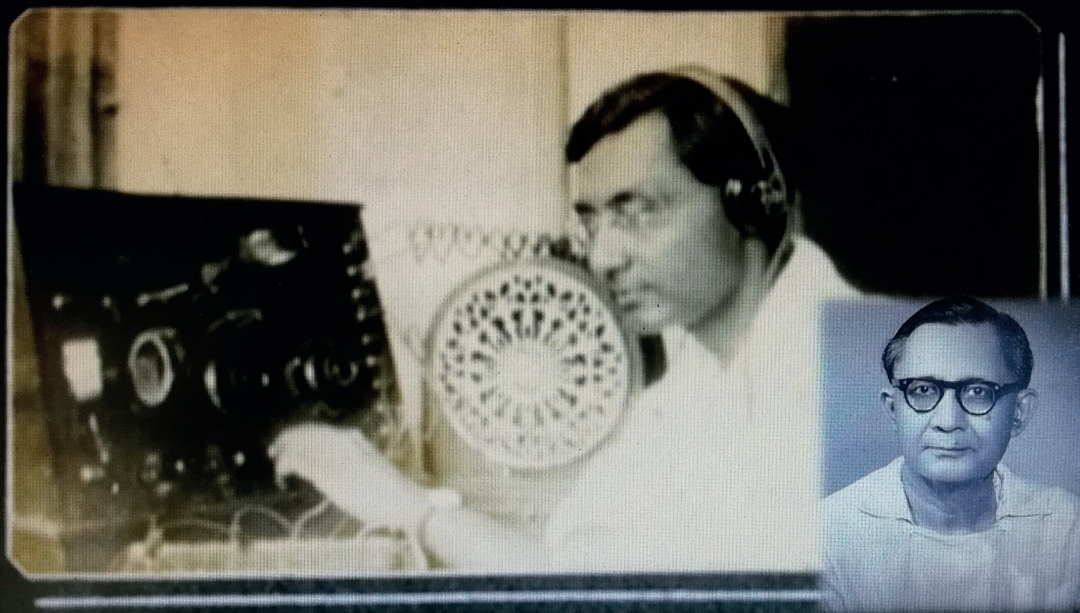


# S.R. Khastgir – A Pioneer of Radio Physics and Atmospherics

RAJINDER SINGH



Wissenschaftsgeschichte / History of Science

**Rajinder Singh**

**S.R. Khastgir – A Pioneer of  
Radio Physics and Atmospheric**

Shaker Verlag  
Düren 2022

**Bibliografische Information der Deutschen Nationalbibliothek**

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über <http://dnb.d-nb.de> abrufbar.

Copyright Shaker Verlag 2022

Alle Rechte, auch das des auszugsweisen Nachdruckes, der auszugsweisen oder vollständigen Wiedergabe, der Speicherung in Datenverarbeitungsanlagen und der Übersetzung, vorbehalten.

Printed in Germany.

ISBN 978-3-8440-8772-7

ISSN 2198-8552

Shaker Verlag GmbH • Am Langen Graben 15a • 52353 Düren

Telefon: 02421 / 99 0 11 - 0 • Telefax: 02421 / 99 0 11 - 9

Internet: [www.shaker.de](http://www.shaker.de) • E-Mail: [info@shaker.de](mailto:info@shaker.de)

## Content

Preface.....	v
Foreword .....	vii
About the author .....	xi
Introduction .....	1
Chapter 1 - Satis Ranjan Khastgir – Some Aspects of His Life .....	9
Beginning of research career in the UK.....	9
Back to India.....	10
Promoting science in Bengali language .....	14
Honours and awards .....	15
Chapter 2 - Detailed Summaries of PhD, DSc Theses and J-Transformation Controversy .....	21
PhD thesis – “The scattering of X-rays and the J-absorption phenomenon” .....	21
Experimental results and their interpretations .....	23
D.Sc. Thesis – The J-transformation of scattered X-rays .....	27
Experimental set up .....	28
X-rays scattered at 90 degrees .....	29
Modified scattering due to filters.....	30
Quantity of the J-absorption .....	31
J-transformation in thin absorbers .....	31
Alternative levels of X-ray activity and effect of scattering angles .....	32
Theory of change of wavelength vs. experimental results.....	34
Characteristics of the J-transformation .....	35
The frustrating end! .....	36
Final conclusions .....	36

