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# A Medieval Islamic Astrolabe with Hebrew Inscriptions in Verona

*The Seventeenth-Century Collection of Ludovico Moscardo*

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## Abstract

This article presents a hitherto unknown remarkable astrolabe from Al-Andalus which likely belonged to the collection of Ludovico Moscardo (1611–1681) assembled in Verona in the seventeenth century. The astrolabe is datable to the eleventh century and features added Hebrew and Latin inscriptions. It underwent many modifications, additions, and adaptations as it changed hands and owners over time thus becoming a palimpsest object. With its added translations from Arabic into Hebrew, the astrolabe closely recalls the recommendations prescribed by the Spanish Jewish polymath Abraham Ibn Ezra (1089–1167) in the earliest surviving treatise on the astrolabe in the Hebrew language written in 1146 precisely in Verona. The astrolabe—today preserved in the Fondazione Museo Miniscalchi-Erizzo—stands out as a testimony to the contacts and exchanges among Arabs, Jews and Europeans in the medieval and early modern periods.

## Keywords

Islamic astrolabe – Hebrew inscriptions – Ludovico Moscardo

A remarkable astrolabe from Al-Andalus, hitherto unknown and unpublished, is preserved in the Fondazione Museo Miniscalchi-Erizzo in Verona. It is datable to the eleventh century and features added Hebrew and Latin inscriptions

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(fig. 1). The astrolabe likely belonged to the collection of Ludovico Moscardo (AD1611–1681) assembled in Verona in the seventeenth century and was inherited by the Miniscalchi family through marriage in the late eighteenth century. Astrolabes first appear in the second catalogue of the Moscardo Museum published in Verona in AD1672: “in this museum are found brass astrolabes suitable for [users of] many languages and which show with ease all the houses of the planets.”<sup>1</sup> The passage reveals that the collection originally contained several astrolabes and that those were inscribed in more than one language, clearly languages foreign to Moscardo, with Arabic and Hebrew the only likely alternatives to Latin. Only the astrolabe under analysis has survived until the present day.

Ludovico Moscardo was born in AD1611 from a noble family of Verona and early on in his life—as he himself explained in the introduction to his catalogues—“not to be the same as the loafers of our age, I applied myself to an occupation that even if it wasn’t learned it was at least praiseworthy.”<sup>2</sup> In the space of his long life he assembled a huge collection which he recorded in two separate catalogues, the first published in AD1656 and the second, after the collection had much increased, and came to include the astrolabes, in AD1672.<sup>3</sup> The absence of any mentions of astrolabes in the earlier 1656 catalogue of the Moscardo Museum provides a rough timing for their acquisition by Ludovico between the late 1650s and the early 1670s, that is, between the first and second print-run of the catalogues.

In this period, Moscardo had acquired the other famous collection of Verona, that of the apothecary Francesco Calzolari (AD1522–1609), comprising mainly of natural specimens.<sup>4</sup> We first know of this acquisition through the memoirs of the travellers Jacob Spon and George Wheler who, in May 1676, found themselves “in Verona, where we saw, the following day, the beautiful cabinet of antiquities, natural things and paintings of Count Moscardi [*sic*], which was

1 “Ritrovansi in questo Museo Astrolabij di ottone, che servono per molte lingue, e con facilità mostrano tutte le case dei pianetti.” Moscardo, *Note ovvero Memorie del Museo di Lodovico Moscardo* (Verona: Per Andrea Rossi, 1672), 443.

2 “Per non esser comune con gli otiosi della nostra età applicai me stesso ad un’occupazione che se non havesse del dotto, almeno del lodevole.” Ludovico Moscardo, “A chi legge,” in *Note ovvero memorie del Museo di Lodovico Moscardo* (Padua: Per Paolo Frambotto, 1656).

3 See previous footnotes.

4 The Calzolari collection was first published during Francesco’s lifetime by Giovanni Battista Oliva *De reconditis, et praecipuis collectaneis ab honestissimo, et solertissimo* (Venice: Paolum Zanfretum, 1584) and then again after his death by Benedetto Cerutti and Andrea Chiocco *Musaeum Franc. Calceolari iun. Veronensis* (Verona: Angelum Tamum, 1622).

previously that of Calzolari: though this latter Count much increased it.”<sup>5</sup> This acquisition, or at least part of it, clearly occurred before the publishing of the second catalogue of the Moscardo Museum in 1672 as some of the specimens therein described can be recognised in those published fifty years prior in the catalogue of the Calzolari Museum.<sup>6</sup> It is a possibility that the astrolabe was originally part of Calzolari’s collection though no mention of it is found in the Calzolari Museum’s catalogues. Calzolari himself claimed to have been a pupil of the prominent philosopher, physician and astronomer of the Padua School Gerolamo Fracastoro (ca. AD 1476–1553), who is sometimes represented with an astrolabe.<sup>7</sup>

The Moscardo Museum quickly became a popular stop for foreign travellers to the city. In AD 1687, Maximilien Misson describes visiting Moscardo’s cabinet and seeing “clocks and other things [...] of different peoples and different centuries,”<sup>8</sup> a possible allusion to the presence of mechanical instruments. Surprisingly, Ludovico never made a testamentary will despite dying quite old, at the age of seventy, as it is explained in the will of his first-born son Francesco Moscardo.<sup>9</sup> Upon Ludovico’s death, in AD 1681, the collection must nonetheless have passed to Francesco, as in AD 1685 the French monk Jean Mabillon, during his time in Verona wrote, “we went to the most illustrious Count Francesco Moscardo, who showed us his very rich museum.”<sup>10</sup> Francesco also did not make any provision concerning his father’s museum and following his death in AD 1698 his heirs quickly tried to sell the majority of the collection. On 7 Jan-

5 “À Verone, où nous vîmes le lendemain le beau Cabinet d’antiquité, de choses naturelles & de tableaux du Comte Moscardi, & qui étoit autrefois celui de Calceolarius: mais ce Comte l’a beaucoup augmenté.” Jacob Spon, Sir George Wheeler, *Voyage d’Italie, de Dalmatie, de Grece, et du Levant: fait aux années 1675 & 1676*, vol. 2 (Lyon: Antoine Cellier le fils, 1678), 372.

