
1942	4	1	-	5
1943	-	-	-	-
1944	-	-	-	-
1945	2	-	-	2
1946	-	-	-	-
1947	-	-	-	-
1948	2	-	-	2
1949	-	-	-	-
1950	-	-	-	-
1951	-	-	-	-
1952	-	-	-	-
1953	-	-	-	-
1954	-	-	-	-
1955	-	-	-	-
1956	-	-	-	-
1957	-	-	-	-
1958	-	-	-	-
1959	-	-	-	-
1960	-	-	-	-
1961	-	-	-	-
1962	1	-	-	1
1963	-	-	-	-

As shown in Table – 2, out of 144 papers, single authorship papers were 79(54.86%), two authorship papers were 61(42.36%) and three authorship papers were only 2 (1.38%). Raman was more interested to publish his research findings individually rather than collaborate with multiple authors.

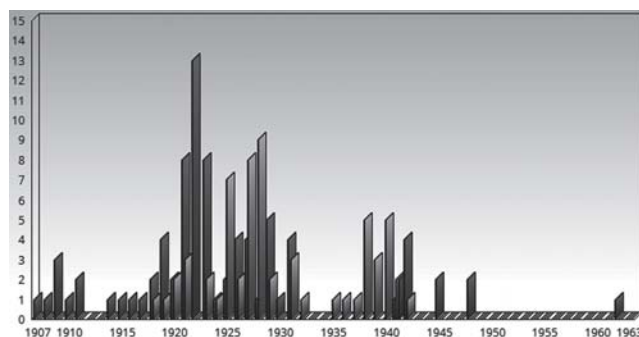


Fig 2: Graphical representation of Authorship Pattern

Table – 3: Authorship credit of Researchers collaborating with C.V.Raman

Collaboration is an intense form of interaction that allows for effective communication as well as the sharing of competence and other resources. Melin [17]. Table – 3 lists the 27 different authors who have contributed with Sir.C.V.Raman in Physics disciplines. Among them Krishnan K.S. (15), Nilakantan P. (7), and Nedungadi T.M.K. (4) are top three collaborators with whom he has published 26 papers.

Co-author Name	Total Co-authored articles (%)	Period of Association		
		From	To	Total Years
Banerji, Bhabonath	1	1920	-	1
Banerji, K.	1	1925	-	1
Bhagavantam, S.	3	1931	1932	2
Chinchalkar, S.W.	1	1931	-	1
Datta, S.K.	1	1925	-	1
Dey, Ashutosh	1	1919	-	1
Ganesan, A.S.	2	1923	1924	2
Ghosh, P.N.	1	1918	-	1
Krishna Datta, Sushil	1	1925	-	1
Krishnamurti, P.	1	1929	-	1
Krishnan, K.S.	15	1925	1929	5
Kumar, Sivakali	1	1920	-	1
Nagendra Nath, N.S.	1	1936	-	1
Nedungadi, T.M.K.	4	1939	1942	4
Nilakantan, P.	7	1940	1941	2
Pisharoty, P. Rama	1	1941	-	1

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Raghavendra Rao, B.V.	3	1935	1938	4
Rajagopalan, V. S.	2	1939	1942	4
Ramakrishna Rao, I.	2	1926	1927	2
Ramanathan, K.R.	1	1923	-	1
Ramdas, L.A.	3	1925	-	1
Ray, Bidhubhusan	1	1921	-	1
Sirkar, S.C.	1	1928	-	1
Sogani, C.M.	3	1927	1928	2
Subbaramaiah, K.	1	1938	-	1
Sutherland, G.A.	2	1921	-	1
Venkateswaran, C. S.	4	1938	1939	2

Channels of Communication

Table. 4 Dissemination of the channels of communication used by Sir. C.V. Raman

Channel of Communication	No. of Publications	%
Applied Optics	1	0.69
Astrophysical Journal	3	2.08
Journal of the Optical Society of America	3	2.08
Nature	101	70.13
Philosophical Magazine	1	0.69
Physical Review	9	6.25
Proceedings of the Physical Society of London A	21	14.58
Scientific American	1	0.69
Transactions of the Optical Society	3	2.08
Zeitschrift für Physik	1	0.69
Total	144(100%)	

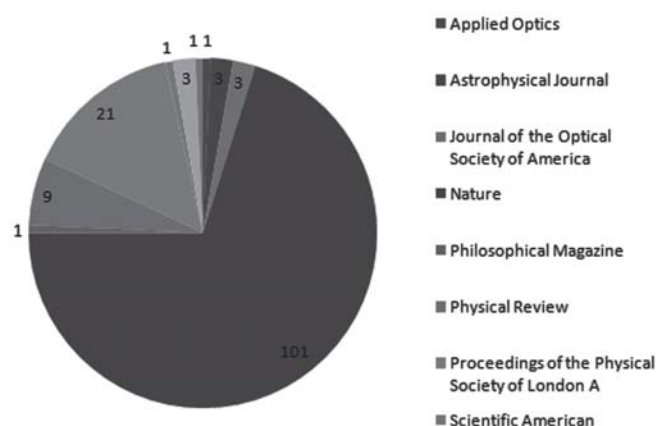


Fig 3: Channels of Communication

On the basis of analysis it is found that Raman had used more than 10 journals to communicate his research findings. Top ranking journals were: *Nature* (101, 70.13%), *Proceedings of the Physical Society of London A* (21, 14.58%) *Astrophysical Journal*, *Journal of the Optical Society of America*, *Transactions of the Optical Society* (3, 2.08%) and *Applied Optics*, *Philosophical Magazine*, *Scientific American* and *Zeitschrift für Physik* (1, 0.69%). Most of his papers were published in Indian journals. He thus created due status to Indian journals at the international science publication activities.

6. CONCLUSION

Scientometrics plays an important role in the dissemination of a particular scientist whose interest lays in the number of important papers he or she has published. One can understand that Raman had taken enormous interest to reach his works to common man's understanding of physics. His discovery of the 'Raman Effect' made a very distinctive contribution to Physics. Even after more than 85 years of this discovery, it is influencing many researchers to study its application in many disciplines.

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