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The Moonlight of the Essence of Mathematics**

Jérôme Petit

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SÜDASIEN

Pherū, Ṭhakkura: Gaṇitasārakaumudī. The Moonlight of the Essence of Mathematics. Ed. with Introduction, Translation, and Mathematical Commentary by SaKHYa. New Delhi: Manohar 2009. XLVI, 278 S. m. Abb. 4°. Hartbd. 995 Rs. ISBN 978-81-70304-809-8. Bespr. von Jérôme Petit, Paris.

The field of the history of Indian mathematics, developed in the last decades particularly by David Pingree to whose memory the present book is dedicated, is witnessing exciting times. The year 2009 has seen, among others, the publication of Kim Plofker's notable *Mathematics in India*,¹ and the present edition, translation and commentary of Ṭhakkura Pherū's *Gaṇitasārakaumudī* (henceforth GSK). The latter is signed "SaKHYa", Sanskrit for "friendship", an acronym generated by a mathematical permutation (*caturakṣaraprastāra*-) of the initial letters of the four authors' names – as revealed in the preface of Sreeramula Rajeswara Sarma, retired professor of Sanskrit at Aligarh Muslim University. Sarma benefited in 2002 from a semester's stay in Kyoto as a guest professor to join a group of three eminent Japanese professorial historians of science: Takanori Kusuba of Osaka University, Takao Hayaishi of Doshisha University in Kyoto and Michio Yano of

¹ Princeton/Woodstock: Princeton University Press 2009.



Kyoto Sangyo University. For six months these four eminent scholars worked together to complete the full translation of the text. Some years were then needed to complete this very precise and precious work.

After an enlightening introduction (pp. xi–xlvi), the work proceeds in four parts: original text in transcription (pp. 1–41), English translation (pp. 43–94), mathematical commentary (pp. 95–193), and a concordance of the GSK and other works (pp. 195–206). Three useful appendices follow: “The Type Problems” (pp. 208–214), “Index to the Numbers in the Text” (pp. 215–221), and an important “Glossary-index to the Text” (pp. 223–256). A bibliography of primary and secondary sources (pp. 257–265), an index of mathematical terms in English (pp. 267–272), an index of things mentioned in the text (e.g. cloth, camel, pearl, sandstone etc.) (pp. 273–276) and an index of Sanskrit/Prakrit authors and titles (pp. 277–278) close the work.

The GSK is probably the first mathematical work to be written in Apabhraṃśa, a Middle Indo-Aryan language more popular than the elitist Sanskrit at that time. Its author, Ṭhakkura Pherū, was a Jain belonging to the Śrīmāla caste affiliated to the Kharatarā Śvetāmbara sect. He was born around 1270 in Kannānapura, today known as Kaliyana in Haryana state. His family, as often among the Śrīmāla, were bankers and jewellers. The first part of the introduction explains in detail the role played by the Jains in banking and money minting, a role that led them to be linked with the Persianised authorities (Pherū himself was engaged by the Ḥalḡī Sultāns of Delhi as an attaché at the treasury). In fact, the Jains, simply through their activities, were ‘mediators’ between the Islamic and Sanskritic traditions, as SaKHYa point out (p. xiii). Pherū himself was such a mediator, as well as a bridge between an elite and a larger audience by using the Apabhraṃśa language, and between trade and science by composing, apart from a small poem of Jain piety, six scientific works, namely (with Sanskritised titles) on gemmology (*Ratnaparīkṣā*), astronomy (*Jyotiṣasāra*), architecture (*Vāstusāra*), economics (*Dravyaparīkṣā*), chemistry (*Dhātūtpatti*) and mathematics (*Gaṇitasārakaumudī*).

The GSK contains five chapters written mostly in Gāhā (Gāthā) metre, close to the Sanskrit Āryā metre. Chapters 1 to 3 have the traditional structure known from Sanskrit works, but the last two chapters bring supplementary material taken from the own experiences of Pherū and his contemporaries. In order to make the mathematical content of the text accessible, SaKHYa give in the introduction some very clear explanations about the main “characteristic features” that readers will meet with, like proportionate distribution (*pakkhevakaraṇa-*) used in the distribution of interest in a business partnership; weights and measures specially detailed in Pherū’s text (two kinds of *amḡula-*, three kinds of *hattha-*, etc.); the calculation of sum and difference, supposed by Pherū to be already known; reductions of fractions and specially the homogenisation of mixed fractions named here “reduction to the same colour”

(*savanna-*); purchase and sale for which Pherū gives four formulae (buying rate, selling rate, capital, net profit) where the *Gaṇitasāra* of Mahāvīra gives only one; sale of living things, like any other mathematical textbook (here Pherū does not deal with the sale of humans, but uses camels in his example). The influence of the *Triśatikā* of Śrīdhara (eighth century) and of the *Gaṇitasāra* of Mahāvīra (ninth century) is very well highlighted by the four scholars. Pherū adopts sometimes the same formula used by Śrīdhara and Mahāvīra, sometimes he adds some innovations, otherwise some complications, like in the example given about “three lengths of a segment of a circle”, in which the authors ask why he did not rewrite the simple algorithm instead of creating a more complicated one (p. xxviii).

If the GSK uses the frame of Sanskrit mathematical texts, it also includes examples of everyday life, which is one of its major contributions and original features. “The value of the *Gaṇitasārakaumudī* lies, to a large extent, in this supplementary material, which offers us a glimpse into the life of the Delhi-Haryana-Rajasthan region in the early fourteenth century as no other mathematical work does” (p. xvii). This material deals with commercial arithmetic, mathematical riddles, rules for converting dates, or the construction of magic squares. The fourth chapter deals particularly with recreational (and poetical) mathematics by noting problems such as the devotee who offers flowers to a god in a temple with four doors, etc. The fifth chapter entitled *Uddesapaṃcaga* “Quintet of Topics” is probably intended to be a kind of supplement to the earlier chapters. The five topics are: grain, sugarcane juice and oil, regional tax, price and measurement. This chapter is particularly important, as SaKHYa point out, to delineate the history of agriculture and industry in mediaeval India. The data provided by Pherū has been used by historians of economics such as Dashrath Sharma or Irfan Habib for their studies.