6 See for example Moscardo, *Note overo Memoria* (1672), 232–234 and Cerutti and Chiocco, *Musaeum*, 90, where the same specimen, a Basiliscus with the exact same illustration, appears.

7 Portrait medal of Girolamo Fracastoro by Giulio della Torre (ca. 1538), Museo Correr, Venice. See Jill Dunkerton, Jennifer Fletcher, and Paul Joannides, “A portrait of ‘Girolamo Fracastoro’ by Titian in the National Gallery,” *The Burlington Magazine* 155, no. 1318 (January 2013), 12.

8 “Des horloges [...] &c. de divers peuples, & de diver siècles.” Maximilien Misson, *Nouveau Voyage d’Italie, Avec un Mémoire contenant des avis utiles à ceux qui voudront faire le mesme voyage*, vol. 1 (La Haye: H. Van Bulderen, 1698), 165.

9 Archivio di Stato di Verona, Fondo Notaio A. Fiorio, busta 5179.

10 “... detulimus ad illustrissimum Comitem Franciscum Moscardum, qui nobis locupletissimum suum museum ostendit.” Jean Mabillon, *Museum italicum: Prima pars complectitur eorumdem iter italicum literarium: altera vero varia patrum opuscula & vetera monumenta, cum sacramentario & penitentiali gallicano* (Paris: Apud viduam Edmundi Martin, Johannem Boudot, & Stephanum Martin, 1687), 24.

uary 1699, the physician and collector Antonio Bianchi wrote from Verona to the Swiss antiquarian Louis Bourguet, “Count [Francesco] Moscardo has died, and his heirs charged me with writing to various places as they want to sell the whole museum, thus you will exceedingly please me if you could pass this news wherever you have contacts.”<sup>11</sup>

It is clear, nonetheless, that not the entire collection was sold in 1699 as in 1732 Francesco Scipione Maffei, in his description of Verona, still mentions the Moscardo Museum as being “famous in the whole of Europe.”<sup>12</sup> It must, however, have been much depleted as in AD1740 the French scholar Charles De Brosses, while describing his journey around Italy laments, “as of the cabinets, that of Moscardo, Italy’s most famous, is almost all gone.”<sup>13</sup> In 1799 the last direct heir of the Moscardo family, Moscardi Moscardo of Tomio, died leaving the remains of Ludovico’s collection to his three daughters, Teresa, Anna and Isabella. The collection thus passed, through the marriage of Teresa Moscardo to Marcantonio Miniscalchi in 1785, to the Miniscalchi family and then to the Fondazione Museo Miniscalchi-Erizzo founded by the family in 1964 to preserve the collections.<sup>14</sup> It is here that the astrolabe is now found.

With its provenance, this astrolabe is one of the earliest Islamic astrolabes documented in early modern Italy still preserved today. It comprises the mater, two plates—one of which is a replacement—and a rete. The alidade, pin and horse are missing. The astrolabe is undated, though it is signed on the back with what looks like a later addition (fig. 10). The signature, which reads صنعة يونس / لا سحاق [...], that is, “for Ishāq [...] / the work of Yūnus,” also includes a conspicuous erasure of the word following the name of the dedicatee, suggest-

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- 11 “Il Sig. Co. Moscardo è morto, e i di lui eredi mi hanno imposto che scriva in varie parti perche vogliono vendere tutto il Museo, onde V.S. mi farà somma grazia dar questa notizia dove hà delle corrispondenze.” Antonio Bianchi to Louis Bourguet, Verona (17 January 1699), Neuchâtel, Bibliothèque de la Ville, Fonds Bourguet, ms. 1267, folio 11, quoted in Dario Calomino, “Collezionismo e commercio numismatico nella Verona di Scipione Maffei: testimonianze inedite su un ‘raro medaglione d’ottone,’” *Rivista Italiana di Numismatica* 112 (2011): 306.
- 12 “Famoso per tutta Europa.” Francesco Scipione Maffei, *Verona illustrata*, vol. 3 (Verona: per Jacopo Vallarsi e Pierantonio Berno, 1732), 426.
- 13 “En cabinets; celui de Moscardo, le plus célèbre de toute l’Italie, est presque tout défait.” Charles de Brosses, *Lettres familières écrites d’Italie en 1739 et 1740 par Charles de Brosses* (Paris: Didier, 1858), 147–148.
- 14 Mariateresa Cuppini and Piero Gazzola, *La Fondazione Miniscalchi Erizzo* (Verona: Stamperia Valdona, 1962). In 1817, the three sisters donated to the Lapidary Museum of Verona much of the epigraphic material and part of the antiquities, some of which eventually ended up in other locations, keeping only the smaller objects. See Nicola Criniti, “Quattro epigrafi veronesi della collezione Moscardiana nell’ex-abbazia di Vertemate,” *Contributi dell’Istituto di storia antica* 1 (1972): 198–211.



FIGURE 1 The Verona astrolabe

ing that a possible patronymic was voluntarily effaced. The round, cursive script of the signature is in stark contrast with the smaller Kufic engravings on the rest of the object, thus marking the presence of a different hand. It is also interesting to remark that the front of the throne is a separate, bulkier plaque detached from the rest of the instrument and riveted onto the back plate, and it could be a later addition. It is therefore conceivable that an original front part of the throne contained a signature or date (the current shackle, which covers the majority of the surface of the throne, is also non-original).

