Account of Three Mathematical Works of Tufuzzool Hoosyn Khan [Tafazzul Husain Khan], Deceased

Drawn up by Mowluwee Hydur ‘Ulee [Maulvi Haidar ‘Ali][1]

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Translated by Adib Masumian, August 2021
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All paragraph breaks were added by the present translator; no such breaks occur in the original text

All footnotes and bracketed additions are likewise the present translator’s

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[pages 1–2, line 2]

The Accounts of the Books of the Late Tafazzul Husain Khan

Given with praise, supplication, and submission

Let it not be hidden and veiled from the possessors of virtue and sagacity, or the people of practice and knowledge, that that noble dweller of Paradise, the late Maulvi Tafazzul Husain Khan, was exceedingly proficient and superior in the sciences of philosophy—especially in the discipline of mathematics, and in particular geometry, astronomy, and their ancillary subjects, such as algebra—and that he excelled the most skilled contenders in the arena of these sciences. Indeed, he hoisted a standard unmatched and unrivaled in this challenging field. Among the books written by that peerless one of his era is a work on the astronomy of Western philosophers, in which he, through the use of numerous lines of reasoning, such instruments as telescopes and other means, and countless proofs, has rectified the views of some of the ancients,[2] who believed in the daily rotation of the earth on its axis—views which the philosopher Ptolemy refined in his *Almagest*, as have his successors more recently in other books.

[1] These works were originally written by Tafazzul Husain Khan in Arabic, and then translated into Persian by Maulvi Haidar ‘Ali. The present translation is based primarily on Haidar ‘Ali’s Persian rendering.
[2] For instance, Aristarchus of Samos.

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They have recorded the transition from day to night, along with the other visible byproducts of this daily movement, [meaning] the rotation of Earth on its axis; its yearly orbit around the sun over the course of 365 days, 6 hours, 56 minutes, and 4 seconds; and the other movements of the planets, which will be discussed below. Through these two movements, it is independent of the first, which is the ninth firmament,[3] and also the sixth, which is the orbit of the Sun. From this elucidation, moreover, it became necessary to reject these two orbits, since the proving philosophers have established the [true] orbits of the heavenly bodies by observing their movements, and this has settled the matter decisively. This astronomy is very different from the one that is known and prevalent in this land, and which is widely read and current in these times and cities.

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It is especially different from the observational astronomy of the latter-day astronomers, and both categories will be unveiled for the reader. Two other works from that scholar of his age deal with algebra, in which he has solved numerical and geometrical problems with algebraic and geometric proofs, lifting the veil of concealment from the faces of the pure thoughts of those epoch-making philosophers.

> With every point he makes, a garden grows
> More radiant than the moon, his brilliance glows
> His words are fresh as youthfulness itself
> His meaning like the living fountain flows[4]

Each of these two mighty trees is truly a masterwork[5]—nay, they are wooded gardens nourished to the utmost with water, gardens of consummate delicacy, succulence, and verdure.

[3] Equivalent to the "crystalline sphere" of Greek astronomical taxonomy, the ninth firmament denoted the greatest extent of the universe in Islamic astronomy.
[4] A quatrain, rendered by the present translator, which appears in Husain Vá'ez Káshefí's *Anvár-i-Suhaylí*, a recasting of *Kalila and Demna* into modern Persian; see here. The first two lines seem to be borrowed from part four of Nizámí Ganjaví's *Laylí and Majnún*; refer to line 21 here.
[5] This word appears to have been written as میاده (*míyádeh*) or میاوه (*míyáveh*), neither of which seems to have any known meaning in Persian. Alternatively, it is possible that the intended word was سیاده (*síyádeh*), meaning "lordship," and it is on the basis of the semantic range which proceeds from that word that "masterwork" was chosen to render it.

It well befits that deathless poet
Anthologist of Paradise
To trace his words with ink jet-black
Upon the whites of maidens' eyes[6]

However, when that great denizen of heaven clothed all three of those meaningful works with the black garments of "rough-copyhood"—and before they were attired with the distinguished white robe of "clean-copyhood,"

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and made to appear in the exhibiting-place of instruction and dissemination arrayed with the vesture of correction[7]—he packed up the gear of his transient life in this ephemeral world, and left behind all three of those precious maidens[8] clad in those same black garments of bereavement. It is thus that the soaring bird of the thoughts of discerning men have failed to approach the bough of their foundational principles, and the royal palace of their objectives, sweet as the mouth of the beloved, has not reached the sugar-craving palates of the seekers of knowledge, whether high or low. At this auspicious time, and in accordance with the virtue-refining view of those distinguished *Sáhibs*[9]—who have always devoted themselves to the fostering of goodness, the spreading of excellence, the promotion of every kind of art, and the promulgation of every sort of science—it was deemed advisable to send all three of those written works from the city of Lucknow, where they were with Tajammul Husain Khan, a son truly worthy of his father.

