good working relations with industrial managers and engineers and retained the respect and loyalty of the scientists who worked for him. He emerges from this book as an energetic, cheerful, extrovert character who liked a joke and was fond of giving nicknames to the people he worked with. He had a powerful presence and considerable personal charm. He drove his subordinates hard, passing on the pressure that he was receiving from above. But he did not shirk the heavy responsibility that rested on his shoulders, and he did his best to help those who worked for him.

Kurchatov had no apparent qualms about his role in developing nuclear weapons. He believed that the Soviet Union needed to guarantee its own security by eliminating the American monopoly and achieving a nuclear balance. His close friend and colleague A. P. Aleksandrov writes, however, that Kurchatov was shaken by the results of the first Soviet thermonuclear test in August 1953. When Aleksandrov asked him what was wrong he replied, "That was such a monstrous sight! These weapons must not be allowed to be used." Kurchatov turned his attention increasingly to the peaceful uses of atomic energy, and especially to research on controlled thermonuclear reactions.

Kurchatov wanted to encourage collaboration between Soviet and foreign scientists. In the mid-1950s he pressed for the declassification of Soviet nuclear research. It was he who decided that Soviet physicists should play a serious role in the first Conference on the Peaceful Uses of Atomic Energy in Geneva in 1955. And in April 1956, when he accompanied Khrushchev and Bulganin to Britain, he gave a lecture on controlled thermonuclear reactions at Harwell, speaking of work that had till then been secret and was still classified in Britain and the United States.

In spite of its deficiencies, this book makes an important contribution to our understanding of one of the most important figures in the nuclear age.

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Struggles and Accomplishments in India

Journey into Light. Life and Science of C. V. Raman. G. VENKATARAMAN. Indian Academy of Sciences, Bangalore, 1988 (U.S. distributor, Oxford University Press). xviii, 570 pp., illus., + plates. $45.

Among the life stories of great men of science, this scientific biography stands out for providing insight into the evolution of a natural philosopher and scientist in a country which, though rich in traditions and cultural heritage, was a colony dominated by foreign rule. C. V. Raman was born and grew up in surroundings that had little to offer by way of tradition in or equipment for scientific research. Yet through love of science, thirst for knowledge, discipline and dedicated work, and personal sacrifices he overcame the obstacles he faced and made many outstanding discoveries. The most important of these, the change in the wavelength of light due to scattering by a transparent medium known as the Raman effect, won him the Nobel Prize in 1930.

In many ways the story of Raman is also the story of evolution of organized scientific research in India, of which he was the pioneer. Like all pioneers he was passionately attached to his cause, and in the cause of science he created many schools of physics, started and maintained research journals, organized national meetings of scientists, and provided inspiring leadership to scholars from all over India. By lifelong devotion to such efforts he came to be regarded as the foremost among the men of science of that country and one of the greatest in the world.

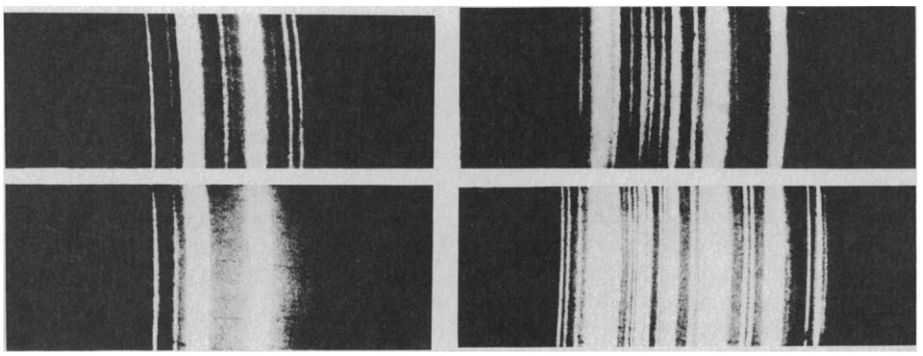
Raman was born on 7 November 1888, in a village near Trichinopoly in South India, the second of eight children. Being a precocious child he finished his primary and secondary schooling and was ready for college at age 11. At 16, he earned his B.A. degree from the Presidency College in Madras, leading his class as usual and winning gold medals for English and physics. His professors, of whom many were Englishmen, advised him to go to England for higher studies, but the civil surgeon of Madras who examined him declared him unfit to withstand the rigors of the English climate. This event produced a lasting effect on Raman's mental and spiritual outlook and played a role in molding his personality. He joined the M.A. class at the Presidency College, where he undertook the study of a great variety of subjects, which included the scientific works of Lord Rayleigh and of Hermann von Helmholtz. His reading also included *The Light of Asia* by Edwin Arnold, and this left a lasting impression on him. He was moved by Siddhartha's renunciation and subsequent search for truth and enlightenment.

In 1906, while still a student at the Presidency College, Raman initiated himself into research by executing a project in optics based on original observations and published the results in the *Philosophical Magazine*, London, all without assistance from anyone. This was soon followed by a second publication in the same journal.

When after earning his M.A. Raman found that research positions were nonexistent, he accepted a job in the finance department of the Indian government in Calcutta. This step could have dashed any hope he might still have had of pursuing physics had he not discovered the Indian Association for the Cultivation of Science within weeks after settling in Calcutta with his new wife, Lokasundari. He lost no time in resuming his researches at the Association, in an honorary capacity. For the next ten years he devoted long hours to research in acoustics and vibration (stringed musical instruments being a particular interest) in addition to fulfilling his duties as an officer of the government in an exemplary manner. Then, in 1917, as a consequence of the excellence of his work as evidenced by his steadily growing national and international reputation, he was appointed to the Palit professorship of the Calcutta University. Raman showed no hesitation in accepting this chair although it involved resigning from his lucrative government job and taking a large salary reduction.