The astrolabe is Andalusian, and from the style of the engraving and the arrangement of the scales on the back, it can be compared to instruments made in Spain in the eleventh century. The astrolabes made in Toledo by Ibrāhīm ibn Saʿīd al-Sahlī during the period of the Taifa (ca. AD1018–1085) present similarities in the style of the inscriptions, the organisation of the scales on the back, the eccentricity of the Julian calendar scale, the presence of a small throne and of a plate inscribed in the womb, and the arrangement of the engravings on the plates (figs. 2 and 3).<sup>15</sup> There are no astrolabes produced under the

15 History of Science Museum, Oxford (HSM), inv. 55331, dated 460AH (AD1068); Museo Arqueológico Nacional de Madrid (MAM), inv. 50762, dated 459AH (AD1067); Museo Astronomico e Copernicano, Rome, inv. 157/688, dated 463AH (AD1071), stolen. Similarities can also be found with an astrolabe made in the tenth century, possibly in Cordoba, and modified in later periods now at the British Museum (BM, inv. OA+371) and one from Cordoba dated 417AH (AD1026/1027) at the National Museums of Scotland (NMS, inv. T.1959.62).

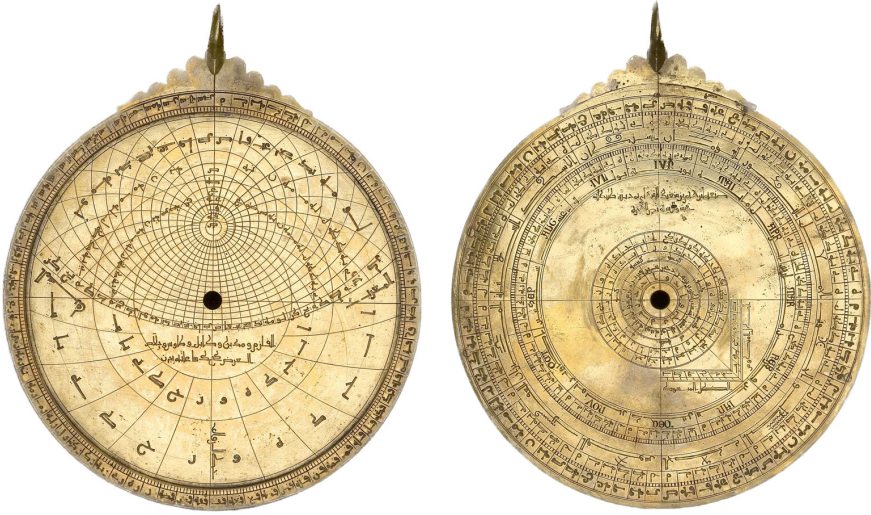


FIGURE 2 Mater of an astrolabe by Ibrāhīm ibn Saʿīd al-Sahli, Toledo, dated 460AH (AD1068). History of Science Museum, Oxford (HSM), inv. 55331



FIGURE 3 Mater of an astrolabe by Ibrāhīm ibn Saʿīd al-Sahli, Toledo, dated 459AH (AD1067). Museo Arqueológico Nacional de Madrid (MAM), inv. 50762

Almoravids (AD1050S–1147) to compare to the Verona astrolabe, while those made in the thirteenth century present some different characteristics.<sup>16</sup> Their shadow square is usually double, while on earlier objects it is engraved only on the right-hand side, the back becomes busier, sporting more scales, the almucantars' markings, instead of following the line of the Tropic of Capricorn, are instead engraved along the last azimuth and then continue along the almucantar tangent to the Tropic of Capricorn, creating a different visual aesthetic. The Verona astrolabe, albeit not dated, present the characteristics of instruments made in the eleventh century.

The womb is engraved with a plate “for the latitude of Medinaceli,  $41^{\circ} 30'$ ,” لعرض مدينة سالم مال (fig. 8). Of the two plates, plate 1 is certainly contemporary with the mater as it is identical to the plate engraved in the womb. It features the exact same calligraphic style, the latitude inscription is likewise split along two diagonal lines, the markings for almucantars and azimuths are subdivided in a similar manner, the unequal hours are likewise marked both in Abjad numerals and in words, and they both feature the exact same prayer lines and prayer names:

خط الزوال	Line of the midday prayer
الظهر	Early afternoon prayer
العصر	Afternoon prayer
اخر العصر	End time of the afternoon prayer

One side of the plate is inscribed “for the latitude of Cordoba,  $38^{\circ} 30'$ ,” لعرض قرطبة ل ح ل (fig. 12), while the other side “for the latitude of Toledo,  $40^{\circ}$ ,” لعرض طليطلة م (fig. 13), thus offering confirmation of the Spanish origins of the instrument.

The second plate is a replacement, it is thinner than the original plate and features different styles of engravings on its two sides. On side 2a the organisation of space is remarkably close to that of the original plate with some noticeable differences (fig. 14). It is engraved “for latitude  $30^{\circ}$ , hours 13h 58m,” لعرض ل ساعاته يج نح,<sup>17</sup> a typical North African latitude, without mention of a

16 See for example the astrolabes made in Seville by Muḥammad ibn Fattuḥ al-Jamā'iri in the AD1220S: HSM, inv. 44141, dated 618AH (AD1221/1222); HSM, inv. 50934, dated 621AH (AD1224/1225). See Azucena Hernández Pérez, *Astrolabios en al-Andalus y los reinos medievales hispanos* (Madrid: La Ergástula, 2018), 96–107; Hernández Pérez, “Astrolabios andalusíes e hispanos: de la precisión a la suntuosidad,” *Anales de Historia del Arte* 24, no. 289 (2014): 295.

17 It is assumed that the engraving of the last digits, نح, though without diacritics is to be read as نح as a typical length of day for latitude  $30^{\circ}$  is 13h 57m.

particular place. Another difference is in the prayer lines; fewer, only three as opposed to the four of the original plate, hatched, and marked with different names than those on the original plate:

مطلع فجر	Early morning prayer
قوس العصر	Arc of the afternoon prayer
مغيب الشفق	Sunset prayer

There are double markings in Abjad numerals for the unequal hours—interestingly, the alphanumerical value  $\text{د}$  (four) is marked in two different calligraphic styles in the two sets—otherwise the plate follows the same features of the original.<sup>18</sup>

