The final chapter searched out exact positions of various geographical locations such as, Death Valley and Mount Whitney. The book then ends rather abruptly with no summary or overall conclusions. The course study shows how the students learned critical thinking and investigative techniques but adds more to social history than to astronomical science.

The book covers a wide range of topics and is well referenced with an extended bibliography at the end of each section for further studies. The author avoids technical terminology and is well illustrated so that it may be enjoyed by a wider audience. The text provides contemporary readers with a broad variety of examples of how astronomical events were intimately intertwined in the lives of the people in earlier cultures.

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Gaṇitagannaḍ: *Mirror of Mathematics, An Astronomy Text of 1604 CE in Kannada by Śankaranārāyana Joisaru of Śṛngeri,* translated and with a mathematical analysis by B.S. Shylaja and Seetharama Javagal. (Bengaluru, Navakarnataka Publications, 2021). Pp. iv + 220. ISBN: 978-81-953177-2-1 (paperback), 140 × 210 mm, Rs 315 (India), US$29 (for overseas).

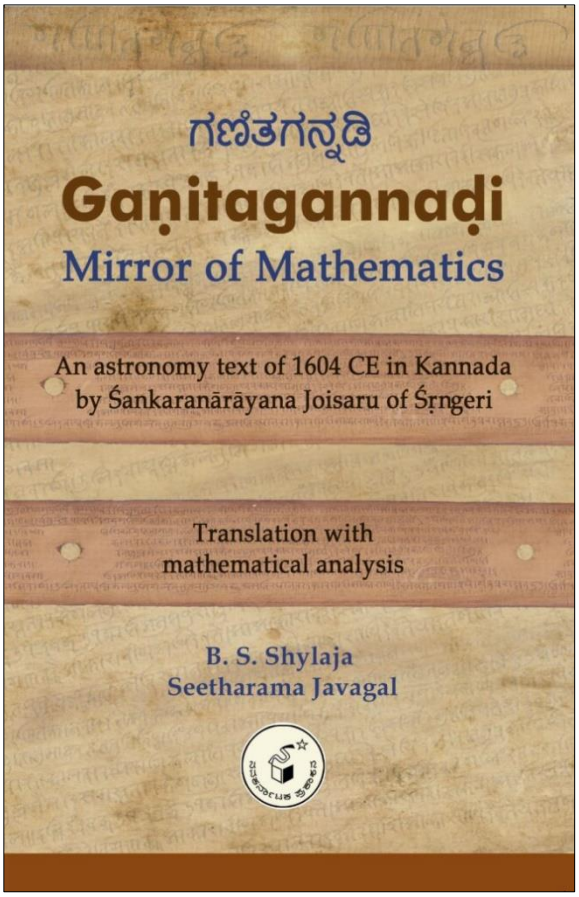
From the fifteenth century onwards there was a great spurt in the preparation of original handbooks (*karanas*) and commentaries on the original *siddhanthas* (canonical works) and even on the handbooks. While the Kerala works on mathematical astronomy from the fourteenth century onwards are now well known, thanks to the dedicated efforts of scholars like the late Professor K.V. Sarma, the contemporary similar output in other languages, such as Telugu and Kannada, is comparatively less known.

The present work under review is a very competent English translation of the learned Kannada commentary (CE 1604) of the original Sanskrit work *Varsikatantra* by Viddanacarya. In the present book, Dr B.S. Shylaja has provided the original *slokas* in Sanskrit along with Sankaranarayana Joisaru's Kannada commentary. She has done a great service to modern science community by providing an explanatory mathematical analysis of the astronomical procedures.

The printed text consists of eight chapters in 220 pages. The English translator has, in appropriate places compared this text with another text *tantra darpana* in Sanskrit. The very first chapter, *dhruvadhikara,* includes the planetary constant parameters and also the computing of the elapsed days since the epoch began (*ahargana*). Furthermore, this chapter elaborates on determining the mean positions of the heavenly bodies.

The *Grahasphutadhikara* provides the detailed procedure for determining the *true* positions of the heavenly bodies. In the case of heavenly bodies (except *Rahu* and *Ketu*), the two major equations applied to their mean positions are (i) *mandaphala* and (ii) *sighraphala*. These two correspond to the equation of the centre and transformation from heliocentric position to geocentric position.

The *Grahanadhikara* discusses the computation of lunar and solar eclipses, and the general procedure of the calculations is explained in detail. One of the key contributions of this text is the chapter on *Parilekha*, the geometrical represent-



ation of eclipses. Dr Shylaja has dwelt on this topic at length by explaining the intricacies of the eclipse diagrams. In fact, the presentation of this topic by the original author shows the importance given to the actual observation of eclipses.