J-phenomenon controversy and S.R. Khastgir's role.....	37
Observation of J-phenomenon.....	37
Compton effect vs. J-phenomenon and SRK's contribution ..	38
Chapter 3 – Establishing Wireless Laboratory at the University of Dacca .....	51
Physics Department .....	51
Background – Ionosphere, thunderclouds, and discharge tubes ..	54
Atmospheric research at Dacca.....	59
1. Radio signals and mapping the city of Dacca .....	59
2. Study of receiver, reflector, and antenna .....	61
3. Noise in radio signals .....	62
4. Dielectric properties of soils and gases for different frequency ranges .....	65
5. Measuring the heights E- and F-layers in Eastern Bengal ...	73
6. Sunset, sunrise, and atmospheric changes .....	73
7. Triode valves and operating conditions .....	77
8. Whistling meteors .....	78
Surface-force theory and crystals rectification .....	79
Chapter 4 – S.R. Khastgir at the Banaras Hindu University .....	91
Ionospheric/Atmospheric research.....	93
1. Variation of intensity of distant atmospherics .....	93
2. Investigation of the waveforms of atmospherics .....	93
3. Salt solutions, dielectric properties at ultra-high frequencies .....	95
4. Abnormal polarization of the atmospherics.....	97
5. A new type of $M_0$ -echo from the ionosphere .....	97
6. Study of F-layer .....	98
7. Beat theory of periodic fading of short-wave radio signals and more.....	98

Clouds – Radio signal disturbances .....	101
Natural phenomena under laboratory conditions .....	103
Research Projects .....	105
Chapter 5 – The University of Calcutta Period.....	113
S.R. Khastgir as Khaira Professor.....	113
National Professor S.N. Bose and SRK .....	115
Asking for better salary for workers .....	116
Continuation of ionosphere and atmospheric studies .....	117
1. ‘Winds’ in the F-region .....	117
2. Ionosphere and the group refractive index .....	117
3. Waveforms of atmospherics at daytime.....	118
4. Polarization of the radio wave in the ionosphere.....	118
5. Auto-correlation coefficient of singly and multiple reflected radio waves.....	119
6. Electric field variations during cloud-to-cloud discharges.....	120
7. Making of the fluxmeter and study of thunder clouds .....	121
Chapter 6 – The Last Period - Bose Institute and Visva-Bharati.....	125
Ionospheric and radio signal disturbances due to lightning and thunderstorms .....	126
Study of ionosphere and atmospherics.....	126
Radio waves and more .....	130
Chapter 7 – Impact on Science and Society .....	135
Reception of scientific work .....	135
Assessment of articles published in ‘ <i>Nature</i> ’ .....	139
SRK as PhD guide.....	140
University of Dacca and PhD theses .....	141
BHU candidates.....	142
PhD Theses guided in Kolkata .....	143

Chapter 8 - Concluding Remarks .....	153
Improved List of Publications .....	161
Scientific articles.....	161
Abstracts in ISC/ISCA.....	171
Book review .....	173
General articles.....	173
Books .....	173
Bibliography .....	175
Index.....	203

## Preface

While writing *The Dazzling Dawn - Physics Department of Calcutta University (1916-36)*, G. Gangopadhyay, A. Kundu, R. Singh, Shaker Publisher, Düren 2021, I came across the name Satis Ranjan Khastgir (abbreviated as SRK in the book). According to the documents of the University of Calcutta, young Satis Ranjan, from the laboratory of the Nobel Laureate C.G. Barkla, applied for a Research Scholarship. His application was declined. Later, I read an article by Brian Wynne, “Between orthodoxy and oblivion: The normalisation of deviance in science”, *The Sociological Review* 27, 67-84, 1979 which deals with the controversy between A.H. Compton and C.G. Barkla, on the quantum nature of light. The article aroused my interest in the person ‘Khastgir’, who had worked in Barkla’s laboratory during the ‘critical’ period of the controversy. I wanted to know – what was the role played by Khastgir in the controversy, and what did he do in his life? I started collecting information on his life, but with very limited success. However, I was able to obtain his PhD and DSc theses, which he had written under C.G. Barkla at the University of Edinburgh. His life story fitted my research project ‘India’s lesser known, though equally important, scientists.’ Based on these reasons, I came to the idea of writing this book.

### *Remarks*

Each publisher and journal have their own style of “Notes and References”. Due to technical reasons, I have developed ‘my own style’, which might not fit to the taste of others.

Under “Notes and References”, the dates given for websites are dates of retrieving them from the internet.