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The present author requested all three of those books, each of which holds the status of a gem, through the head secretary of the exalted office of Maulvi Mirza Kazim ʿAli Sahib, who tasked the writer of these lines with composing a work on some of the truths of the matter to confirm and discuss a number of the subjects in all three of those documents cherished by the people of learning and excellence. Thus, as directed, the present author has translated a small sample from the plentiful treasuries of each book—a mere fraction of their full vastness—into the Persian language, so that anyone may understand their contents and

[6] Perhaps an original composition by the author, rendered by the present translator.
[7] It seems to the present translator that the author is referring figuratively to the process of composition, revision, and publication which Tafazzul Husain Khan's three works underwent, from the initial, smudge-ridden rough drafts (hence, blackness), to clean copies purged of those smudges (hence, whiteness), to corrected versions of those drafts, and finally to the point where they became suitable for public use.
[8] A figurative reference to the aforementioned three works of Tafazzul Husain Khan. The original word is *mukhaddarát*, literally "women behind the veil," meaning chaste and virtuous women.
[9] A title of courtesy used for men in certain parts of South Asia.

obtain a cursory knowledge thereof. *It is through him [God] that protection from shortcomings, errors, [and?] idle talk can be successfully achieved.*[10]

* * *

I begin the composition of this book in the name of that God

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who is the God of supreme mercy and of beneficence. It is through your unseen kindness that we seek to be guarded from the gaze of others and protected from error, O most generous one, the Lord of abundant bounty!

The first part of this book consists of several sections which explain the movements of the heavenly bodies, and included therein are a number of chapters. The first chapter briefly discusses the solar system. The solar system comprises a group of celestial bodies that include multiple planets, which will be mentioned in the first section.

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The first section pertains to the solar system, which consists of several heavenly bodies; these are the sun and six planets, which make up the first category: first, Mercury; second, Venus; third, Earth; fourth, Mars; fifth, Jupiter; and sixth, Saturn. There are also ten planets which belong to the second category. One of these is Earth's moon, along with the four moons of Jupiter and the five moons of Saturn.

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This is an explanation of the solar system, and in this system, according to the view of the philosopher Copernicus, there are six planets which make up the first category and rotate on their axes. They also perform another movement, [this one] around the sun, from the west to the east. #And there are ten other planets which fall into a second category and move in orbits around their corresponding planets from the first category—that is, Earth, Jupiter, and Saturn—from the west to the east, each at a unique distance [from their corresponding planet] and orbital frequency.

[10] This sentence was originally written (not entirely coherently) in Arabic and rendered by the present translator with the help of Abir Majid. From this point forward, the author reproduces a series of passages from the books of Tafazzul Husain Khan in the original Arabic, and then immediately follows each of these quotes with his corresponding translation into Persian. In all these cases, the present translation into English is based primarily on the author's Persian renderings, rather than the original Arabic texts, and some of the translated pages from here on out will seem shorter than the preceding ones as a result.

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According to this view of Copernicus, the sun, depicted with this symbol ☉ , lies at the center of this system. The first planet, ☿ , which is Mercury; the second, ♀ , which is Venus; the third, ⊕ , which is Earth;

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the fourth, ♂, which is Mars; the fifth, ♃ , which is Jupiter; and the sixth, ♄ , which is Saturn, move along elliptical orbits around the sun. One of the planets in the second category, ☽ , which is the Moon, revolves around Earth, and the four moons of Jupiter and the five moons of Saturn revolve around Jupiter and Saturn [respectively]. These are planets which belong to the first category, and their orbital planes intersect with each other. This view has resulted in correction. As you will soon come to know, all the visible movements, as well as the other incidental phenomena associated with the heavens—all these laws are discussed below in the subsequent chapters. *Thus ends the fundamental explanation*.[11]

Know that, as a result of this view, it became necessary to discard the other firmaments,[12] major and minor alike, *and this is not concealed from the one who is proficient in the science of astronomy*.[13] And this appears as a circle:[14]

[11] This sentence was originally written in Arabic.
[12] A reference to the nine firmaments of Islamic astronomy that were thought as being surfaces at progressive distances in the sky from one another.
[13] The italicized portion of this sentence was originally written in Arabic.
[14] The circle being the face of a sphere.

