



Gaṇita-Yukti-Bhāṣā (Rationales in Mathematical Astronomy) of Jyēṣṭhadeva, Volume I: Mathematics and Volume II: Astronomy. Critically edited with English translation by K. V. Sarma and Explanatory notes by K. Ramasubramaniam, M. D. Srinivas and M. S. Sriram. Hindustan Book Agency (India), P 19, Grean Park Extension, New Delhi 110 016. 2008. 470 and 613 pp. Price: Rs 1500 (both volumes).

The history of astronomy and mathematics in the context of the Indian subcontinent resembles a multiplex with different screens, such as the centres around Kusu-mapura, Ujjayinī and Kerala. Among these centres, the glorious screen of Kerala had been little known till the middle of the last century, as is evident from the historical accounts coined till then. Against the above scenario of the early 1950s, K. V. Sarma physicist turned Sanskrit scholar, moving from place to place in search of manuscripts on astronomy and mathematics which lay buried unattended in many traditional households of Kerala. Sarma devoted his life for bringing to light the annals of the Kerala school of astronomy. *Gaṇita-Yukti-Bhāṣā of Jyēṣṭhadeva*, critically edited with English translation and notes, last of Sarma's contributions to the world of science and it offers a standing testimony to clear many misconceptions that have been in vogue about Indian astronomy and mathematics.

Work is split into two volumes respectively, of Mathematics (chapters 1–7) and Astronomy (chapters 8–15) and is a well brought out edition.

The original text is in Malayalam prose of the early 16th century, a period before the introduction of the modern Malayalam script based on Devanāgarī by Ezhuthacchan (AD 1497–1560) and it is spread across the social climes. Obviously, the terminology employed and linguistic style are not those familiar to

the modern Keralite trained in mathematics. When we look at the past efforts to have *Yuktibhāṣā* published and the focus that Sarma gave to the present work in his last years, the fact is obvious that he was not happy with earlier efforts and so dedicated himself to the mission of bringing out a flawless original text and translation. Only an erudite scholar like Sarma could have translated the rationales couched in archaic Malayalam expressions into English, without any loss of meaning.

Jyēṣṭhadeva's presentation is notable for the systematic presentation of the topics he has discussed based on the astronomical treatise, *Tantrasaṅgraha*. The initial chapters have been devoted to discuss the rationales of arithmetical operations of integers and fractions, rule of three, pulverizer and trigonometry, while the latter sections deal with the planetary model of siddhāntic astronomy. *Gaṇita* discussed is much the same as that of the Āryabhaṭa tradition and the equality stated of the square of a number with the area of a square as we see in *Āryabhaṭīya* *Gaṇita*-3, is especially noteworthy. What distinguishes *Yuktibhāṣā* is the algebraic and geometrical logics presented and also the geometrical proofs presented for important propositions. It can easily be inferred that Jyēṣṭhadeva has drawn style and material from *Āryabhaṭīya*, *Līlavati*, etc. and the work is a compilation of the traditional teaching on mathematics and astronomy which can be traced to *Āryabhaṭīya* and *Mahābhāskarīya* in Kerala. It may not be prudent to ascribe originality to the discussion presented in terms of algebraic rationales and geometrical proofs.

To spell out a few notable aspects of the treatment given of mathematics:

1. Arithmetical operations have been presented in terms of different methods which owe their origin to algebraic deduction. Methodology adopted is a borrowal from *Līlavati*, wherein we can find arithmetic and algebra treated respectively, as *Avyakta gaṇita* and *Vyakta gaṇita*. May be it was known even earlier to *Līlavati* of Bhāskara-II, as for example, to Āryabhaṭa himself that algebra reveals the rationale of arithmetic operations.
2. Geometrical proofs presented for Bhujakoṭikarṇanyāya (Pythagoras principle), circumference, area and volume formulae, etc. also represent a summary of the traditional teachings.

