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KUSHYAR IBN LABBAN, *Al-zif al-jami wa-l-baligh* ("The comprehensive and extensive tables")
[Astronomical handbook]
In Arabic in Hebrew characters [Yemenite style], manuscript on paper
[San'a, dated 1499]

iii + 128 + iii, complete (collation: original medieval collation impossible to determine because original quires unbound during modern rebinding), paper size 235 x 165 mm, f. 6 is a singleton (186 x 120 mm), no watermarks, modern foliation in Arabic numerals on upper left fore edge recto side in pencil, medieval foliation on verso side, lower left spine edge in black ink on ff. 1v-24v and 85v-117v, written black ink, table rulings, diagrams, and headings in rubric, single column text throughout (justification 170 x 110 mm), text columns unruled, 24 lines per page, marginalia in rubric and black ink, OVER ONE HUNDRED LARGE ASTRONOMICAL TABLES in rubric and black ink on ff. 25v-82r (justification 167 x 112 mm), SEVENTY-SEVEN GEOMETRIC CALCULATIONS in rubric and black ink on ff. 83r, 86v-91v, 92v-94v, 95v-96v, 97v, 99v-106r, and 109v, TWENTY-ONE CALCULATION TABLES in rubric and black ink on ff. 1r, 82v, 118v-119r, 125v-126r, 127v, and 128v, medium rubricated initial in Arabic on f. 25r (50 x 122 mm), medium illustrated scale in rubric and black ink (100 x 110 mm), text moderately to severely worn on ff. 119v, 126v-128v, marginalia severely worn on ff. 15r, 22r, 20v-21r, 28v, 29r, and 80r, a few insignificant ink smudges not affecting text, worming on ff. 1-8, 22-24, 105-121, chipped edges on ff. 1-16, 9-10, 22-23, extensive chipping and minor soiling to fore and bottom edge of margins on ff. 115-128, minor to moderate paper creasing on ff. 1-22, 31-39, 105-107, slight damp staining and foxing on margins throughout, minor mildew staining on upper and fore edges, small holes in paper on ff. 83 and 126 not affecting text, modern paper affixed tags with text on ff. 31v, 35v, and 41v, small modern paper repairs with text corrections on ff. 33v-34r and 35v, modern paper repairs to writing space and margins on ff. 23, 39v, 107-9, 119, and 127-128, extensive modern paper repairs in upper margin affecting text and illustrations on ff. 110-119, mottled blue ink staining on front, upper, and lower fore edges of paper. Bound in modern brown leather over sturdy cardboard, stamped gilded library catalogue information and ornamentation on spine and front cover, ex libris stamp in brown ink on f. 1r, first front and rear flyleaves are modern maroon cloth that are also used as pastedowns, inner flyleaves are modern paper. Dimensions 243 x 180 mm.

By an important Persian astronomer and mathematician, this early and little-studied astronomical handbook survives in only nine Arabic-letter copies and four Hebrew-letter copies, of which this one is among the most interesting. Contemporary notes in the manuscript claim that it is based upon Kushyâr's own autograph, and it contains the complete tables (absent in many of the extant copies), which advance Ptolemaic astronomy and evidently anticipate other astronomer's methods some five centuries later. There is no modern critical edition.

PROVENANCE:

1. Written in Yemen (San'a) in 1499, dated by colophon. San'a is an ancient Yemeni city dating back to the sixth century B.C., and after being the capital of the Ethiopian viceroys, it became in 570 the capital of the Persians. The present manuscript dates before the arrival of the Mamelukes in 1517. Yemen supported a robust community of Jews, the only non-Muslim minority.
2. Rabbi Yosef Kapach Kafah (born in San'a [Yemen] 1917; died 1999 in Jerusalem), the leading scholar of the Yemenite community in Jerusalem, fluent in Arabic and Hebrew, and the foremost scholar on Maimonides whose Mishnah Torah he reissued in 24 volumes. Rav Kapach's grandfather, Rabbi Yehiah, had an extraordinary library, which Rav Kapach brought to Israel and enhanced. It is said "these ancient manuscripts were collected from travelers or found in the graveyards of San'a. It had been common to place torn books and pages of holy works in ceramic jars and bury them in the cemetery. Whenever there were heavy rains, the young Kapach would go exploring in the graveyard, often returning with the contents of broken jugs—singular remains of forgotten halachic works."