[pages 11–12, unnumbered in the original text]

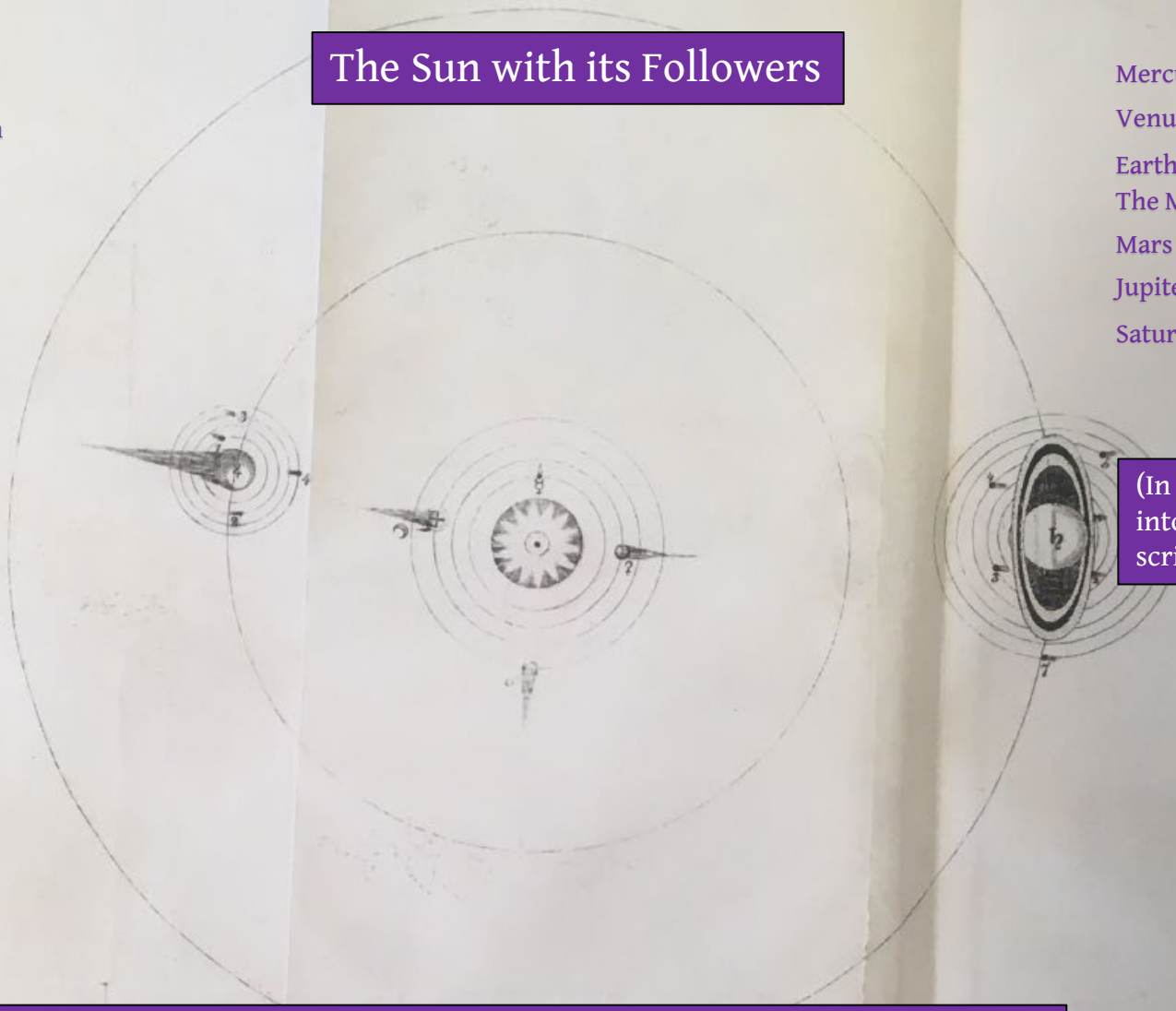
The Sun with its Followers

☿ عطارد	Mercury
♀ زهرہ	Venus
⊕ ارض	Earth
☽ قمر	The Moon
♂ مریخ	Mars
♃ مشتری	Jupiter
♄ زحل	Saturn

(In Arabic, but also applicable to Persian)

Mercury	بُدھ	☿
Venus	شُکر	♀
Earth	بھوم	⊕
The Moon	چاند	☽
Mars	منگل	♂
Jupiter	برہسپت	♃
Saturn	سنی	♄

(In Sanskrit, rendered into the Perso-Arabic script)



The solar system as arranged by the philosopher Copernicus

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The second chapter gives an explanation of Earth,

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and in this chapter there are several sections. The first section deals with the spherical shape of Earth, the daily rotation of Earth on its axis, the other visible byproducts of Earth's roundness, and the aforementioned movement.