The phenomena of 'Parallel Aspects' called *Vaidhriti* and *Vyatipata* correspond to the equality of the declinations (*Kraanti saamya*). This topic is also explained in detail by Dr Shylaja. The chapter *Yuddha – Samagama* discusses two special phenomena viz., (1) the rising and setting of stars and planets both heliacally and daily, and (2) conjunctions of any two planets with them-

selves or the conjunction of a moving heavenly body with a fixed star.

The final chapter, *Sringonnati*, is about the altitude of the cusp of the Moon. In fact, this topic deals with the calculation of the determination of the phases of the Moon, especially with reference to the cusps of the Moon.

Specialities of the Text

In the third chapter (*Chayadhyaya*) all the computations are based on a single parameter, namely the shadow length. Other quantities are based on *Dyu-nishardha-Karna*, to be obtained daily. This includes *vishuvat-karna* and *vishuvat-chaya*. This clearly demonstrates the importance of actual observations. These traditional astronomers always advocated *drig-ganita-aikya* (i.e., the concordance between observation and computation). The famous Kerala astronomer Paramesvara (1360–1455) rightly advised "Kalaantaretu sam skaraschintyataam ganakottamaih" ("In the course of time, corrections must be thought over by the best among mathematicians.").

Viddanacarya provides a method of obtaining the square root of a number using the expansion of $\sqrt{1-x^2}$. This shows that he was familiar with the binomial series. The occultations and transits are a part of the chapter on *Grahayuti*, although the ancient and medieval astronomers could not have observed the transits of Mercury and Venus before the advent of telescope.

The translators Dr B.S. Shylaja and Sri Seetharam Javagal deserve our hearty congratulations for bringing to light the unique *Ganita-gannadi* text, and the prestigious Nava Karnataka publications deserve our special thanks for popularizing this remarkable astronomical text in Kannada.

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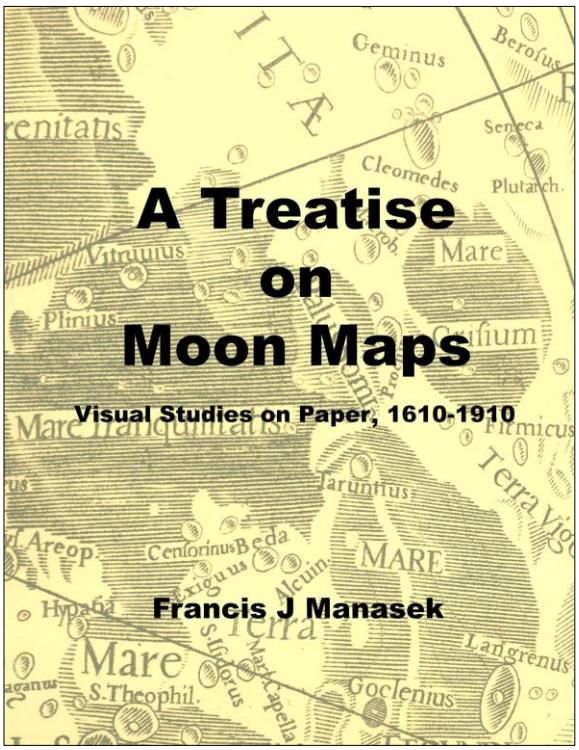
***A Treatise on Moon Maps: Visual Studies on Paper, 1610-1910*, by Francis J. Manasek. (Norwich (Vermont), self-published pdf file, 2022). Pp. xviii + 355. IBSN (PDF) 978-0-578-38675-1. 216 × 279 mm. Free download https://www.mappingthemoon.org/Book.pdf**

This is a truly wonderful book for anyone interested in selenography—especially those of us who grew up in the 1950s, mesmerized by the Moon, nourished by Patrick Moore's *Guide to the Moon* (1953), Willkins' *Our Moon* (1954) and Wilkins and Moore's *The Moon* (1955), and with the first drawings in our brand-new observing books being of lunar craters. In my own case, my second publication ever was "Topographical changes on the lunar surface", which not only included unpublished information kindly supplied by Patrick Moore but also my first drawing of Messier and Pickering (Orchiston, 1964).

So the chance discovery of Frank Manasek's self-published free 373-page e-book was a special surprise. In his "Author's Prolusion" Frank explains that his book is partly

> … an outgrowth of decades of scrutinizing Moon maps and viewing them as prime sources of data rather than as images part of a long temporal sequence. I also drew upon my familiarity with the appearance and production of early terrestrial maps, as well as an interest in printed images … (page xiii).



This explains one of the features of this book that particularly appeals to me: after an Introduction the inclusion of a chapter on "Printing Images on Paper', that discusses the evolution of the printing process from about 1600 to 1900, as it applied to maps. Thus, we are introduced to woodblock printing, etching, engraving and various kinds of lithography, and

> An understanding of the distinct images produced by each process will enable us to understand the methods of Moon map production and, importantly, the visual consequences of technique. (page 20).

The following 13 pages provide details of these techniques, along with the limitations each imposed when astronomers tried to produce realistic-looking depictions of different lunar surface feat-