Side 2b presents the same divisions as on the other plates, almucantars every three degrees and azimuths every five, yet the calligraphy of the engravings is of a completely different style, suggesting that the replacement plate had initially been left blank on one side, or, most likely, with simple lines for almucantars, azimuths and unequal hours, and that the inscriptions and prayer lines were added in a later phase (fig. 15). It is simply marked “for latitude 35°,” لعرض 35°, again a North African latitude, in a writing style that is larger, engraved deeper and wider and filled with a white filling in a much more prominent way than the rest of the object, thus further setting this one side of the plate apart from the others. The two prayer lines, also matching the style of writing in depth and colour, are roughly drawn, and stand out in contrast with the neat hour divisions which likely belong to an earlier phase of creation. The most interesting detail of this side of the plate is an added inscription in Hebrew engraved quite neatly above the Arabic marking for latitude 35°, reading “34 and a half,” ל"ד וחצי.<sup>19</sup> It is to be noted that the more typical way of writing fractions on astrolabes in Hebrew would be in alphanumerical values (that is, ל"ד ל', “34 1/2”) rather than in words as in this case, a detail that might reveal that the engraver of this addition was not an astronomer or astrolabe maker.<sup>20</sup>

This correction, however, is not an isolated case. All plates on all sides—the one engraved in the womb and that with Hebrew included—feature lightly scratched markings in Western Arabic numerals translating and correcting the

18 With some amended numeration for the azimuths.

19 I am grateful to Hanna Gentili for her help in deciphering this and the other Hebrew inscriptions.

20 I would like to thank Josefina Rodriguez-Arribas for pointing out this difference to me.



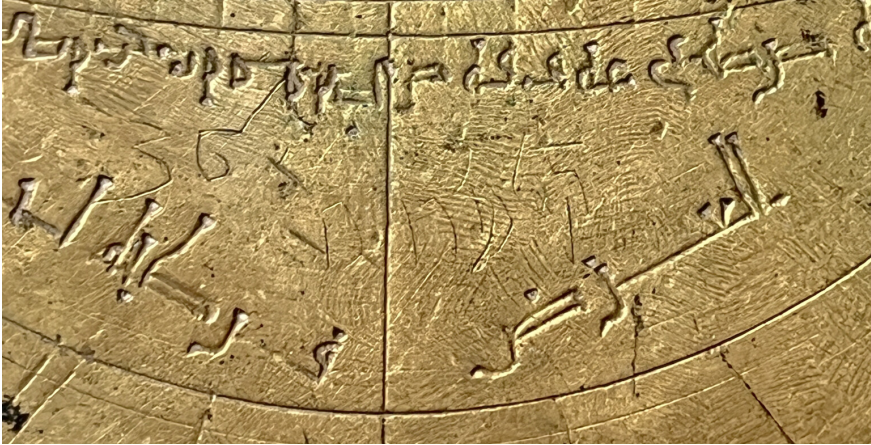


FIGURE 4 Detail of scratched Western numerals and Hebrew inscription on plate 1a

latitude values, some even multiple times (fig. 4).<sup>21</sup> These were probably added by a Latin or Romance language speaker, as an Arabic speaker would not have felt the need to translate standard Arabic numerals with Western Arabic style numerals, from which the numbers used in the Latin West derive. On the womb, just above the inscription “for the latitude of Medinaceli,  $41^{\circ} 30'$ ” two lightly scratched numbers can be made up. The one on the left reads “42” while the one on the right reads “40.” This is quite striking as both numerals differ from the value given in the Arabic but they do not agree between themselves. Yet, the hand who scratched them both—a clearly inexpert hand at engraving metal who scratched every line multiple times—seems to be the same. Was the original Arabic value for the latitude of Medinaceli considered erroneous by a later user of the instrument who amended it, firstly in defect and then in excess? The correct, modern value for the latitude of Medinaceli is  $41^{\circ} 15'$ , making the Arabic value of  $41^{\circ} 30'$  more accurate than either amendment.

On plate 1a the same markings are found above the latitude inscription “for the latitude of Cordoba,  $38^{\circ} 30'$ ,” one on the left reading “36” and one on the right reading “36,5,” (fig. 4) and then below the Tropic of Cancer in the seventh unequal hour, reading “36” again. The common value for the latitude of Cordoba on Maghrebi astrolabes is indeed  $38^{\circ} 30'$ <sup>22</sup> while the modern, cor-

21 It is sometimes difficult to differentiate between Western Islamic or Maghrebi numerals, and the Arabic numerals we use in Western languages as the latter derive from the former.

22 See for example the Toledo astrolabe made in 460AH (AD1068) by Ibrāhīm ibn Saʿīd al-Sahli (HSM, inv. 55331), or the astrolabe by Muḥammad ibn al-Ṣaffār made in Cordoba in 417AH (AD1026/1027) at Royal Scottish Museum in Edinburgh (RSM, inv. T1959–1962).

rect value is  $37^{\circ} 8'$ , making the scratched corrections for  $36^{\circ}$  or  $36^{\circ} 30'$  quite misplaced. As in the case of the womb, moreover, the amendments are multiple, and they disagree between themselves. The same type of correction also applies to side 1b where above the latitude inscription “for the latitude of Toledo,  $40^{\circ}$ ” two lightly scratched markings read “39” on the left-hand side and “39,0” on the right-hand side. They are still marked twice but this time they provide the same value. Again, latitude  $40^{\circ}$  is standard for Toledo on such instruments, and the modern value is calculated at  $39^{\circ} 8'$ , making the correction of  $39^{\circ}$  instead of  $40^{\circ}$  inaccurate again.<sup>23</sup>

The second plate, despite belonging to a later phase, is no exception. Above the inscription “for latitude  $30^{\circ}$ , hours 13h 58m,” the number “30” scratched very lightly in Western numerals is legible in three different spots. The additions, in this case, do not amend the original Arabic number but simply repeat it, suggesting that those markings were added not only to correct but also to translate. Also, side 2b, the one containing the Hebrew amendment, shows the same lightly scratched Western numerals, reading “34.” This time, however, they appear below the inscription “for latitude  $35^{\circ}$ ,” as the spot above it is taken by the Hebrew translation, demonstrating that the latter was already in place when Western numerals were added. There seems to be no correspondence between the Hebrew inscription reading “34 and a half” and the inscription in Western numerals reading “34” as they give two separate values. Yet, the phenomenon is peculiar. Have two separate users, at different times of the object’s life, felt the need to amend in their own script the latitudes’ values on the plates? There is more, on plate 1a, a lightly scratched Hebrew inscription reading קארד [א] בע, Cordoba, can be made up above the Arabic latitude inscription (between the two Western numeral markings) (fig. 4). A second scratched word that could be a Hebrew inscription possibly reading שבביעי, “seventh,” can just be made up in the partition for the seventh hour, above the Arabic ordinal السابعة, “seventh.” Such amendments and translations are not limited to the plates but are also present on the rete.

