The ‘Zij Muhammad Shahi’ is a set of astronomical tables prepared under the direction of Jai Singh II and named after the Emperor, Muhammad Shah.

There exists a complete manuscript in Persian in the British Museum.

The following is from a translation of the preface drawn from G R Kaye’s “A Guide to the Observatories at Delhi, Jaipur, Ujjain, Benares” published by the Archaeological Society of Calcutta in 1920.

Praise be to God, such that the minutely discerning genius of the profoundest geometers in uttering the smallest particle of it, may open the mouth in confession of inability; and such adoration, that the study and accuracy of astronomers who measure the heavens, on the first step towards expressing it may acknowledge the astonishment and utter insufficiency. Let us devote ourselves at the altar of the King of Kings – hallowed be his name – in the book of the register of whose power and lofty orbs of heaven are only a few leaves; and the stars and that heavenly courser the sun, a small piece of money in the treasury of the empire of the Most High.

If He had not adorned the pages of the table of the climates of earth with the lines of rivers, and the characters of grasses and trees, no calculator could
have constructed the almanac of the various kinds of seed and of fruit which it contains. And if He had not enlightened the dark path of the elements with the torches of the fixed stars, the planets and the resplendent sun and moon, how could it have been possible to arrive at the end of our wishes, or to escape from the labyrinth and the precipices of ignorance?

From inability to comprehend the all encompassing beneficence of His power, Hipparchus is an ignorant clown, who wrings the hands of vexation; and in the contemplation of His Exalted Majesty, Ptolemy is a bat, who can never arrive at the sun of truth: the demonstrations of Euclid are an imperfect sketch of the forms of His contrivance; and thousands of Jamshid Kashi or Nasir Tusi in this attempt would labour in vain.

But since the well-wisher of the works of creation and the admiring spectator of the theatre of infinite wisdom and providence, Sawai Jai Singh, from the first dawning of reason in his mind and during its progress towards maturity, was entirely devoted to the study of mathematical science, and the bent of his mind was constantly directed to the solution of its most difficult problems; by the aid of the Supreme Artificer he obtained a thorough knowledge of its principle and rules.

He found that the calculation of the places of the stars as obtained from the tables in common use, such as the new tables of S’aid Gurgani and Khaqani and the Tasahilat-Mula Chand Akbar Shahi and the Hindu books and the European tables, in very many cases give them widely different to those determined by observation: especially in the appearance of the new moons, the computation does not agree with observation.

Seeing that very important affairs both regarding religion and the administration of empire depend upon these; and that in the time of the rising and setting of the planets, and the seasons of the eclipses of the sun and moon, many considerable disagreements of a similar nature were found – he represented it to His Majesty of dignity and power, the sun of the firmament of felicity and dominion, the splendour of the forehead of imperial magnificence, the unrivalled pearl of the sea of sovereignty, the incomparably brightest star of the heaven of empire, whose standard is the sun, whose retinue the moon, whose lance is Mars and whose pen is Mercury, with attendants like Venus, whose threshold is the sky, whose signet is Jupiter, whose sentinel is Saturn – the Emperor descended from a long race of kings, an Alexander in dignity, the shadow of God, the victorious king Muhammad Shah: May he be ever triumphant in battle.

He was pleased to reply, “Since you, who are leaned in the mysteries of science, have a perfect knowledge of this matter, having assembled the astronomers and geometricians of the faith of Islam, and the Brahmans and Pandits, and the astronomers of Europe and having prepared all the apparatus of an observatory, do you so labour for the ascertaining of the point in question, that the disagreement between the calculated times of those
phenomena and the times which they are observed to happen, may be rectified.”

Although this was a mighty task, which during a long period of time none of the powerful Rajas had prosecuted: nor among the tribes of Islam, since the time of the martyr prince, whose sins are forgiven, Mirza Ulugh Beg, to the present, which comprehends a period of more than three hundred years, had any one of the kings possessed of power and dignity turned his attention to this object. Yet to accomplish the exalted command he had received, he bound the girdle of resolution about the loins of his soul and constructed here several of the instruments of an observatory such as had been erected at Samakand, agreeable to the Mussalman books, such as Zat-al Halqa, of brass, in diameter three gaz of the measure now in use, and Zat al-Sha batain, and Sads Fakhri and Shamalah.

But finding the brass instruments did not come up to the ideas which he had formed of accuracy, because of the smallness of their size, the want of divisions into minutes, the shaking and wearing of their axes, the displacement of the centres of the circles, and the shifting of the planes of the instruments, he concluded that the reason why the determinations of the ancients such as Hipparchus and Ptolemy, proved inaccurate, must have been of this kind.

