

BOOK REVIEW

Lucio Russo (Trans. by Silvio Levy), **The Forgotten Revolution : How Science was Born in 300 BC and How it had to be Reborn**, Springer, \$99, ISBN 3-540-20088-1

Reviewed by: Rajesh Kocchar, National Institute of Science, Technology and Development Studies (NISTADS), Pusa Gate, New Delhi 110012.

Alexander's military campaigns which extended up to the River Indus brought about intellectual interaction and cross-fertilization of ideas in the region. The cosmopolitan Egyptian city of Alexandria (founded 331 BC), with a substantial Greek-speaking population, emerged as a major center of activity. Starting with the year 212 BC when Syracuse was plundered and Archimedes (287-212 BC) killed, Hellenistic centers were defeated and conquered by the Romans, with Alexandria itself being conquered in 30 BC. Scientific activity there however had already come to an abrupt end in 144 BC, when the king Ptolemy VIII, acting as proxy for the Romans, "initiated a policy of brutal persecution against the city's Greek ruling class". This scholarly book discusses "the appearance of science as we understand it now" in the Hellenistic period (The Classical period that lasted the preceding two centuries can be taken to close with the death of Aristotle in 322 BC). The Hellenistic period includes apart from Archimedes such well-known names as Euclid (c.300 BC), Aristarchus (c.310-230 BC), the librarian Eratosthenes (c.275-192 BC), and Hipparchus (c.190-120 BC) plus a host of lesser known names.

Science went into decline with the rise of Rome and eventually disappeared. Most of the writings of the period (with the notable exception of Euclid's *Elements*) have been lost. Much of our information about the scholars of the Hellenistic period comes from remarks made by later authors. Also, even when texts were saved, the selection process worked in reverse, preserving some of the worst and destroying some of the best. Hellenistic period was almost immediately forgotten and interest in classical philosophers like Aristotle and Plato

revived. Reconstruction of past from such scanty and dispersed primary materials is a difficult task. Russo, who is a modern mathematician as also a classical philologist, seems to have done an admirable job.

As an illustration of decline in science, Russo gives an interesting example. Pliny in his *Natural History* refers to Aristomachus of Soli who “did nothing else” in his whole life than study bees. Pliny knows that beehives have hexagonal cells, but instead of digging complex reasoning from his Greek sources simply says that this is so because “each side is the work of one leg”. Consistent with the apathy of the times, translation of Euclid into Latin was not attempted till the 6th century AD. The first complete translation seems to have been made as late as around 1120 AD and that too from the Arabic.

How did Hellenistic science come to being? Alexander’s conquests brought Greeks to Egypt and Mesopotamia, which had older civilization, bigger economy and geography and higher levels of practical knowledge and technological developments. The combination of these with the classical Greek tradition gave rise to science. Thus the vastness of Egypt made possible the celebrated experiment by Eratosthenes to measure the circumference of the earth (His own work is lost : we know about it from a later account). Aswan (modern name) and Alexandria are on the same longitude: the noon therefore occurs at the same time at both the places. Aswan in addition lies near the tropic of Cancer, so that at noon on summer solstice the sun is almost exactly overhead. By measuring the inclination of the sun to the vertical at Alexandria on summer solstice noon, we get a value for the angle subtended by the Aswan-Alexandria base-line at the sun. Now, combining this angle with the direct distance between the two cities translates one degree of great circle into a length. In other words, we obtain a fairly accurate value for the circumference of the earth (Similarly, the vastness of British India permitted the measurement of the great meridional arc under George Everest).

The best-known surviving documentation of Hellenistic technology is the work by Heron of Alexandria who probably lived around 100 AD. Too much reliance on this late work can be misleading in the sense that he gives the impression of technology for amusement only. Russo persuasively argues for a high level of technological knowledge and application in a wide variety of

fields: instrumentation, aqueducts, ship-building, light-houses, etc.

The author is on less firm ground while discussing the role of Hellenistic achievements in fashioning modern science. To him, Copernicus was merely taking sides in the old dispute between Aristarchus' heliocentrism and Ptolemy's geocentrism. It is more likely that Copernicus worked out his model and then sought to use the authority of the ancient Aristarchus as a shield against anticipated contemporaneous hostile attacks.

Russo does not take into account the impetus given by maritime trade and colonial expansion to the advent and growth of modern science. Isolated pieces of information cited by Russo make better sense if they are placed in an external context.