The rete is one of the most interesting parts of the astrolabe (fig. 11). It is an early Andalusian rete with dagger star pointers and a zoomorphic pointer for Vega.<sup>24</sup> It features characteristics of Abbasid retes. It is interesting to note in this respect, that Abbasid-style retes are found on the earliest Andalusian astrolabes, such as the astrolabe by Jalaf ibn al-Mu’ad datable to the late tenth

23 See again HSM, inv. 55331, RSM, inv. T1959–1962.

24 The zodiac band coincides with the circle of Cancer and the circle of Capricorn on the underlying plate suggesting it might have been made for this instrument and be original.



FIGURE 5 Andalusian astrolabe, tenth century with later interventions. British Museum, inv. OA+371

century and known only through a drawing,<sup>25</sup> the British Museum astrolabe attributed to the tenth century with later interventions (fig. 5),<sup>26</sup> as well as an astrolabe by Muḥammad ibn al-Ṣaffār at the National Museum of Scotland dated 417 AH (AD1026/1027) whose rete is a resized replacement.<sup>27</sup> Further confirmation that the rete was produced in al-Andalus is given by the nomenclature of its star pointers, in particular بنات نعش *banāt naʿsh*, which is found mainly on Andalusian or Magherbi retes.

The similarities of the Verona rete are not only with early Andalusian retes, but also with the earliest Latin Spanish retes, such as the earliest known European astrolabe, made in tenth-century Catalonia, the so-called “Carolingian” astrolabe,<sup>28</sup> or the twelfth/thirteenth-century astrolabe at the National Mar-

25 Bibliothèque Nationale de France, Paris (BNF), Ms. Lat. 7412, folios 19<sup>v</sup>–23<sup>v</sup>, in Hernández Pérez, *Astrolabios en al-Andalus y los reinos medievales hispanos*, 97.

26 BM, inv. OA+371, in Hernández Pérez, *Astrolabios en al-Andalus y los reinos medievales hispanos*, 97.

27 NMS, inv. T1959–1962; David A. King, “Medieval Astronomical Instruments: A Catalogue in Preparation,” *Bulletin of the Scientific Instrument Society* 31 (1991), 3–7.

28 Marcel Destombes, “Un astrolabe carolingien et l’origine de nos chiffres arabes,” *Archives internationales d’Histoire des Sciences* 58–59 (1962), 3–45.

itime Museum of Greenwich.<sup>29</sup> It is also to be noted the very close similarity between the Verona rete and the only surviving Byzantine astrolabe dated AD1062 (fig. 6).<sup>30</sup> The shape of the star pointers is very close to those found on the Verona rete but what is really striking is the presence of a single zoomorphic pointer for Vega in the shape of a bird seen in profile, albeit facing the opposite direction, on both retes.

An analysis of the position of the star pointers suggests a dating around the late eleventh century. As the Tropic of Capricorn is bent and broken in correspondence to the first point of Aries, thus affecting the position of all the star pointers outside the ecliptic band, only the pointers inside the ecliptic band are taken into account in this analysis. The mediation and declination of the star pointers do not exactly match any medieval star table.<sup>31</sup> They match, however, very closely the position of the star pointers of late eleventh-century retes, in particular the rete of the Oxford astrolabe by Ibrāhīm ibn Sa'īd al-Sahli made in Toledo in AD1068.<sup>32</sup> It is therefore likely that the original rete dates (or at least was based on star coordinates) from the late eleventh century. Finally, the style of calligraphy on the rete is compatible with an object made in the eleventh/twelfth century, thus giving further credit to the dating.<sup>33</sup>

One of the most peculiar features of the Verona rete, however, is the presence of Hebrew inscriptions. The zodiacal divisions on the ecliptic band for Scorpio, Sagittarius, Capricorn, Aquarius, Pisces, and Aries all feature added inscrip-

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- 29 National Maritime Museum of Greenwich (NMM), inv. AST 0558. The rete is quite crudely executed but already presents the circle linking the Equator to the Tropic of Capricorn typical of Maghrebi retes.
- 30 Museo di Santa Giulia, Brescia, inv. IC n. 2. David A. King, *Astrolabes and Angels, Epigrams and Enigmas: From Regiomontanus' acrostic for Cardinal Bessarion to Piero della Francesca's Flagellation of Christ* (Stuttgart: Steiner, 2007).
- 31 The closest matching star tables are Kunitzsch Type VI and Type XI. With regard to Type VI—which according to Elly Dekker (Dekker, “A Close Look at two Astrolabes and their Star Tables”, in *Sic Itur ad Astra* (Harrassowitz Verlag: Wiesbaden), 177–215 (192)) features star positions for a sky of the AD1150—the Verona rete presents variants in mediation in the order of -2 up to +3 (the declination values are closer, apart from  $\eta$  Ursae Majoris which is  $55^\circ$  on the rete and  $51^\circ$  on Table VI). With regard to Table XI—which according to Elly Dekker is based on an Andalusian instrument made in Spain in around 1070 (Dekker, “A Close Look”, 185)—the Verona rete presents variants in mediation in the order of -1 up to +6, while the declination values match quite closely. Paul Kunitzsch, *Typen Von Sternverzeichnissen in Astronomischen Handschriften Des Zehnten Bis Vierzehnten Jahrhunderts* (Harrassowitz: Wiesbaden, 1966).
- 32 HSM inv. 55331. The values of the mediation and declination are almost identical on the two retes apart from  $\alpha$  Ophiuchi which is a replacement on the Oxford astrolabe.
- 33 I would like to thank Alain George for this information and for sharing his knowledge of calligraphy with me.



