

## Nīlakantha Somayāji (1444 - 1545)

In the 19th century, the prevailing belief among the historians of science was that Mathematics and Astronomy in the Indian subcontinent had gone into hibernation after Bhāskarachārya in the 12th century. The credit for demonstrating that this was not so must surely go to Charles M Whish, Esq., a civil servant in the East-India Company. In 1832 he brought to the attention of the historians the magnificent achievements of the *Kerala School* which flourished from the 14th to 17th century. (Whish's paper, *On the Hindu Quadrature of the circle*, has been reproduced in *A modern introduction to ancient Indian mathematics*, T S Bhanumurthy, Wiley Eastern, as an appendix.) Among the major figures of this school are Mādhava (1350-1410) of Sangamagrāma, Paramesvara (1360-1455), Nīlakantha Somayāji (1444-1545) and Jyesthadēva (c.1500-1600) whose significant contributions to mathematics include infinite series expansions of trigonometric functions and very accurate approximations to  $\pi$ .

The most comprehensive work of the Kerala school available to us is the *Tantrasangraha* of Nīlakantha Somayāji along with commentaries on it by some of his followers. Fortunately the biographical details of Nīlakantha are well recorded. He was born on Wednesday, June 14, 1444, and was a resident of Trkkantiyūr (Sanskritised into Śrī Ākunda-pura), near Tirur, Ponnai taluk, South Malabar. His teachers were Ravi with whom he studied Vedānta, and Dāmodara, son of Paramesvara, who initiated him into Astronomy and the underlying mathematical principles. That Nīlakantha lived upto a ripe old age, even to become a centenarian, is attested by a contemporary reference made to him in a Malayalam work on astrology *Prasnasāra* composed in 1542-43.

Nīlakantha's writings substantiate his knowledge of several branches of Indian philosophy and culture. It is said that he could refer to a Mīmāṃsā authority to establish his view-point in a debate and with equal felicity apply a grammatical dictum to the same purpose. Sundararāja, a contemporary Tamil astronomer, refers to Nīlakantha as *sad-darshani-pārangata*, one who had mastered the six systems of Indian philosophy. Another major work of Nīlakantha is his *Bhāṣya* on *Āryabhaṭīyam* of Aryabhata (476 A.D). The lucid manner in which difficult concepts and cryptic astronomical calculations from *Āryabhaṭīyam* are explained, the wealth of quotations, and the results of personal investigation amply justify Nīlakantha referring to his work as a *Mahābhāṣya*.

The *Tantrasangraha* of Nīlakantha Somayāji along with commentaries on it by some of his followers has been critically edited by K V Sharma. Another source book, also by K V Sharma, is *A History of the Kerala School of Hindu Astronomy*; both these books have been published by the V V B Institute of Sanskrit and Indological Studies, Panjab University, Hoshiarpur, Punjab.



## Leonhard Euler (1707-1783)

Leonhard Euler (pronounced 'oiler') was born in Basel, Switzerland in 1707. His father was a clergyman and he wished that Leonhard would follow his footsteps though he himself had studied mathematics under Jacques Bernoulli and instructed his son in the elements of the subject. The young Euler studied under Jean Bernoulli and was associated with his sons, Daniel and Nicholas. In addition to mathematics he was broadly trained in theology, medicine, astronomy, physics, and oriental languages.

He followed Daniel Bernoulli to the St. Petersburg Academy in 1727 and was initially in the department of medicine! When Daniel Bernoulli left Russia for Basel in 1733 Euler became the Academy's chief mathematician. He married and settled down to pursue in earnest mathematical research and rear a family which ultimately included thirteen children. In 1735 he lost the sight of his right eye, due to overwork, but his misfortune in no way diminished the rate of output of his research. In 1741 Euler joined the Berlin Academy accepting an invitation from Frederick the Great and spent twenty-five years there. Unsophisticated as he was, Euler was not entirely happy at Berlin and the monarch used to refer to him as a "mathematical cyclops". He returned to the St. Petersburg Academy in 1766 and stayed there till the end. He was losing sight in his left eye by cataract and an operation was performed in 1771. Though his sight was restored for a few days, the success was short-lived and he was blind for the last seventeen years of his life. Even this tragedy did not stem the flood of research and publications which continued unabated until 1783 when at the age of seventy-six he suddenly died while sipping tea and enjoying the company of one of his grandchildren.

Euler was by far the most prolific contributor to mathematical literature and averaged about 800 pages a year; he published more than 500 books and papers during his lifetime. He worked in practically every branch of mathematics, pure and applied, and at all levels from the most elementary to the most advanced. He was also the most successful notation builder of all times. He introduced the symbol  $e$  ( $e$  for exponential) for the base of the natural logarithm and  $i$  for  $\sqrt{-1}$  and was largely responsible for popularising the symbol  $\pi$  to denote the ratio of the circumference of a circle to its diameter; these three symbols appear together in the equation  $e^{i\pi} + 1 = 0$  a general form of which,  $\cos \theta + i \sin \theta = e^{i\theta}$ , is due to Euler. The notation  $f(x)$  for a function of  $x$  is also due to him. One finds ubiquitous use of Eulerian symbols and terminology in geometry, algebra, trigonometry, and analysis which is why his name appears frequently in school through college-level mathematics (as well as in *Resonance!*).

Euler won the coveted biennial prize awarded by the Parisian Académie des Sciences twelve times; the essays he submitted to the académie for the contests covered a wide range of topics.

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