At the outset Jyēṣṭhadeva himself has stated that the work has *Tantrasaṅgraha* as basic reference and this meant that the traditional teachings underlying the major siddhāntic astronomical treatise *Tantrasaṅgraha* are put forth in the work. Rationales explained and the geometrical proofs given as such belong to the tradition which can be traced as far back as a millennium when the Kerala astronomy had its beginning with Āryabhaṭa (AD 522).

Taking a glance at the astronomical part, the work is notable for detailed exposition of the computation of true planets, celestial sphere, gnomonic shadow and calculations involving great circles, eclipse and the Vyāpīpāta, etc. cannot be found elsewhere with such explanations. Space constraints do not permit me to go into a discussion on the merits of the discussions and derivations.

Also, I have not ventured to discuss in detail certain omissions in the explanatory notes by Ramasubrahmaniam *et al.*, where misleading account is given of the Indian epicyclic planetary theory. On p. 652, the statement reads:

‘This is essentially the same as the standard planetary model employed in modern astronomy since Kepler (except that here the *śiṅhrocca* is the mean Sun whereas it should be the true Sun) as the stated value of r_s/R is equal to the ratio of the planet–Sun and Earth–Sun distances in the modern picture.’

Nothing can be more misleading to students and those who are unfamiliar with the nuances of epicycle models. In fact the mean sun cannot be observed and none could have made a revised planetary model based on mean sun. Mean sun alone attests the fact that an alternative computational contrivance experimented by Nīlakaṇṭha is getting misinterpreted in terms of an ‘implied heliocentrism of the revised planetary model of Nīlakaṇṭha’.

As we have already stated above, in translating the astro-mathematical Malayalam prose of 16th century AD into English, none could have excelled Sarma, and this fact is evident in the elegance that we meet within the pages of the present edition of *Yuktibhāṣā*.

Elaborate and excellent explanatory notes presented in the language and style of modern mathematics by well-known researchers adds to the usefulness of the otherwise terse discussion of mathematics and astronomy.

The elegance of the book and the translation by Sarma are beyond comparison and shall add new perspectives to the history and content of Indian astronomy and mathematics.

The epilogue of Volume I, discussing the tradition of proofs in Indian mathematics, is a valuable addition to the work and helps students and scholars alike to understand the nuances of Indian scientific tradition better. Also, it helps gain the right perspectives on great works like that of Āryabhaṭa, which have met with hostile criticism at the hands of certain Western scholars.

Last but not the least, certain facts which mar an otherwise excellent edition need to be mentioned here. Absence of Sarma during the final stages of publication of the work has facilitated the addition of some spurious content in the name of an epilogue to an otherwise perfect edition of *Yuktibhāṣā*.

Ramasubrahmaniam *et al.* have been overzealous in adding, their published work on *Implied Heliocentric Picture of Planetary Motion*, which is already under challenge, to the monumental work of Sarma. The epilogue as above which presents a speculative interpretation of the computational contrivance of Nīlakaṇṭha's *Tantrasaṅgraha* has no connection with *Yuktibhāṣā* at all. Reference to *Tantrasaṅgraha* at the outset in *Yuktibhāṣā* is only in a general sense to mean the traditional wisdom adapted for his particular epoch and in the discussion on planetary theory, Jyēṣṭhadeva only explains the algorithmic deviation that is incorporated in *Tantrasaṅgraha*. No change in the geocentric epicycle model of planetary motion is discussed. Over enthusiasm for giving reference to *Tantrasaṅgraha* is evident also in Volume I (p. 173), where the original text explains the traditional method of using the avāntarayuga of 576 years in the computation of planetary mean longitudes.