FIGURE 6  
Byzantine astrolabe, dated AD1062. Museo di Santa Giulia, Brescia, inv. IC n. 2

tions in Hebrew offering translations of the signs of the zodiac lightly scratched with an insecure hand. Above the sign of Scorpio, some Hebrew letters are difficult to make up, while above the other zodiacal divisions, the Hebrew letters are clearly legible (fig. 7):

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... ע	קֶשֶׁת	גְּדִי	דָּלִי	דָּגִים	טֹלָה
العقرب	القوس	الجدي	الدلو	الحوت	الحمل
Scorpio	Sagittarius	Capricorn	Aquarius	Pisces	Aries

---

It is surprising that the added Hebrew labels run from Scorpio to Aries, rather than, as one would expect, from Libra to Pisces, that is, symmetrically on the larger sign divisions above the equinoctial bar.<sup>34</sup> It is to be noted that the Islamic astrolabes with added Hebrew inscriptions that have survived till the present day are mainly from Spain, produced, like the Verona astrolabe, between the eleventh and early thirteenth century, such as the astrolabe by Muḥammad ibn al-Ṣaffār, made in Toledo in 420AH (AD1029/1030),<sup>35</sup> the astro-

34 The treatise on the astrolabe by the Jewish polymath Abraham ibn Ezra (AD1089–1167) written in Verona in 1146 clearly distinguishes between the two sets of signs, see Josefina Rodríguez Arribas, “Medieval Jews And Medieval Astrolabes: Where, Why, How, And What For?,” in *Time, Astronomy, and Calendars in the Jewish Tradition*, ed. Sacha Stern and Charles Burnett (Leiden: Brill, 2014), 229, 232.

35 Staatsbibliothek, Preussischer Kulturbesitz, Orientabteilung, Berlin (SPKO), inv. 6567. Franz Woepcke, *Über ein in der Königlichen Bibliothek zu Berlin befindliches arabisches Astrolabium* (Berlin: Druckerei der Königl. akademie der wissenschaften, 1858); Gunther, *The Astrolabes of the World*, vol. 1, 251–252 (no. 116).



FIGURE 7 Detail of Hebrew translation on the ecliptic band

labe by Muḥammad ibn al-Sahlī made in Valencia in 483AH (AD1090/1091)<sup>36</sup> where the rete is a replacement that has been reworked with Hebrew inscriptions, or the astrolabe by Muḥammad ibn Fattūḥ al-Khamā'irī made in Seville in 628AH (AD1230/1231).<sup>37</sup>

The added, and then partly erased, signature, is also worthy of investigation (fig. 10). It reads “the work of Yūnus” (صنعة يونس), a name that appears only once more on a celestial globe, probably made in Iran and dated 540AH (AD1144), as Yūnūs bin al-Ḥusayn al-aṣṭurlābī (يونس بن الحسين الاصطرباني).<sup>38</sup> It is impossible to say whether there is any relation between the two names, which are also spelt slightly differently. The other name in the signature, that of the dedicatee, Ishāq (اسحاق), is followed by an erased word, possibly a patronymic. The two names, Ishāq and Yūnus, that is Isaac and Jonah in English, could be Jewish names written in the Arabic script, a detail that might suggest that the

36 National Museum of American History (NMAH), inv. 318178. George Saliba and Bernard R. Goldstein, “A Hispano-Arabic Astrolabe with Hebrew Star Names,” *Annali dell'Istituto e Museo di storia della scienza di Firenze* 8, no. 1 (1983), 19–29; Sharon Gibbs and George Saliba, *Planispheric Astrolabes from the National Museum of American History* (Washington, D.C.: Smithsonian Institution Press, 1984), 174–177 (no. 2752).

37 Museum of Islamic Art, Cairo (MIA), inv. 15371. See also Aga Khan Foundation, inv. AKM 611. There exists also a composite astrolabe with a European mater and a set of plates and rete from the Eastern Islamic world at the Biblioteca Comunale of Palermo with additional markings for the latitudes in both Hebrew and Western numeral, David King, *A Catalogue of Medieval Astronomical Instruments*, Parts 1.1–2.3, October 1996 version, unpublished, #1072.

38 Musée du Louvre, Paris (ML), inv. MAO 824.

object was at a certain point circulating within a Sephardi Jewish community in Spain, where Arabic was the *lingua franca*. The other remarkable detail is the presence of Hebrew inscriptions added to both the rete and the plates, by more than one hand. The Hebrew additions on plate 2b are carved deeply and neatly, if not professionally. The Hebrew translations added on plate 1a and on the rete, on the other hand, are very light, uneven, and show an insecure hand, thus revealing the work of two different people. The presence of such additions and translations in Hebrew likely testify that by the time those were added, the object had left Spain and was circulating amongst the Jewish diaspora community, probably in Italy, where Arabic was not understood, and Hebrew was used instead.<sup>39</sup>

Verona in the twelfth century hosted one of the longest-standing and most important Jewish communities in Italy.<sup>40</sup> It is in Verona that the earliest surviving treatise on the astrolabe written in the Hebrew language was composed in AD 1146 by the Spanish Jewish polymath Abraham Ibn Ezra (AD 1089–1167). Ibn Ezra treatise assumes pre-existing knowledge of the astrolabe among the Verona Jewish community, showing that the instrument must already have been popular. He writes not about a particular object but about a generic type of astrolabe, likely the type that circulated in twelfth-century Verona amongst the Jewish community.<sup>41</sup> The instrument he describes was engraved in Arabic, like our astrolabe, was originally a Muslim object and featured Muslim prayer lines, like our astrolabe, and was created for latitudes in territories under Muslim rule, like our astrolabe.<sup>42</sup> Ibn Ezra warns his readers that the instrument must be checked before use in order to verify the accuracy of the values to be calculated. In particular, he reports five different methods to calculate and verify the latitude of a particular plate.<sup>43</sup> Could perhaps the hand who added the Hebrew alphanumerical values to amend the latitude for plate 2b have been following such advice? Ibn Ezra pays particular attention to the use of Hebrew translations of Arabic terminology as a means of appropriating the astrolabe.<sup>44</sup> Could the Hebrew translations on plate 1a and on the rete be part of this

39 Rodríguez Arribas, “Medieval Jews and Medieval Astrolabes,” 224–225; Rodríguez Arribas, “Reading Astrolabes in Medieval Hebrew,” in *Language as a Scientific Tool Shaping Scientific Language Across Time and National Traditions*, ed. Miles MacLeod, Rocío G. Sumillera, Jan Surman and Ekaterina Smirnova (London: Routledge, 2016), 89–112.