The first matter: Earth is spherical in shape for four reasons. The first reason is that the shadow cast by Earth onto the Moon during lunar eclipses is always round, notwithstanding the differences between the times of those eclipses, and regardless of their duration or where they are observed on earth, [whether] in the east or in the west. This would not be possible were it not for the spherical shape of Earth. The second reason is the convex appearance of the surface of water [over the horizon], since the tips of ships' masts can be seen before ships' surfaces, and this is solely because

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the convex surface of water prevents [one from] seeing the lower portions [of the ship]. If the surface of water were level, the [ships'] masts and surfaces would both strike the eye at the same time, and since the convex surface of water has been proven, the roundness of Earth must be necessarily inferred therefrom. The third reason is that, as one moves toward the North Pole, the latitude gradually increases based on the distance that has been traversed. This, too, would be impossible without a spherical shape, because if the surface of Earth were flat, its latitude would be perceived as uniform regardless of one's location. The fourth reason is that sailors have sailed around the world numerous times, and this is impossible to do without Earth's roundness.

A translation of one of two books on algebra

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I begin this book in the name of the one [God] who is sanctified and pure.

The first path describes the signs of algebra, and an explanation of the symbols which are used within the context of this technique are as follows.

Algebra is a technique that explains the relationships that exist between abstract numbers, and

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also the way comparisons can be made between these numbers in a manner that makes it easy to solve those problems which are not possible to solve with the common kind of mathematics known by the name of arithmetic.

Changes from numbers and values are not depicted in this technique with the forms of those numbers and values which are well known, nor with those symbols

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which are specific to them. Rather, every number and value indicates that it is either known or unknown, and is expressed through certain letters of the alphabet. Thus, known numbers and known values are represented by some letters which occur at the beginning of the alphabet, such as the ones written firstly in the alphabet [a, b, c],[15] while those numbers and values which are unknown and sought are represented by some letters which occur at the end of the alphabet, such as the ones written secondly in the alphabet [x, y, z].[16]

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Also used in this technique are certain symbols which describe the relationships that reveal the connections between numbers and values. It would be appropriate for the intended purposes and meanings of these symbols to be introduced, lest the reader of this technique be confused by the inclusion of something from among these symbols in the course of the [ensuing] discussion of [mathematical] problems.

The translation of this book up to this point will suffice, so as not to prolong the text. Furthermore, these symbols will be clarified presently in the translation of the third book.

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The first of the two objectives of this book pertains to numerical problems and their algebraic operation, while the second—which will be discussed after the conclusion of this

[15] The author includes these letters in his reproduction of the original Arabic text, but not in his Persian rendering of that text; they have been inserted here by the present translator.
[16] See the preceding footnote.

objective—deals with geometrical problems and their solutions.[17] The first problem is as follows:

We want to find the number which, when doubled and increased by 16, equals a total of 188. To solve this problem, the number being sought must be equal to *x*. It follows that the doubling thereof

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will be equivalent to 2*x*. When 16 is added to 2*x*, it will equal 188, as is stipulated in the problem [2x + 16 = 188]. When we remove 16 from both sides of the equation, what will be left is 2*x* = 188, and when 16 is subtracted from this, it equals 172 [2x = 188 - 16 = 172]. What will remain is *x* equals the quotient of 172 ÷ 2 , which is 86. *Thus ends the fundamental explanation*.[18] Hence, 86 is the number which became 172 when doubled, and then 188 when 16 was added to it, and it is this very number that was being sought.

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The second problem is as follows:

We want to find the number which, when added to 56, will equal the triple of the number being sought. To solve this problem, the sought number must be equal to *x*. It follows that the tripling thereof will necessarily be equivalent to 3*x*, and that 3x will be equal to *x* + 56, according to the question which has been posed [3x = x + 56]. Thus, when we remove *x* from both sides [of the equation], what will remain is

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2*x* = 56. And when we divide 56 by 2, the result will be a quotient of 28 which equals *x*. Hence, it is this same number, 28, that was being sought. *Thus ends the fundamental explanation*.[19] And when we add 28 to 56, the result is 84, which is the triple of 28.

[17] This second objective on geometrical problems and solutions appears not to be included in Maulvi Haidar 'Ali's account.
[18] This sentence was originally written in Arabic.
[19] This sentence was originally written in Arabic.