Therefore he constructed in Dar al-Khalafat Shah Jahanabad, which is the seat of empire and prosperity, instruments of his own invention, such as Jai Prakas and Ram Yantra and Samrat Yantra, the semi-diameter of which is of eighteen cubits and one minute on it is a barley corn and a half – of stone and lime of perfect stability, with attention to the rules of geometry and adjustment to the meridian and to the latitude of the place and with care in the measuring and fixing of them, so that the inaccuracies from the shaking of the circles and the wearing of their axes and displacement of their centres and the inequality of the minutes might be corrected. Thus an accurate method of constructing an observatory was established and the difference which had existed between the computed and observed places of the fixed stars and planets by means of observing their mean motions, was removed.

And in order to confirm the truth of these observations, he constructed instruments of the same kind in Sawai Jaipur, Muttra and Benares and Ujjain. When he compared these observations, after allowing for the difference of longitude between the places where they stood, the observations agreed. Hence he determined to erect similar observatories in other large cities so that every person who is devoted to these studies, whenever he wished to ascertain the place of a star or the relative situation of one star to another might, by these instruments, observe the phenomena.

But seeing that it is in many cases necessary to determine past or future phenomena; and that also in the instant of their occurrence cloud or rain may prevent the observation - or the power and opportunity of access to an observatory may be wanting - he deemed it necessary that a table be
constructed by means of which the daily places of the stars being calculated every year and disposed in a calendar may always be in readiness.

In the same manner as the geometers and astronomers of antiquity bestowed many years on the practices of observation – thus for the establishment of a certain method, after having constructed these instruments, the places of stars were daily observed.

After seven years had been spent in this employment information was received that about this time observatories had been constructed in Europe and that the learned of that country were employed in the prosecution of this important work: that the business of the observatory was still carrying on there and that they were constantly labouring to determine with accuracy the subtleties of this science.

For this reason, having sent to that country several skilful persons along with Padre Manuel, and having procured the new tables which had been constructed there thirty years before and published under the name Lir, as well as the Europe tables anterior to those; on examining and comparing the calculations of these tables with actual observations it appeared that there was an error in the former of assigning the moon’s place of half a degree. Although the error in the other planets was not so great, yet the times of solar and lunar eclipses he found to come out later or earlier that the truth by the fourth part of a ghati or fifteen palas. Hence he concluded that, since in Europe astronomical instruments have not been constructed of such size and so large diameters, the motions which have been observed with them may have deviated a little from the truth.

Since in this place by the aid of the unerring Artificer astronomical instruments have been constructed with all the accuracy that the heart can desire and the motions of the stars have for a long period been constantly observed with them, agreeable to observations mean motions and equations were established; he found the calculation to agree perfectly with the observation. And although to this day the business of the observatory is carried on, a table, under the name of His Majesty, the shadow of God, comprehending the most accurate rules, and most perfect methods of computation was constructed – so that, when the places of the stars and appearance of the new moons and the eclipse of the sun and the moon and the conjunction of the heavenly bodies are computed by it, they may arrive as nearly as possible at the truth, which in fact, is every day seen and confirmed at the observatory.

It therefore behoveth those who excel in this art, in return for so great a benefit, to offer up their prayers for the long continuance of the power and the prosperity of so good a King, the safeguard of the earth, and thus obtain for themselves a blessing in both worlds.
Notes

1 Jamshid was one of Ulugh Beg’s astronomers
2 Nasir al-Din al-Tusi born AD 1201 worked at Maragha Observatory (in Azerbaijan) and published the Ilkhanic Tables. He translated both Ptolemy’s Almagest and Euclid’s Elements into Arabic.
3 Probably a reference to Ulugh Beg’s tables which were sometimes referred to as the Gurgani
4 Khakani was an astronomer (died AD 1038) who worked on improving the astronomical tables
5 An Astrologer skilled in the use of the Astrolabe and the constructing of almanacs. He cast the Horoscope of Jahangir Khan in AD 1570
6 He was deputed to be at the portals of the cupola of chastity in order that he might observe the happy time and ascertain exactly the period of birth of Akbar, the greatest ruler in Indian history. His reign was from 1556 to 1605
7 Probably a reference to La Hire’s Tabulae Astronomicae and to Flamsteed’s Historia Coelestis Britannica
8 Muhammad Shah reigned from 1719 to 1748
9 Ulugh Beg, grandson of Tamerlane, set up the observatory at Samarkand and published a set of astronomical tables superseding all previous. He was assassinated in 1449, 297 years before the publication of the Zij Muhammad Shahi
10 A ring instrument
11 3 gaz = 9 feet
12 An astrolabe with two rings or parts
13 The Shashtamsa Yantra an arc of 60 degrees placed in the meridian
14 The Jai Prakas Yantra
15 Delhi
16 This shows that the Dehli observatory was completed and put to use before the others were started and all were built before the preface was written placing its publication no earlier than 1734
17 As far as is known this was never carried out
18 Probably the Reverend Father Figueredo, a Portuguese Jesuit went to Europe on the orders of Jai Singh in 1728 or 1729
19 La Hire’s Tabulae Astronomicae
20 Six minutes