40 Nello Pavoncello, *Gli ebrei in Verona, dalle origini al secolo XX* (Verona: Edizioni Vita Veronese, 1960), 9.

41 Rodríguez Arribas, “Medieval Jews and Medieval Astrolabes,” 242–243.

42 *Ibid.*, 244.

43 *Ibid.*, 248.

44 *Ibid.*, 258–259.

broader phenomenon of translation and appropriation? Although it is impossible to verify whether the astrolabe under analysis was indeed one of those in circulation at the time Ibn Ezra resided in Verona or thereafter, it is compelling to remark the similarities and coincidences between what he describes and our extant Verona object.

It must have been at a later stage still that the astrolabe passed into the hands of a new owner who made his own additions to the plates, using Western numerals, likely a Latin or Romance language speaker. That the Western numerals were added after the Hebrew inscription on plate 2b is inferable, as noted above, from the fact that on the left-hand side, they are engraved below the Arabic latitude inscription rather than above it, as is the case on all other plates (including the one engraved in the womb), as the spot above it must already have been occupied by the Hebrew. Why the additions of Western numerals are multiple and even disagree among themselves is more difficult to explain as the hand carving them looks consistent throughout. Given that some are simple translations and do not change the value of the Arabic numerals, while others differ from it, it can be hypothesised that a non-Arabic and non-Jewish speaking user added them probably once the object was already in Italy, and that the presence of multiple values shows the user grappling with reading the value off the instrument, rather than of the Arabic. The inner-most almucantars are in fact not drawn on the plates, making it difficult for someone not able to read the value marked in the Arabic inscription to decipher the correct latitude of the plate, especially when this is meant to show decimals. It is nonetheless interesting to remark that at least three separate users felt the need to add translations, and in some cases amendments, to this one object, two in Hebrew and one in a Western language.

The Verona astrolabe appears, therefore, as a palimpsest, revealing the needs and the hands of several users, adding, modifying, and erasing information on it. The original astrolabe is a fine medieval Andalusian instrument made in the Islamic Spanish peninsula in the eleventh century which later passed into the hands of one or possibly more Jewish owners as well as one or more Italian owners. It is likely that the added Hebrew numerals and translations, as well as the Western numerals, were already in place before AD 1672 when the object entered the Moscardo Museum. Ludovico Moscardo was no astronomer and the additions and modifications are more compatible with a practitioner than a collector. Ultimately, the survival of such a remarkable Andalusian astrolabe in Verona, is likely due to the presence in the city of a large Sephardi Jewish community, whether or not the astrolabe was already in Verona in AD 1146 when Abraham Ibn Ezra wrote his Hebrew treatise on the astrolabe. What is certain is that the Verona astrolabe stands out as a remarkable example of an object



whose history remains legible on its surface, like a palimpsest, attesting to the contacts and exchanges between Arabs, Jews and Europeans in the medieval and early modern periods.

## 1 Description

**Date:** 11th century AD

**Diameter:** 19.1 cm

**Height with extended ring:** 25 cm

**Depth:** 4 mm

**Weight:** 1.07 Kg

**Material:** brass

**Location:** Museo Fondazione Miniscalchi-Erizzo

**Provenance:** Museo Ludovico Moscardo, 17th century AD

**Parts:** Mater, rete, 2 plates.

**Throne:** the throne is particularly small, it is plain with two lobes per side. The back of the throne is part of the back plate of the mater; the front of the throne is a separate piece riveted onto the rim and might have been repaired or replaced.

**Shackle:** the shackle is of the eye-bolt type and it is likely a replacement. The front of the throne shows abrasion markings larger than the size of the current shackle.

**Ring:** the ring is cast in one piece and has a three-lobed section.

**Mater:** the mater is made of a back plate on which the rim is riveted. The notch for holding the plates in place is located at the throne.

The rim is marked with a degree scale  $0-360^\circ$  divided every 5 degrees and subdivided every degree, and it is labelled every 5 degrees in Abjad numerals with the full numeral expressed throughout.

The mater is inscribed with a plate for latitude  $41^\circ 30'$ .

لعرض مدينة سالم مال For the latitude of Medinaceli,  $41^\circ 30'$

There are some very lightly scratched markings above the latitude inscription, one reading “42” on the left-hand side, and one reading “40” on the right-hand side in Western numerals.

Almucantars are given for every 3 degrees. They are labelled in Abjad numerals twice on the left-hand side facing outwards and twice on the right-hand side facing inwards going up to  $39^\circ$  in the inner line and  $36^\circ$  in the outer line. The numeration then continues along the meridian line from  $39^\circ$  to  $90^\circ$ .



FIGURE 8 Mater of the Verona astrolabe



FIGURE 9 Back of the Verona astrolabe

Azimuths are given for every 5 degrees  $0-90^\circ$  for each of the four quarters created by the meridian line and the colure line. These are labelled every 5 degrees in Abjad numerals:  $5-90^\circ$  below the horizon line,  $5-30^\circ$  above the horizon line, and  $35-90^\circ$  below the Tropic of Capricorn, facing outwards on the left-hand side, and inwards on the right-hand side.

Unequal hours are given and labelled in Abjad numerals between the Tropic of Cancer and the Equator and in words between the Equator and the Tropic of Capricorn:

الاولي الثانيه	الثالثه	الرابعه	الخامسه	السادسه	السابعه	الثامنه	التاسعه	العاشره	الحاديه عشر	الثانيه عشر
The first	The second	The third	The fourth	The fifth	The sixth	The seventh	The eighth	The ninth	The tenth	The eleventh

East and West are marked **المغرب** and **المشرق**.

