

enlightening one. Small interfering RNA (siRNA) pathway of the RNA interference response is the primary antiviral defense mechanism against insect viruses. This siRNA pathway confers long-term immune memory against the same pathogen which may be inherited. The authors suggest that insect virus molecular interactions may provide knowledge for the control of agricultural pests and vectors of diseases, as well as the protection of beneficial insects.

The article ‘Mechanism of resistance to insecticidal proteins from *Bacillus thuringiensis* (BT)’ highlights the development of resistance in insects to BT. To date, high levels of resistance to BT sprays have been limited to one species in the field, another in greenhouses and eight species in transgenic plants. Insects may develop high level of resistance through altered trans-regulators of Cry binding proteins.

The article ‘How dung beetles steer straight’ is quite fascinating. The authors surmise that the dung beetle compass is not pre-programmed. It continuously adapts to the visual cues; in the morning and in the afternoon, it orients with the sun; at midday, it reacts to the wind; and at night or in a forest, it favours the celestial polarization pattern. The same neurons switch their responses to various cues. The authors suggest that insect’s navigation system can help in designing a robust compass system.

In the article ‘Semiochemicals for thrips and their use in pest management’, the authors state that over 100 species of thrips or plant pests in agriculture, horticulture and forestry are causing damage through feeding and transmission of plant viruses and the semiochemicals offer significant opportunities for their management. A rich diversity of chemicals has been identified in the defensive secretions of wide range of thrips. More studies are needed to assess the behavioural responses of thrips to semiochemicals.

The article ‘Transposable elements (TEs) and the evolution of insects’ shows that in addition to being involved in insect adaptations and ageing, TEs are at the cornerstone of insect antiviral immunity. Phylogenetic relatedness generally correlates with similarity in TE content. The authors state that TE appears to be involved in a variety of adaptive events in many insect species.

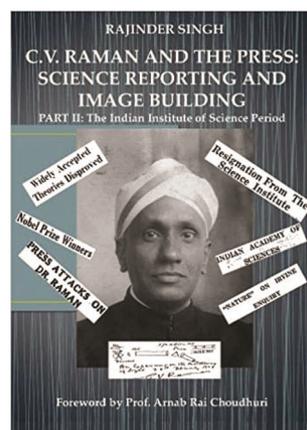
The articles touching on ‘gene drive to control wild populations of insects’, and ‘the interplay between viruses and RNAi

pathways in insects’ offer interesting and thought provoking reading.

On the whole the editors have done a commendable job of selecting many relevant and informative articles and presenting them in a concise manner. The authors also deserve our appreciation for compressing the vast available literature into limited pages with suitable figures, tables, summaries and future possibilities. This volume is certainly a good addition to the literature related to entomology.

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C.V. Raman and the Press: Science Reporting and Image Building – Part II. The Indian Institute of Science Period. Rajinder Singh. Shaker Verlag, Düren. 2020. xviii + 173 pages. Price: € 21.90.

Rajinder Singh, author of this volume, is a renowned science historian of India. His journey into the history of science of India starts with C. V. Raman. This is his fifth volume in the Raman series. In the preface, the author recounts: ‘In the past, I have written the following books on Sir C.V. Raman, the founder of Raman Spectroscopy: (i) “C.V. Raman and the Press: Science Reporting and Image Building – Part I: Kolkata Period” (2019). (ii) “C.V. Raman’s Laboratory and Discovery of the Raman effect” (2018). (iii) “Nobel Laureate C.V. Raman’s Science, Philosophy and Religion” (2005), and (iv) “Nobel

Laureate C.V. Raman’s Work on Light Scattering – Historical Contributions to a Scientific Biography” (2004).’ The volume under review deals with Raman’s stay in Indian Institute of Science (IISc) where he tried to create an independent ‘Bangalore School of Physics’.

In the foreword to this volume, Arnab Ray Choudhuri pays tribute to the author as follows: ‘Rajinder Singh, who is known for his important studies on the history of Indian physics in the early decades of the twentieth century, has embarked on a study of the relationship between Raman and the press in three volumes. I am not aware of similar studies of other scientists by historians of science in other countries. There is no doubt that this book contains invaluable materials for the scholar interested in Indian science of that period.’

In the introduction, the author writes that ‘C.V. Raman spent 25 years in Kolkata at the Indian Association for the Cultivation of Science (IACS) and the University of Calcutta. In 1932, he was appointed as the first Indian director of the Indian Institute of Science. Raman’s interaction with media was explored until 1932 which forms the basis of my first volume, “C.V. Raman and the Press: Science Reporting and Image Building – Part I: Kolkata Period”. This volume covers Part II: The Indian Institute of Science Period from 1933 to 1948.’