Russo asks: "How did solutions with ruler and compass, which in Antiquity were considered simpler, got replaced by numerical calculations in the modern age?" He gives the answer himself: advent of printed tables of logarithms, in 1614. It is noteworthy that log to the base ten was devised by Briggs in Gresham College Oxford to help East India Company with the laborious navigational calculations.

Similarly, Russo points out that the ancient light-houses were half heartedly revived in the 12th century, but it was only in the closing years of the 17th century "that light-house construction began in earnest, and on new and original lines". Makes sense when you notice that at the time European ships had a whole lot of far-off places to bring merchandise from.

Russo is plainly anachronistic when he dubs as primitive the ancient lack of interest in technological progress. He gives the example of Emperor Vespasian who vetoed a device to move heavy columns at a low cost in order 'that he might be able to feed the mob'[Quotes in the text itself] with labour intensive projects. In the 18th century England John Kay of Bury who invented the weaving machine called the fly shuttle faced such violent hostility from fellow weavers that he had to flee the country. In fact, industrial innovation did not take roots in England till the textile manufacturing focus shifted from the traditional woolen to pure cotton (as distinct from the mixed linen warp-cotton weft cloth), which could be exported to a captive India and elsewhere.

Russo has done well to caution on academic grounds against talking of an unresolved monolithic period of Antiquity extending from the 6th century BC (Greek philosopher Thales) to 2nd century AD (Greek astronomer Ptolemy). And yet, this monolithic nomenclature did serve a valuable practical purpose. Creation of the modern powerful system of modern science was used to assert the cultural and ethnical superiority of its authors, which thus had a right to dominate over others. In this ideological game, the roots of science were taken back to the European Greece but no further. Any discussion of the structure and influences within the Antiquity would only have weakened the imperialist argument. It is in this context that one can appreciate the significance of Russo's observation that in the hybrid Hellenistic period the classicist Aristotle did not enjoy the type of reputation Europe bestowed on him later.

It is my assessment that even if Europe had not been aware of the Greek science, modern would still have come up the way it did. Emphasis on its Greek antecedents (even if not to the extent Russo would have preferred) helped present it as Western Science to the exclusion of others. In this scheme of things Arabs were wrongly told that their role had been no more than librarians and archivists for preserving Greek science till Europe was in a position to take its heritage back. And yet when the Indians pointed out that the Buddhists had worked extensively on health-related chemistry, they were told with a straight face that in their ancient texts, probably by Buddhist, Arabs were meant.

Incidentally, the book is a good example of constructive cooperation between the author and the translator. The English translation is an improvement over the Italian original; the improvements are now being taken to the new Italian edition.

Given the limitations of the source material it is at times difficult to say where rigour ends and speculation begins. Whether Russo overstates his case and undermines the Classical period to sharpen the contrast can only be decided by the specialists. But there can be no doubt that he has produced an influential text. It would be useful to those who are interested in Antiquity, in the internal growth of modern science or in assessing the external factors influence the advent and growth of modern science and technology.

Rajinder Singh, **Nobel laureate C.V. Raman's Science, Philosophy and Religion**, Dharmaram Publications, Bangalore 5600029, 2005, pages 383 + ix, price Rs. 250/-, US\$ 20.00.

Reviewed by: K. R. Rao, 29/2, 11th Cross, 3rd Main, Malleswaram, Bangalore 560003.

Reviewing a biography on C.V.Raman, be it on his science, philosophy or religion is a daunting task, for it demands some knowledge, however scanty it may be, of the numerous biographies, pictorial biographies and biographical sketches dealing with various aspects of life and activities of Raman, that are already available¹⁻¹⁰. Some biographies are lengthy and some short. They serve different purposes ranging from, introducing Raman to laymen and students, to critically review his life and works. I have had some acquaintance with a few of these. The biography by G.Venkataraman was commissioned by the Indian Academy of Sciences and by INSA. Venkataraman, known for his science popularization books and himself a Physicist, is passionate about his works, be it a piece of research in physics or writing a book. To me, Venkataraman's book seems to be a touch-stone against which other biographies of Raman should be compared. In my humble opinion, what is contained in Venkataraman's book may be found elsewhere but what is not contained in that biography may not be found elsewhere! In spite of such a 'prejudice', I have read the book by Rajinder Singh, the book under review as objectively as I can, because Raman is an iconic figure. Every biographer of Raman has approached his subject with awe, inspiration, curiosity and respect.