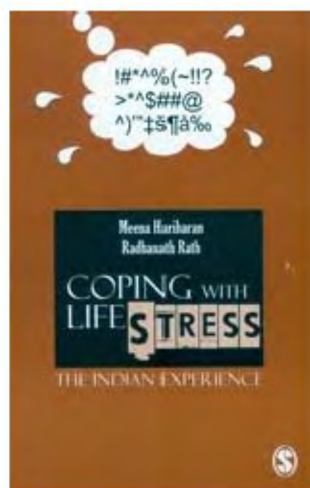
Text of the *Yuktibhāṣā* and the translation by Sarma do not refer to *Tantrasaṅgraha* in the discussion on the avāntarayuga of 576 years (210,389 days). Explanatory notes by Ramasubrahmaniam *et al.* give the impression that the minor period owes its origin to *Tantrasaṅgraha* of Nīlakaṇṭha. In fact, the *Tantrasaṅgraha* dyugāṇa or day-count of 1,577,917,200 could not have given the perfect integer day count of 210,389 days in 576 solar years. The original text and the translation by Sarma are clear in specifying that there will be 'no bhagaṇaśeṣa at the end

of 576 years or 210,389 days'. This is not possible with the *Tantrasaṅgraha* yuga conception of 1,577,917,200 days. Any reference to *Tantrasaṅgraha* is unwarranted as the technique of mean planet computation using Dhījagannūpura (210,389) has its origin with Haridatta (AD 681) in his work *Grahacāranibandhana*. The arithmetic involved is $210,389 \times 7500 = 1,577,917,500$ days of Āryabhaṭa and not 1,577,917,200 days of Nīlakaṇṭha.

It is hoped that the publishers shall do the needful to relieve the great work of K. V. Sarma of the burden of a spurious thesis.

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Coping with Life Stress: The Indian Experience. Meena Hariharan and Radhanath Rath. Sage Publications India Pvt Ltd, B-1/I-1, Mohan Cooperative Industrial Area, Mathura Road, New Delhi 110 004. 2008. 286 pp. Price: Rs 375.

In this book, the authors have not only provided the theoretical underpinning of the phenomenon of stress and coping with it, but through their analysis of several case-reports drive home the fact that there cannot be any single unitary global explanation, as the perception of stress and modalities of coping with it vary across cultures and societies. Their insights into the Indian experience are valuable and highly rewarding.

Modern life for many is not about the process, but 'end results'. It is often characterized as 'the tyranny of ends'. Modern existence is driven by relentless

desire to 'achieve' things and judge ourselves on the basis of what we have 'achieved'. Thus we become prisoners of the 'end result', do not enjoy the process of doing things and turn our lives into a monotonous pursuit of demands and expectations that have a negative effect on our well-being. Modern lifestyles, such as 'workaholism', 'rat race', etc. inexorably ensue from such ruthless chase in life. Often we accept things that are thrust on us. We increasingly tend to do things that we really do not like doing, with a distant goal of achieving something else which others impose on us and which we feel are not worthwhile. The origin of stress can be traced to this incongruity between being able to live our lives and being obsessed by false demands made on our lives that outweigh our capabilities and interests.

Stress is primarily a process of motivation since it requires a form of adaptation or coping with the demand or set of demands in a given situation that concerns the physical, mental and social well-being of the agent. Often stress is associated with such emotions as anger, anticipation or fear, because stress usually accompanies such emotions. Nevertheless, stress by itself, it is not considered a particular emotion.

Ann L. Weber in *Introduction to Psychology* (Harper Collins, New York, 1991) makes a distinction between 'motivation' and 'emotion' by claiming that the former involves a thought process that both brings forth and directs goal-oriented behaviour, whereas the latter includes subjective experiences, and feelings that accompany motivational states.

The critical factor in coping with life stress is that it involves thought processes and evaluation of the situation in which agents or cognizers find themselves. The relevant thought processes and evaluation often lead the agent and the cognizer to decide that the demands of the situation outweigh the skills they have. This in turn induces them to label the situation as 'stressful' and react with a stress response. If they decide that their coping skills outweigh the demands of the situation, then the agent or the cognizer does not perceive it as 'stressful'.

The study of stress and coping with it has evolved as an interdisciplinary research programme encompassing several disciplines, beginning with all areas of psychology such as health psychology, environmental psychology, neuropsychology and developmental psycho-