## Acknowledgements

I am thankful to Prof. Suprakash C. Roy, former Editor-in-Chief of *Science and Culture* for sharing some articles. Heartily, I acknowledge



S.C. Roy and his wife Sujata Roy's effort in improving upon the language of the text.

Thanks are due to Prof. Arnab Rai Choudhuri, IIS Bangalore for sending information on the history of Banaras Hindu University. I thank Dr. Manoranjan Rao, one of the students of S.R. Khastgir, for sharing his thoughts about his teacher and writing the 'Foreword'.

Prof. Gautam Gangopadhyay, General Secretary of Bangiya Bijnan Parishad, Kolkata is thanked for sending information regarding S.R. Khastgir's activities in the Parishad.

Thanks are also due to S.R. Khastgir's granddaughters Rosinka (Rinka) Chaudhuri and Priyanka Khastgir for providing important information and some photographs.

I am greatly thankful to the workers of the Greek restaurant Santorini: Mayer Yalak, Serhat Oba, Susi Oba, Aram Yussef, Nienke Bloy, Shilan Hori, Mikail Yalak and Laila Sulaiman for providing an inspiring atmosphere.

I thank my wife (Birgit Krah) and children (Amer Simone and Hira Michael) for moral support. It is my pleasure to acknowledge the support of my colleagues Prof. Michael Komorek, Dr. Falk Riess, Dr. Kai Bliesmer, Dr. Christin Sajon, Dr. Chistine Richter, Anatasia Striligka, Jonas Tischer and Jana D. Schmitz, Research Group – Physics Education and Public Understanding of Science, Physics Institute, University of Oldenburg, Germany for research facilities.

I also thank my colleagues Petra Raue, Aleksandra Bartels, and Simone Treunert, Heads of 'Grund- und Oberschule' Syke, for helping me in one way or other.

Last but not the least, I thank Ms. Heike Jansen, Shaker Publisher Düren for publishing this book.

## Foreword

I never knew Dr. Rajinder Singh till I received a mail from him on April 16, 2022, in which he said he wanted to write a biography of my teacher and my doctoral guide, the late Prof. S.R. Khastgir. I first thought this was Dr. R.N. Singh who was also a doctoral student of Prof. Khastgir in the Banaras Hindu University (BHU). But no, Dr. Rajinder Singh is different!

I thought that Dr. Rajinder Singh was embarking on a futile project because most of the people who did their doctoral studies under Prof. Khastgir are no longer with us. As far as I know, only two of us, I and Dr. Suman Ganguly (now in the USA), are the surviving members!! Dr. Rajinder Singh is an exceptional researcher. He could dig deep into any archives available anywhere in the world.

Singh has discussed in detail all about research done by Khastgir under C.G. Barkla, the Nobel Laureate during 1920s – a period considered as the Golden Era of Physics. It was Barkla who proved through his polarisation experiments that X-radiation was part of the electromagnetic spectrum which meant that X-rays were waves. Soon enough, A.H. Compton in the USA showed that X-rays behaved like particles. This was difficult for Barkla to swallow. Barkla thought he discovered a new radiation for which he gave the name J-transformation. With hindsight we can see where Barkla went wrong but we must remember that in those days the dual nature of all elementary particles was yet to be accepted universally. Barkla stuck to his guns and so did his doctoral scholars, including Khastgir.

Around 1930s when Khastgir returned to India, he joined the Dhaka (Dacca) University (now in Bangladesh) where S.N. Bose, the famous discoverer of Bose-Einstein statistics was the Head of the Physics Department. There Khastgir switched over to radio physics and atmospheric. Beside radio physics and atmospheric, Khastgir & co did some experiments in measuring dielectric constants of various materials.

Khastgir pursued research in the ionospheric and atmospheric physics even after he left the Dhaka University to join the BHU. Indeed, he continued to study these two subjects till the very end of his life! Thus in 1970, just two years before his death in Santiniketan (West Bengal) he wrote me a letter in which he discussed his new ideas about the leader stroke of a lightning discharge. While I was doing my Masters in BHU, I met some of the scholars doing their doctoral research under Khastgir. These were: R.N. Singh, B.A.P. Tantry, R.S. Srivastava, Y.S.N. Murthy *et al.*

In 1958 Khastgir moved from BHU to the Calcutta University where he was the Professor and Head of the Department of Physics and Dean of Faculty of Science. In the early 1960s I joined him as the Khaira Scholar in the University College of Science, Calcutta to start my studies in atmospheric and lightning discharge. At that time my colleague was H. Bhattacharya who, I am sorry to say, is no more. Some interesting details of the happenings at the College of Science, Calcutta University can be found in this book.