Falk Reiss, a co-author of many a publication of Rajinder Singh, has noted in his Foreword to Rajinder Singh's book that "most of the biographies of Raman suffer from a rather subjective view of authors. In contrast... ..Rajinder Singh offers a critical view". He goes on to state that "for the first time the process of the discovery of the so-called Raman Effect is critically analysed including the role of his collaborators and the simultaneous discovery of the same phenomenon by the Russian physicists Mandelstam and Landsberg...". How true are these statements ?. After going through the book I do not subscribe to these 'subjective' views of Reiss.

The first thing that struck me was that the style and syntax of Rajinder Singh's book have left much to be improved upon. It looks as if proof reading has been given a go-by, by the author and the publisher. I shall quote a few examples, without pointing out the nature of flaws:

- (i) page I, 2nd para: "Not only political but scientific as well, as national heroes were required to motivate the public"
- (ii) Page 2, 2nd para: "Out of 92 pages, only 12 are devoted to Raman's life and a very scant scientific work"
- (iii) Page 3, 4th para: "The better known work is that of G.Venkataraman, *Journey into Light*....brought out into in 1988 at Raman's birth anniversary (Venkataraman G, :: 1994]"
- (iv) page 3, last but I para: "Very often, the appearance of differential and integral equations seems to not be out of place"
- (v) page 4, 2nd para: "The latest short biography, which did not contain new material, is based on *Journey into light* does not offer new information for historians.. ..."
- (vi) page 4, last para: "What was special in his personality that instead of other Europeans, who had almost a monopoly on, he was given the Nobel Prize?"
- (vii) page 5, 5th para: "What meant religion for Raman?"
- (viii) page 6, I st para: "What thought Raman about the religion?"
- (ix) Page 10, 4th para: " He was of the opinion that if religion is unable to improve the standard of living, it needs not to exist....."
- (x) Page 18-19 : "At the occasion of 99th birthday of Swami Ramakrishna Paramahansa he shocked his audiences..... message of the great teachers like Buddha and Ramakrishnan"
- (xi) Page 20, 2nd para: "Being a man of science, he was convinced that using brain the human in his powers of penetration into the mysteries of the nature had almost reached the stage of God".

I can continue, on and on, and I may be accused of nick-picking. But I cannot help it because, such usage and errors in the language distracted me from reading the book easily. If such is the number of errors in the first twenty pages, one can only guess at the large number of such errors in the rest of the book.

Then there are some statements that appeared funny to me. For example:

- (i) Page 17, 2nd para: “As the Indian wives do not leave their houses alone, I suppose Raman accompanied his wife”
- (ii) This biography begins with a chapter entitled, “Nature, Religion and C.V.Raman”, unlike many others that start with Raman’s parentage or his birth. On page 22: Rajinder Singh has quoted answers to a questionnaire (sent to V. Radhakrishnan) ‘chosen to be’ replied by Dominique Radhakrishnan.

“R.S. In your parents house, where you were born, whether there were pictures of Hindu Gods as in every Indian house?

D.R. No

R.S. Whether your father did prayers at home as every Indian does?

D.R. Never

R.S. During his Calcutta days, whether the family or Professor Raman lone attended religious places like temple and church?

D.R. Never

R.S. Did he ever discussed religious topics?

D.R. No

R.S. In the house, where you are living now, were there ever religious pictures or paintings?

D.R. No

R.S. In his old days, did Professor Raman started taking more time for religion?

D.R. Unthinkable.

From the above it should be clear that there is neither material nor justification for any book or even article on Raman and religion”.

If only one can comment on the religiosity of a person, based on the existence or otherwise of religious pictures and paintings in one’s home, it speaks of the objective conclusions drawn!

The book is, at places, unravelling hidden mysteries a la Sherlock Homes. Rajinder Singh depends on ‘private’ versions vis-a-vis published versions. On page 99 he notes, “A paper written for a scientific journal was needed to give some conclusive results. In this case, the conclusions drawn were certainly not in accord with the private version. But why is it a Fellow of the Royal Society (Raman) and his assistant made so many assertions without being afraid to loose their image?”