TEXT

There are a considerable number of short notices and fragmentary texts on the front and back pages, and on ff. 83-85 as well. All of these, like the *zij* of Kushyâr, are in Arabic, written out in Hebrew characters. The two fragmentary texts are:

ff. 1-119, Kushyâr ibn Labbân, *al-Zîj al-Jâmi*, tables and instructions for their use in computing the positions of the planets and obtaining other astronomical information (the tables start on f. 84).

ff. 119b-120a, The beginning of a treatise on twilight. The author mentions Ibn Mu'âdh and Abu Abd al-Rahmân bin Tâhir, both of whom also wrote on the subject.

ff. 120b-125b, Fragment of a rather extensive, unidentified work on arithmetic, divided in *maqâla*, *bâb*, and *fasl*. The pages in the present manuscript cover II.2.8--II.7.1. Kushyâr wrote two books on arithmetic, both of them rare, but there is no proof that he is the author of the text partially preserved here.

The body of the manuscript consists of a copy of the *al-Zîj al-Jâmi*, an astronomical handbook written by the tenth century astronomer and mathematician Kushyâr ibn Labbân (fl. c. 1000, died 1029), in Arabic, but using the Hebrew alphabet and copied in San'a. This book was popular among the Jews of Yemen, and there are three other copies transcribed into Hebrew characters, all of them Yemeni (identified by Langermann, 1996, p. 151). Arabic-speaking Jews copied out many, many Arabic books on science, philosophy, and other subjects into the Hebrew alphabet.

Sezgin lists nine Arabic-letter manuscripts of the *al-Zîj al-Jâmi*, most of them incomplete. The present manuscript is not complete; it lacks the definitions of astronomical terms that are found at the beginning of some copies, and it is also missing the third of the four sections into which the treatise is divided. On the other hand, this copy has the full set of astronomical tables (Brummelen cites only 4 Arabic-letter manuscripts that possess the complete tables, 1998, p. 266). It is by far

the most complete of the Hebrew-letter copies, and, in fact, it appears to be one of the most interesting of all known copies of this early and as yet little-studied zij. Attention should be drawn in particular to the notes on ff. 82v and 119r, which indicate that this copy was prepared from a manuscript that was based upon Kushyâr's own autograph. Moreover, the front and back matter, as well some of the marginalia, contain valuable technical comments.

Brummelen has recently studied the *al-Zîj al-Jâmi*, placing it in the context of early Islamic astronomy, in particular the paradigm established by Ptolemy's *Almagest*. Composed C.E. 150 and known in the Islamic world from the ninth century, the *Almagest* was the most important source of ancient Greek astronomy, and it provided the foundations for Islamic astronomy. Five zijes mostly from around A.D. 1000 are based on al-Battani's zij, itself following the *Almagest* methods almost to the letter. Kushyâr's *al-Zîj al-Jâmi* is one of these. Brummelen systematically examines for the first time the tables of planetary motion, showing how Kushyâr's method "anticipates other astronomer's techniques five centuries later" (p. 266). He concludes that while the tables contain much that derives from their predecessors, "his [Kushyâr's] use of displacement and shift, possibly his use of a different parameter for Mars, and particularly his ingenious new interpolation scheme for tabulating the double argument equation of anomaly, reveal that he was no mere copyist. His restructuring of the planetary motion tables significantly simplified the process of determining a planet's longitude at a given time, long before others made similar attempts." (p. 279).

Kushyâr ibn Labban (or Abu-l-Hasan Kushayr ibn Labban ibn Bashahri al-Jili) was a Persian mathematician, geographer, and astronomer from Jilan (Gilan), south of the Caspian Sea in Iran, who was influenced by al-Battani (died 929, influenced Copernicus). Completed in the beginning of the eleventh century, his main work was an elaboration of trigonometry, for which he continued the investigations of Abul Wafa, and devoted much space to this in his *Al-zif al-jami*, which was translated into Persian before the end of the eleventh century. He also wrote an astrological introduction and an arithmetic treatise (extant in Hebrew, but rare). His most significant work is on Hindu reckoning, because it is the earliest known work on Arabic arithmetic, which deals with Hindu numerals and was written c. 1000 A.D. He was the teacher of Ahmad Nasawi and is thought to have died in Baghdad.

The more noteworthy of the shorter pieces (from among those which do not refer to Kushyâr's zij) are the following:

f. 1r, a note on the Milky Way (*al-majarra*);

f. 1r, a short passage copied from al-Zîj al-Hâkimi of Ibn Yûnus (tenth century);

f. 83v, a short passage on stati Kafah cs, including a picture of the balance (*al-qarastûn*);

f. 84r-84v, a long note on the dateline (or, in their terms, the possibility that the same instant could be Thursday for one person and Friday for another, for example);

84v, a short passage on finding hidden things, by Muhammad bin Aflah al-Khâzarûnî;

85r, two short items attributed to "Timaeus," that is, to Plato;

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<http://faculty.kfupm.edu.sa/phys/alshukri/PHYS215/Islamic%20astronomy.htm>

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