KERALA MATHEMATICS AND ITS POSSIBLE TRANSMISSION TO EUROPE

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Abstract: Mathematical techniques of great importance, involving elements of the calculus, were developed between the 14th and 16th centuries in Kerala, India. In this period Kerala was in continuous contact with the outside world, with China to the East and with Arabia to the West. Also Europe was in contact with Arabia and China during this period. It is possible that some of the Kerala mathematical techniques were transmitted to Europe via these contacts. In this paper we discuss the nature of the Kerala techniques, some of which were invented independently by Newton and Leibniz in the late 17th century after exploiting the works of European pioneers such as Fermat, Roberval, Taylor, Gregory, Pascal, and Barrow. In the preceding half century. However, what appears to be less well known is that the fundamental elements of the calculus including numerical integration methods and infinite series derivations for (and for trigonometric functions such as sin x, cos x and tan-1 x (the so-called Gregory series) had already been discovered over 250 years earlier in Kerala. These developments first occurred in the works of the Kerala mathematician Madhava and were subsequently elaborated on by his followers Nilakantha Somayaji, Jyesthadeva, Sankara Variyar and others between the 14th and 16th centuries . In the latter half of the 20th century there has been some acknowledgement of these facts outside India. There are several modern European histories of mathematics which acknowledge the work of the Kerala school. However it needs to be pointed out that Indian and Kerala mathematics. In the early part of the second millennium evaluations of Indian mathematics or, to be precise, astronomy were generally from Arab commentators. They tended to indicate that Indian science and mathematics was independently derived. Some, like Said Al-Andalusi, claimed it to be of a high order: "[The Indians] have acquired immense information and reached the zenith in their knowledge of the movements of the stars [astronomy] and the secrets of the skies [astrology] as well as other mathematical studies. After all that, they have surpassed all the other peoples in their knowledge of medical science and the strengths of various drugs, the characteristics of compounds, and the peculiarities of substances." Others like Al-Biruni were more critical. He asserted that Indian mathematics and astronomy was much like the vast mathematical literature of the 21st century – uneven with a few good quality research papers and a majority of error strewn publications: "I can only compare their mathematical and astronomical literature to a mixture of pearls and excrement. Unfortunately, the quantity of the latter is so great and the quality of the former so small." Such comments have led to the generally held view that Indian mathematics was not only was Indian science indebted to Europe but also that the Indian numbers are an 'abbreviated form' of Roman numbers, that Sanskrit is 'muddled' Greek , and that India had no chronology. Although Seidlitz's assertions were based on imperfect knowledge and understanding of the nature and scope of Indian mathematics, this did not deter him from concluding: "On one side, there is a perfect language, the language of Homer, approved by many centuries, by all branches of human cultural knowledge, by arts brought to high levels of perfection. On the other side, there is [in India] Tamil with innumerable dialects and that Brahmanic filth which survived to our day in the environment of the most crude superstitions". In a similar vein Bentley also cast doubt on the chronology of India by locating Aryabhata and other Indian mathematicians several centuries later than was actually the case. He was of the opinion that Brahmins had actively fabricated evidence to locate Indian mathematicians earlier than they actually were: "We come now to notice another forgery, the Brahma Siddhanta Sphuta, the author of which I know. The object of this forgery was to throw Varaha Mihira, who lived about the time of Akber, back into antiquity. ...Thus we see how Brahma Gupta, a person who lived long before Aryabhata and Varaha Mihira, is made to quote them, for the purpose of throwing them back into antiquity. ...It proves most certainly that the Brahan Siddhanta cited, or at least a part of it, is a complete forgery, probably framed, among many other books, during the last century by a pretender to science, for the purpose of supporting the ridiculous claims of the Brahmins to a high antiquity. ...Bramagupta, who lived at Ujjeni in the year 1501 ... Nor is he justifiable for a different reason, viz. that he is a modern author, and therefore ignorant of the ancient Hindu discoveries; his system is a fabrication based on a pretended ancient chronology, and on the effect ascribed to it of producing a conjunction of the seven planets at the beginning of the Kaliyuga, which is a mere fable. 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On the other side, there is [in India] Tamil with innumerable dialects and that Brahmanic filth which survived to our day in the environment of the most crude superstitions". In a similar vein Bentley also cast doubt on the chronology of India by locating Aryabhata and other Indian mathematicians several centuries later than was actually the case. He was of the opinion that Brahmins had actively fabricated evidence to locate Indian mathematicians earlier than they actually were: "We come now to notice another forgery, the Brahma Siddhanta Sphuta, the author of which I know. 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