In chapter 1, the author reports about Raman joining as first Indian Director of IISc on 1 April 1933 and starting the Department of Physics from a scratch in July 1933. Raman, even as a Director was not having full financial powers and was feeling handicapped due to bureaucratic hurdles. Within two years, he was able to attract the best available researchers of India to join his group. Raman reported to *Bombay Chronicle* (23 June 1935) under the heading ‘Nobel Prize Winners of the Future’, with a photo of S. Bhagavantam under the banner line, about planned research activities of IISc and the physics department: ‘New activities started in Applied Physics, especially the study of Geo-Physical methods of prospecting for minerals. The School of Physical Metallurgy and investigation in Fuel Technology on the fundamental side. It is hoped to initiate research work on Cosmic Rays and to make a beginning with the investigation of Nuclear Physics.’

Raman was in favour of pure science as reported in *The Illustrated Weekly* (June 21, 1936): ‘Science, alas, is a very particular

mistress. She will not yield if you woo her for her wealth. She insists that you love her for herself. All most beneficent inventions are the achievements of men who gave their lives seeking no return.'

Chapter 2 discusses the history of foundation of Science Academies in India. Before this idea fructified, four Indian scientists, namely, S. Ramanujan, J. C. Bose, C. V. Raman and M. N. Saha were elected as fellows of the Royal Society of London. Saha set up the first Science Academy in Allahabad in December 1930, 'The Academy of Sciences of United Provinces of Agra and Oudh' (in 1935 renamed as The National Academy of Sciences, India). The Indian Science Congress Association (ISCA) set up a committee to create a National Academy of Sciences. But Raman was annoyed with dominating Kolkata group of scientists and proposed for his own Academy on 27 April 1934. A local journalist reported: 'Sir C.V. Raman has thus presented his opponents with a *fait accompli*, and their announcement that they are carrying on their labours and organising an Indian Academy of Sciences, pales in the light of his direct methods.' A proposal for National Academy of Sciences was mooted by ISCA committee: 'It was decided to name the new academy as "National Academy of Sciences of India", which should supplement the existing Science Academies and the Asiatic Society' but it failed in view of conflicting stands taken by the Kolkata group and the Bangalore group.

Chapter 3 'Irvine Committee (IC) and Future of Sir CV Raman' is the most important chapter of this volume as this reveals the state of affairs at one of the premier institutes of science in India and vicissitudes of the life of Raman, its Director. J. C. Irvine, Principal and Vice-Chancellor of the University of St. Andrews submitted his 42-page report to the Secretary, Govt of India on 24 March 1936. The report was highly critical of Raman: (i) He was accused of misusing financial resources to promote pure physics, and via press creating an atmosphere against applied science; (ii) He was accused of abolishing of General Chemistry and grouping it with Physics under the name 'Chemical Physics'; (iii) The Institute failed in its objective to promote industry in India; (iv) The post of Registrar was sanctioned for administrative work and to establish contact between the Institute and industry. This post was sanctioned against the wishes of Raman; (v) The post of Pro-

fessor of Mathematical Physics was abolished; (vi) Raman was accused of misinterpreting Senate documents while transiting them to the Council.

In chapters 4 and 5, the conflict between Raman and Kolkata group of scientists is highlighted. Jubilee of Indian Science Congress Association was celebrated on 3 January 1938 where 47 European scientists participated in the proceedings. The President designate, Lord Rutherford, died in October 1937 and James Jeans replaced him. Raman was interested to be nominated as the Acting President in place of Rutherford, but he was ignored. He was so upset that he resigned from ISCA membership and did not participate in the Jubilee session held in Kolkata.

To add insult to the injury, Saha wrote an article about IISc published under the title 'The Indian Institute of Science, Bangalore' in March issue of *Science & Culture* edited by him. *Nature* took notice of Saha's write up. Saha wrote another 16-page 'Confidential' document based on Irvine Committee Report, even before it was made public, with the sole purpose to malign Raman. Another twenty-eight page document, 'Indian Institute of Science, Bangalore – A frank statement of facts since 1933' was written by L. M. Chakraborty, a student of the Department of Electrical Technology. In the conclusion, he writes: 'I strongly hope that the Council when they meet on 24th August, 1936 would recommend to the Government of India that Sir C.V. Raman be discharged from his office as the Director for inefficiency in the discharge of his duties.'

Chapter 6 'C.V. Raman's Forced Resignation' discusses his exit which was a foregone conclusion if we investigate the adverse comments of the Irvine Committee and representations made against him by the staff and students of the IISc. On 17 July 1937, an informal meeting of the Governing Council was held, and the Director was asked not to attend it. A memorandum was sent to Raman with the following two alternatives: (i) CV Raman ceases to be Director and continues as Professor of Physics on a salary of Rs 2000 per month. (ii) Sir C.V. Raman resigns with effect from April 1, 1938, 'on such retiring allowances as he may be entitled to under the Regulations and Bye-laws and further that he apply for permission to proceed on leave immediately preparatory to retirement.'