After he retired from the Calcutta University, Khastgir joined the Bose Institute (named after the famous discoverer of microwaves, Jagadish Chandra Bose). Bhattacharya and I moved along with him. The Bose Institute is next door to the University College of Science. Khastgir was appointed as the Professor and Head of the Physics Department at the Bose Institute. Both Bhattacharya and I obtained our D.Phil. degrees of the Calcutta University while we were at the Bose Institute. Our main work consisted of the waveforms of atmospheric, computation of the waveforms after multiple reflections from the ionosphere, VLF (very low frequency) and ELF (extremely low frequency) radiation emitted by the lightning discharges, theoretical model of the C-field change in atmospheric waveforms, propagation of VLF waves, etc.

Suman Ganguly, exceptionally good at rigging up complicated electronic circuitry, also worked under Khastgir on ionospheric absorption of radio waves at the Bose Institute. He also got his D.Phil. degree as a student of Khastgir. Ganguly is now in the USA, running his own company.

Khastgir retired from the Bose Institute to settle down at the Santiniketan where he continued his work till the very end. R. Singh deals with Khastgir's work at the Bose Institute and Visva-Bharati (Santiniketan).

Dr. Singh writes about the so-called h-index as a means of evaluating a scientist's work. I agree with the author's view that h-index is not a reliable tool to judge the worth of a scientist. Even so, Dr. Singh has unearthed a remarkable amount of information on this aspect Khastgir's work.

In the concluding Chapter in this book, we are reminded that while recounting the recent advances made by India in radio science, ionospheric and atmospheric physics and allied fields, we should remember that the journey began with the work done by S.K. Mitra, S.R. Khastgir, *et al.* The book ends with the hope that the young generation of scientists would take the trouble to bring to light those scientists who, though not very famous, did pioneering work during their times.

I personally congratulate Dr. Rajinder Singh for doing just that in the case of Professor Satish Ranjan Khastgir, my teacher and *guru*. I am grateful to Dr. Rajinder Singh for perpetuating the memory of Professor Satish Ranjan Khastgir through this book.

Dr. P.V. Manoranjan Rao  
Thiruvananthapuram, India  
May 25, 2022.



## About the author



Dr. Rajinder Singh, Research Group – Physics Education and Public Understanding of Science, Physics Institute, University of Oldenburg, 26111 Oldenburg, Germany.

E-Mail: [rajinder.singh@uni-oldenburg.de](mailto:rajinder.singh@uni-oldenburg.de)

Website: <http://www.rajindersinghdr.npage.de>

Dr. Rajinder Singh is: Member of Editorial Team: *Sci. Cult.*, Kolkata (Indian Science News Association), and *Scientific Voyage*, Kolkata.

Dr. Rajinder Singh has written more than 140 articles and the following books:

- 1) Nobel Laureate C.V. Raman's Work on Light Scattering, Logos Publisher, Berlin 2004.
- 2) Nobel Laureate C.V. Raman's Science, Philosophy and Religion, Dharmaram Publications, Bangalore 2005.
- 3) Characteristics of Solar Radiation Photovoltaic Pyranometers - Licor 200SZ and Matrix 1G, Shaker Publisher, Aachen 2012.
- 4) (R. Singh, Ed.), "Jugend forscht – Schüler experimentieren" – nicht nur für Hochbegabte und Überflieger, Shaker Verlag, Aachen 2012.