The chapter on “Emergence of physics as an academic discipline in India” deals with the nature of scientific activities at the Indian Association for the Cultivation of Science (IACS) before and after Raman joined IACS. This chapter is based on several annual reports of IACS. Singh refers to the background against which Raman left IACS. Referring to the appointment of K.S.Krishnan to the Mahendra Lal Sircar Professorship in 1933, he presents a story that differs from the one that is said to have been given in Venkataraman’s biography. This is based on some articles published in *Illustrated Weekly of Indian* (sic and undated).

In the 3rd chapter dealing with Raman’s Scientific achievements, Singh, referring to Raman’s interest in light scattering, notes “It is generally believed that Raman’s interest was invoked due to the blue colour of the sea, which he observed during his voyage to England in 1921 (Venkataraman G., 1994, p. 51; Jayaraman A. ..Mallik D.C.V..]. But due to the following reasons, it seems that this hypothesis is not correct”. After giving some reasons, Singh arrives at the conclusion that “Raman’s interest in light scattering must have begun at some early stage”. A desire to rewrite such *historical* aspects seems to underlie Singh’s interest in writing this biography.

In the 4th chapter, Singh has tried to find answers to queries like “From where Raman got the instruments he needed for his research? Were these instruments ‘made in India’ or were they imported? If they were made in India, then what we learn from this story?” (p. 75). After devoting some four pages, he concludes “Raman had enough money to import the necessary instruments. At the same time he had trained workers who could build or modify the instruments according to Raman’s needs” (p. 79). Singh has belaboured the cost of the equipment used, over two to three pages. So also Singh has belaboured the fact that Raman had referred to the light scattering effect that he had observed as an analogue of Compton effect, whereas he is said to have been criticised after some 20 years later, for this comparison due to various reasons.

Raman’s biographers have idolised him at times and also painted him as a man with human foibles. Rajinder Singh is no exception. There is a section titled “The private and official version of the discovery of Raman Effect”. In a sub-section, Singh refers extensively to K.S.Krishnan’s diary. The biographer Singh seems to be focussing his attention on discovering ‘discrepancies’ in

scientific aspects. On page 95 it is stated “until March 28, the Indian authors did not spectroscopic proof”. In page 108, there is a sub-section ‘Raman’s different versions of the discovery’. Singh says “How a scientist might change the story of his discovery according to his public and can occasionally is well illustrated with Raman’s example”!! Earlier, on page 87, it is stated “from the (Krishnan’s) diary we know that they have not studied gases but a few vapours. So the mentioning of gases is exaggerated”. Of course, I could not understand what is scientifically meant by this statement. On page 89, Singh seems to find fault with some scientific inaccuracy: “Without naming the liquids in publication, it was written that about 60 common liquids were examined..”..

Scientists are expected to rely upon published data and publications, preferably, in peer-reviewed journals and refer to such sources in subsequent publications. On the other hand, as a ‘science-historian’, Singh has relied heavily on sources that are not considered authentic such as annual reports, private diaries and news paper clippings and so on. Nevertheless, this book, with all its flaws in English writing skill, has perhaps succeeded in pointing out several inconsistencies in statements and writings made by Raman and his coworkers over a period when Raman Effect got recognised as a fundamental discovery in experimental physics. The discrepancies and inconsistencies, nevertheless do not rob credit due to Raman and co-workers for their unique observations that have only been reinforced over the following - nearly- a century of research based on Raman spectroscopy.

I shall stop commenting on other chapters in the book but for the benefit of readers of this review, I shall merely list them. The chapters are:

“C.V. Raman and the Nobel Prize” which goes into the intrigues and stories connected with nomination of Raman to the Nobel Prize and so on;

“C.V.Raman: A controversial personality and a quarrelsome scientist -Part I”

“C.V.Raman: A controversial personality and a quarrelsome scientist - Part II”

“Raman’s research style”

“Raman’s contacts with scientists abroad”

Rajinder Singh has based the entire book on published and unpublished materials, news paper reports, correspondence with various students and col-

materials, news paper reports, correspondence with various students and colleagues of Raman and in a few cases based on personal interviews. Other biographers have also followed this method. But unlike, say, in Venkataraman's book, there is hardly any hard-core science in Singh's book.

Would I recommend the book? In my opinion, the book will not serve any useful purpose for a young student. It may fulfill voyeuristic desires of some. A book, with so many grammatical mistakes and wrong syntax is not meant to be seen at a coffee-table, lest browsers may wonder how a publisher could publish such a book.

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