Raman had no choice but to accept the Council's decision. According to the Mi-

nutes of the Council of 19 July 1937, Raman ceased to be Director w.e.f. from 19 July 1937. He remained in charge of the Department of Physics, at a salary of Rs 2500 per month, for a period of ten years. Raman remained a sulking scientist for the rest of his tenure in IISc. On the day of his retirement, he gave vent to his feelings: 'One need not fight everybody, but he should do so when his freedom or honour was at stake. ... He was afraid that such qualities were not encouraged in India.' Raman declared that he had always held in high esteem such fighting qualities in the proper circumstances and added: 'I will fight to the last drop of blood in me if anybody tries to sit on me'.

Chapter 7 reports about the discoveries made by Raman group during his 15-year tenure in IISc, out of which first 5 years were full of turmoil. Raman extensively worked in the fields of ultrasonic waves and crystallography. The accomplishment of the Raman-Nath theory was one of Raman's greatest achievements at the IISc. Experiments were conducted to find out the structure of solids with ultrasonic waves. Raman was highly critical of Debye's specific heat theory: 'He called Debye's theory without foundation, as there was no experimental proof of it'. Discovery of Diffuse Spots or 'Modified Reflection' caused by X-ray reflection in crystals was another discovery of great importance. Raman was fascinated by the study of the structure of diamond and collected 300 of them. He studied the luminescence, birefringence pattern, and crystal forms of diamond. He challenged lattice dynamics theory of Max Born which led to unsavoury situation for Raman.

His nationalism is reflected when he asked for the transfer of Kohinoor diamond to India in 1946 before the transfer of power by the British. In a similar vein, he proclaims: 'We in India have been brought up to look for inspiration from the west. We have past glories of our own and I do not think for a moment we will ever rise to the full height of nationhood until we stop looking for inspiration from the west and unless we start seeking inspiration in the history of our own land with its glories of the past. ... He was not against imbibing the best things from the west, ...'

Chapter 8 is of general interest where Raman's interaction with the media is reported. He is nostalgic about his college teachers: 'Some of my pleasantest, recollections of the four years I spent at College in Madras are of the extraordinary kindness

and consideration which I received from the European members of the staff who were then heads of departments of study.' He writes about his physics teacher: 'Professor Jones was regular with his lectures and took pains, now and again, to show us some lovely experiments which helped to impress on my mind the aesthetic beauty of scientific studies. Very early in my career at College, I had reason to be grateful to him for an act which made the study of Physics a pleasure instead of being a burden.'

His political views are not well defined. On the eve of independence, he wrote in *Indian Express* on 15 August 1947 an article 'Freedom for the Individual'. He was not in favour of India joining any power block. His intention was to suggest to the Government of India neither to follow Russia, nor the USA, but take some positive ideological ideas from them. Raman wrote popular science articles in newspapers about his research. He wrote a full page article on Diamonds in *The Indian Express* and another one 'Knowing more about the Atom' in *The Deccan Herald*. Raman gave nineteen talks, which were broadcast by the All India Radio Station, Madras. They were published in the form of a book *Aspects of Science*.

In chapter 9 'Honours and Awards', we find a list of awards conferred on Raman, mostly after he won the Nobel Prize. Raman was not holding a Doctorate degree of any University like S. N. Bose or M. N. Saha, but he was awarded *Honoris Causa* degrees by many universities of India and abroad. In July 1942, Raman was awarded a medal by the Franklin Institute which mentions 'in recognition of his many brilliant contributions to physical science and his leadership in renaissance of scientific work and scientific education in India during the last thirty years.'

Chapter 10 'Conclusions' is a critique of life-long achievements of Raman. A total of 98 research scholars worked for Raman during 1933–48 when he was Director of IISc and later as Head of the Physics Department. His research investigations covered a vast domain: 'Doppler Effect in light scattering, diffraction of light by ultrasonic waves, and Raman spectroscopy. This was followed in subsequent years by crystal physics, dynamics of crystal lattices, e.g. the soft mode, physics of diamond, second-order Raman spectra of crystals; X-ray topography, and Brillouin scattering.'

Raman had a strong personality and liked to be in the mid point of the world. The author Rajendra Singh concludes: 'CV

Raman was not a democrat as he remained life-long President of the Indian Academy of Sciences. His life at the IISc was one of the worst experiences of his life. Here he learnt – what bureaucracy is. Here he saw that rules and regulations can "kill" the intellectuality of a scientist. In order to avoid such hurdles in future life, he decided to establish his own private institute, where he worked until the last day of his life.'

In my view, Rajinder Singh has done excellent work in digging up archival material to prepare this volume on Raman. He has established his credentials as the best historian of Raman and his era of Indian science, known as the Golden era of Physics during 1930s, which produced a galaxy of brilliant physicists, like C. V. Raman, M. N. Saha, S. N. Bose, H. J. Bhabha, D. M. Bose and K. S. Krishnan. I was looking for reasons of India's failure to continue the legacy of Golden era of 1930s, but could not find it in this volume. I wish the author ventures into this dark spot of history of Indian science in future.

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