- 5) Upendranath Brahmachari – A Pioneer of Tropical Diseases – A Summary of his Discoveries and Scientific Work, Shaker Publisher, Aachen 2013.
- 6) Nobel Prize Nominator Sisir Kumar Mitra F.R.S. - His Scientific Work in International Context, Shaker Publisher, Aachen 2014.
- 7) Mahatma Gandhi – ... the Missed Nobel Peace Prize, Shaker Publisher, Aachen 2015.
- 8) The Making of the Politician M. Gandhi by Muslims, Jews and Christians – Gandhi's Methods to Solve Immigration Problems, Shaker Publisher, Aachen 2015.
- 9) Inside Story of Nobel Peace Prize Award – Indian Contestants, Shaker Publisher, Aachen 2016.
- 10) India's Nobel Prize Nominators and Nominees – The Praxis of Nomination and Geographical Distribution, Shaker Publisher, Aachen 2016.
- 11) Die Nobelpreise und die indische Elite, Shaker Verlag, Aachen 2016.
- 12) D.M. Bose – His scientific Work in International Context, Shaker Publisher, Aachen 2016.
- 13) Chemistry and Physics Nobel Prizes – India's Contribution, Shaker Publisher, Aachen 2016.
- 14) Mahatma Gandhi – Die Schattenseite - ..., Shaker Verlag, Aachen 2016.
- 15) Mahatma Gandhi für Lehrkräfte und Eltern – „Mahatma“ – ein normaler Menschen wie du und ich, Shaker Verlag, Aachen 2016.
- 16) Mahatma Gandhi – der verpasste Friedensnobelpreis, Shaker Verlag, Aachen 2017.
- 17) Bidhu Bhushan Ray – A Pioneer of X-ray Spectroscopy, Shaker Publisher, Aachen 2017.
- 18) Gandhi and the Nobel Peace Prize, Routledge Publisher, New York 2017.
- 19) (S.C. Roy, R. Singh), DM Bose - A Scientist Incognito, Bose

Institute Press, Kolkata 2017.

- 20) C.V. Raman's Laboratory and Discovery of the Raman Effect, Shaker Verlag, Aachen 2018.
- 21) Gandhi and the Nobel Peace Prize, Manohar Publisher, New Delhi 2018.
- 22) (R. Singh, S.C. Roy), A Jewel Unearthed: Bibha Chowdhuri - The Story of an Indian Woman Scientist, Shaker Verlag, Aachen 2018.
- 23) C.V. Raman's Students – Sukumar Chandra Sirkar: Life and Science, Shaker Verlag, Aachen 2019.
- 24) Mahatma Gandhi für Anfänger - 100 Fragen und Antworten, Shaker Verlag, Aachen 2019.
- 25) Einstein Rediscovered - Interactions with Indian Academics, Shaker Publisher, Düren 2019.
- 26) (S.C. Roy, R. Singh), D.M. Bose - His Life, Science and Connection with Global Elites, Shaker Publisher, Düren 2019.
- 27) C.V. Raman and the Press: Science Reporting and Image Building – Part I: Kolkata Period, Shaker Publisher, Dueren 2019.
- 28) (R. Singh, S.C. Roy), Clay, Craft, Music and Science: Purnima Sinha's Life, Shaker Publisher, Dueren 2020.
- 29) (R. Singh, S.C. Roy), Bibha Chowdhuri, eine indische Hochenergiephysikerin als „Star“ am Himmel, Shaker Publisher, Dueren 2020.
- 30) Einstein und Indien - Wissenschaftliche und persönliche Verbindungen, Shaker Verlag, Düren 2020.
- 31) C.V. Raman and the Press: Science Reporting and Image Building - Part II: The Indian Institute of Science Period, Shaker Publisher, Dueren 2020.
- 32) C.V. Raman and the Press: Science Reporting and Image Building - Part III: The Raman Research Institute Period, Shaker Publisher, Dueren 2020.
- 33) (R. Singh, S.C. Roy), A Jewel Unearthed: Bibha Chowdhuri - The Story of an Indian Woman Scientist, Shaker Publisher, Aachen



2018. Ebenezer Printing House, Mumbai 2020.

- 34) (R. Singh, S.C. Roy), N.R. Sen – Life and Science, Shaker Publisher, Düren 2021.
- 35) C.V. Raman's student Kedareshwar Banerjee – His life and science, Shaker Publisher, Düren 2021.
- 36) (G. Gangopadhyay, A. Kundu, R. Singh), The Dazzling Dawn – Physics Department of Calcutta University (1916-36), Shaker Publisher, Düren 2021.
- 37) Snehamoy Datta – His scientific work in international context, Shaker Publisher, Düren 2021.
- 38) (R. Singh, S. Roy), Suprakash C. Roy: A Multidimensional Physicist - A story of courage and determination, Shaker Publisher, Düren 2021.
- 39) Suman Beri – Higgs Boson, Top Quark and Single Top Quark - The Story of a Punjabi Woman Scientist, Shaker Publisher, Düren 2022.
- 40) (R. Singh, S.C. Roy), S.D. Chatterjee – A Scientist's Journey from Tradition to Modernity, Shaker Publisher, Düren 2022 (forthcoming).