Raman was committed to excellence, and to him the pursuit of science meant total involvement. When appointed to the directorship of the Indian Institute of Science in Bangalore in 1933, he made a dynamic drive to make that Institute a center of excellence by world standards. But his efforts were met with strong resistance, and in 1938 he had to step down from the directorship. Experiences such as these made him believe that politics and science should not mix and that the organization of pure research should not be influenced by governmental authority, which would tend to encourage mediocrity.

"Raman with his baby quartz spectrograph in Calcutta." [From *Journey into Light*; courtesy Raman Research Institute]



"Some of the first spectra taken by Raman," shown by him in a lecture at the Science Congress in Bangalore in March 1928. [From *Journey into Light*; courtesy Raman Research Institute]

It was no surprise that, well in advance of his retirement from the Indian Institute, he planned and built his own research establishment, the Raman Research Institute, which was later to be his sanctuary for pursuing his quest unhindered by outside influences. In the serenity of this institution he extended his researchers into such new domains as the physiology of vision and the colors of gems and minerals. Often during these years he was a recluse, his free and independent spirit being one with "Nature." However, even during such times, and throughout his professional life, he kept working and publishing the results of his researches.

The author of this biography is also the author of two monographs in condensed matter physics. The material for this book was gathered through extensive surveys of relevant publications, including Raman's monographs, research papers, public lectures, correspondence, newspaper articles, and radio talks. The author also interviewed many relatives, friends, and former associates of Raman's to come up with this authentic account. The task of writing Raman's biography is difficult because of the political turmoil that existed in India owing to foreign rule and the struggle for independence and the many hostile forces Raman had to confront during his long life. A further complication is the unique cultural heritage of India, which necessitates the introduction of names, anecdotes, and customs that are foreign to the rest of the world. The author has nevertheless succeeded in sustaining the interest of the reader till the end of the book, and he provides well-referenced explanatory notes (pp. 502–21). The technical sections or chapters, which expound the mathematical background to Raman's work, require a knowledge of undergraduate physics but are readily identified and may be omitted by the non-technical reader. In writing this book, which appears to be the only comprehensive scientific biography of Raman, the author has rendered a valuable service to the science-oriented reading public.

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The Solar System: Records from $t \geq 0$

Meteorites and the Early Solar System. JOHN F. KERRIDGE and MILDRED SHAPLEY MATTHEWS, Eds. University of Arizona Press, Tucson, 1988. xviii, 1269 pp., illus. $55. Space Science Series.

Observational discoveries beginning in the mid-'70s led to the conclusion that some types of meteorites are quite primitive in the sense that their matrix contains materials that were formed from the solar nebula, long before the accretion of planets. These observations launched a series of ingenious investigations in meteoritics to learn about the evolutionary history of the early solar system. This compilation is an attempt to bring together information that has resulted from these studies.

The methods of decoding the evolution of the solar nebula are many, since characterization of the primitive meteoritic materials includes their physical, chemical, and isotopic compositions. Most of the meteorites that fall on the earth have, in addition, been altered by secondary processes such as heating, shock, and exposure to water. It is thus imperative to distinguish meteoritic records that are indicative of solar nebular processes from those that primarily tell us about later processes operating in the solar system.

The most fascinating aspects of the study of the early solar system are those which take us closer to $t=0$, the time of collapse of the solar nebula. The book contains appropriate discussions of several such topics. High-precision nuclear chronologies with clocks reset at different times after the isolation of the molecular cloud that collapsed to form the sun and the solar system, exotic isotopic anomalies indicating specific nucleosynthetic inputs from various stellar sites into the solar nebula, and cosmogenic records that perhaps date back to the beginning of the solar nebula have been discovered in primitive meteoritic materials. These discoveries, along with chemical and mineralogical characterization of primitive meteoritic components, constitute the most exciting investigations carried out yet, often on microgram- to milligram-size samples, using sophisticated sample-extraction and analytical methods. They have provided a great deal of insight into early solar system processes. The results to date do not lead to any consistent model of the evolution of the solar system; but they do place important constraints on such models. The present gaps appear not just to reflect lack of samples or suitable techniques but to be manifestations of the complexities of solar system evolution, including reprocessing of materials.

The book makes a strong case for further detailed studies, combined with astrophysical observations of young stars, to resolve the difficulties in the modeling of solar system evolution. The character of the meteoritic record, present knowledge of early solar system processes based on it, enigmas and limitations, and future directions are the main subject matter of the book; such a complex treatment of the subject has not been attempted before.

The book is appropriately dedicated to two scientists who made major contributions to the field of meteoritics: H. H. Nininger and H. C. Urey. It is an encyclopedic effort by more than 65 scientists. The coverage is fairly well organized and is comprehensive. The book begins by discussing classification of meteorites, their source regions, processes by which meteoritic materials are altered, effects of their exposure to solar and galactic corpuscular radiation, solar system chronology, protostellar collapse, and solar system formation. There follow papers on topics such as abundances of elements, isotopic anomalies, and interstellar components in meteorites that have a direct bearing on our understanding of physicochemical conditions in the solar nebula. Papers on the enigmatic "chondrules," refractory inclusions (one type of primitive meteoritic component), interplanetary dust, and nucleosynthetic processes make the presentation very comprehensive. The content can be considered adequate to acquaint a