See e.g. 5,4–8: “The yield of food-grains is obtained at harvest, from an area of one *vīgaha* of twenty *visuvas*. Know sixty *maṇas* of *koḍrava* grains, twenty-four of kidney beans”; 5,2: “Grain grows everywhere, but because of the quality of the soil, there is much difference [in the yield]. Delhi, Hansi, and Narhad: Know that these are irrigated regions”; about the yield of regional tax, 5,14: “Ten for a she-goat, the same for a cow, twice that for a she-buffalo, and four *vayallas* for a plough. For fire of hearth, the hearth tax, excepting things related to barbers, necklaces and dowry”.

The last two chapters present some problems of vocabulary in using many regional terms (*deśī-*). The author himself exclaims: “Pherū, son of Caṃḍa, speaks of the regional method of writing and counting (*desa-leha-payaḍī*) which is to be observed in transactions for profit in Delhi and in Rajasthan” (4.1, translation p. 75). These terms are explained to the extent of today’s knowledge by referring to the *Hobson-Jobson*,² which is a good idea. It might have

² Henry Yule / Arthur Coke Burnell: *Hobson-Jobson*. A Glossary of Anglo-Indian Colloquial Words and Phrases, and of Kindred Terms, Etymological,

been useful to also give references from Grierson's *Bihar Peasant Life*,³ as the text contains many agricultural terms.

In any case, the translation of the text is as close to the original as possible while remaining readable. The additions in brackets of the author's deliberate omissions (supposed to be known due to the background of the target audience) helps in understanding the text. Then too, the reader can refer to the mathematical commentaries which are very clear and helpful, for specialists as well as for neophytes who might have forgotten their mathematics classes a little. Each problem is literally explained and algorithms are noted in mathematical formulae.

By being relegated to a third part, the commentary allows the translation to express the essence of the original in a concise and living style. The glossary-index of the text is also a tool which is very cleverly made. Excluding pronouns and indeclinables having no mathematical connection, as well as occurrences of *hava-* (Sanskrit $\sqrt{bhū}$ "to be"), it contains words for mathematical topics (such as *saṃkaliya-*), mathematical operations (such as *paḍhama-*), weights and measures (such as *aṅgula-*) and numerical expressions (such as *ikki-*), and words used in connection with the topics in examples (such as *aṃba-*). The etymology of every word (Old, Middle and New Indo-Aryan, and Persian) as well as an English translation are given, which is to be welcomed.

The text itself is a revised version of the Rājasthān Prācyavidyā Pratiṣṭhān edition of Pherū's seven works.⁴ This edition is made from a single manuscript, the only one known containing the GSK, discovered by the Nāh'tās in 1946 at the Śrīmaṇi Jīvan Jain Library in Calcutta. The revisions focus on the mathematical, grammatical and metrical coherence. Corrections are made directly to the text, and the presumed errors of the edition are rejected in footnotes. Sandhi are separated, although they are recorded well, which allows a good readability of the original Apabhraṃśa.

As we can see, nothing is left to chance in this remarkable study: no difficulty is avoided, every element is stated and detailed (see for example the wonderful table of agricultural produce in Apabhraṃśa, Sanskrit, English and Latin, p. 186). SaKHYa offer us a very clear and complete work, like a new foundation stone on which the edifice of the history of Indian mathematics, as well as that of Indian economics, might be firmly raised. The context of the emergence of the text is well highlighted, and we can see how GSK is a proof of the development and popularisation

of mathematics in North India at that time. Pherū's is a kind of manual which would have been widely used especially in the Jain Śrīmāla milieu. We may even speculate that the GSK had fallen into the hands of Banār'sīdās, the Jain merchant of Jaunpur belonging to the Śrīmāla jāti, who says in his New Indo-Aryan⁵ autobiography *Ardh'ka-thānak* of 1641 that he learned arithmetic through such manuals, though he did not give any name. In any case, the lack of manuscripts says nothing on the popularity of the GSK, for this kind of book was not intended to be kept in libraries: such books were mostly used, read and reread by the merchants who were keeping them at hand in order to face all business situations. We are grateful to SaKHYa for having familiarised us with such an everyday object in the life of Indian merchants in mediaeval times.

Historical, Geographical, and Discursive. New edition by William Crooke. London: John Murray 1903.

³ George A. Grierson: *Bihar Peasant Life being a Discursive Catalogue of the Surroundings of the People of that Province*. Patna: Superintendent, Government Printing, Bihar and Orissa ²1926.

⁴ Agar'cand and Bhamvar'lāl Nāh'tā, Jinavijay Muni (eds.): *Thakkur-pherū-viracit ratnaparīkṣādi sapt-granth samgrah*. (Rājasthān Purātan Granth'mālā 44.) Jodhpur: Rājasthān Prācyavidyā Pratiṣṭhān ²1996 (1st ed. 1961).

⁵ It is difficult to classify the language precisely; cf. Ravīndrakumār Jain: *Kavivar banār'sīdās. Jīv'nī aur kṛtīva*. (Jñān'pīṭh Lokoday Granth'mālā 230.) Kal'kattā/Vārāṇasī/Dillī: Bhār'tiya Jñān'pīṭh Prakāśan 1966, pp. 217 f.