There are four prayer lines, all marked below the horizon line. They are labelled as follows:

خط الزوال	Line of the midday prayer
الظهر	Early afternoon prayer
العصر	Afternoon prayer
اخر العصر	End time of the afternoon prayer

**Back:** the rim is marked with four altitude scales  $0-90^\circ$ , one for each quarter, divided every 5 degrees and further subdivided every degree. They are labelled every 5 degrees in Abjad numerals with each quarter alternating facing inwards or outwards.

There are five further concentric rings. The outermost three rings give a zodiacal calendar starting with Aries at  $90^\circ$ , and two scales of degrees, one above and one below, with each sign divided into  $30^\circ$ . The scale is divided every 5 degrees, is subdivided every degree and it is labelled every 5 degrees in Abjad numerals.

The two innermost rings give a Julian calendar scale of the eccentric type with equal divisions and the relative scale of the days of the month. Each scale is divided every 5 days, subdivided every day, and labelled in Abjad numerals every 5 days plus the last day. This goes either up to 30 or 31 days according to the length of the month, with the exception of February which goes up to 28 days.

An inscription has been added in the middle of the top half, part of which has been polished to erase a word. This is clearly not contemporary with the object:

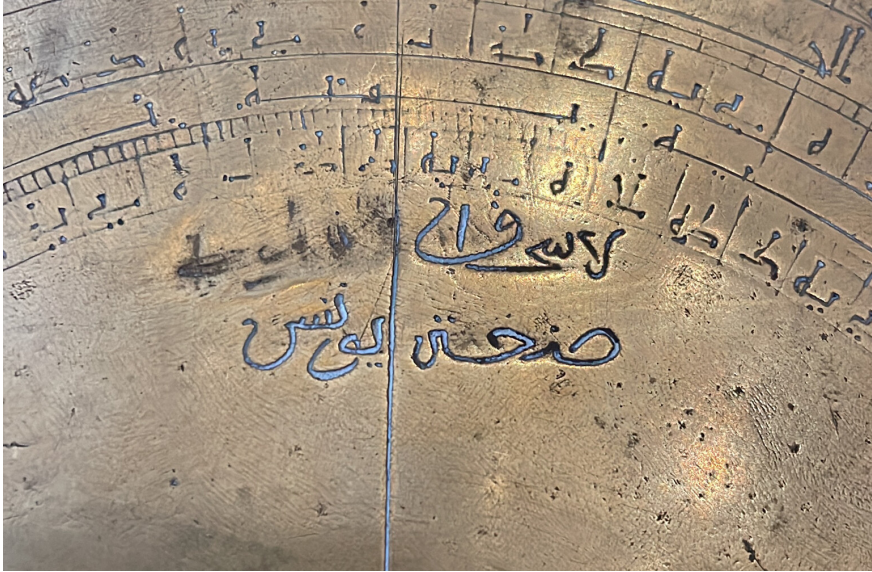


FIGURE 10 Dedication and signature

صنعة يونس / لا شحاق [...] For Ishāq [...], the work of Yūnus

A shadow square features in the lower-right quarter. Both the bottom and right-hand sides are marked with 12 fingers vertical and 12 fingers horizontal, divided every 2 fingers and subdivided every finger. They are labelled every 2 fingers in Abjad numerals.

**Alidade:** the alidade is missing.

**Rete:** the rete is in Abbasid style. The style of calligraphy is close enough to the engravings on the mater to justify believing that this is the original rete. It features 17 dagger star pointers with Vega in the shape of a bird. The equinoctial bar is counter-changed once at the pole. There is one single knob for rotation which is a replacement or addition. The Tropic of Capricorn is broken just below the equinoctial bar.

The ecliptic band is divided into 12 zodiac signs, each divided every 6 degrees and subdivided every 3 degrees along the bevelled edge. It is labelled in Arabic with some added inscriptions in Hebrew, engraved very lightly above the Arabic names (Sagittarius features a mistake in the engraving of the ق which shows an overlapping ع):

الحوت	الدلو	الجدى	القوس	العقرب	الميزان	السنبلة	الأسد	السرطان	الجوز	الثور	الحمل
Aries	Taurus	Gemini	Cancer	Leo	Virgo	Libra	Scorpio	Sagittarius	Capricorn	Aquarius	Pisces
דגים	דלי	גדי	קשת	ע ...							טלה

The 17 star-pointers are labelled as follows by increasing order of mediation (it is to be noted that mediation and declination for stars outside the ecliptic are distorted due to the band of Capricorn being bent):

Name as given on rete	Trans-literation	Modern name	Scientific name	Mediation	Declination
<b>Inside the ecliptic</b>					
1	عيوق	Capella	$\alpha$ Aurigae	9° of Gemini	46°
2	بنات نعش	Alkaid	$\eta$ Ursae Majoris	21° of Libra	55°
3	الرمح	Arcturus	$\alpha$ Boötis	Broken pointer	Broken pointer
4	الحوا	Rasalhague	$\alpha$ Ophiuchi	18° of Sagittarius	14°
5	النسر الواقع	Vega	$\alpha$ Lyrae	2° of Capricorn	38°
6	الطاير	Altair	$\alpha$ Aquilae	18° of Capricorn	8°
7	الردف	Deneb	$\alpha$ Cygni	3° of Aquarius	44°
8	منكب	Scheat	$\beta$ Pegasi	5° of Pisces	24°
<b>Outside the ecliptic</b>					
9	الديران	Aldebaran	$\alpha$ Tauri	5° of Gemini	18°
10	رجل الجوزا	Rigel	$\beta$ Orionis	15° of Gemini	-6°
11	يد الجوزا	Betelgeuse	$\alpha$ Orionis	26° of Gemini	7°
12	اليمانية	Sirius	$\alpha$ Canis Majoris	Pointer broken	Pointer broken
13	الشامية	Procyon	$\alpha$ Canis Minoris	Pointer broken	Pointer broken
14	القلب	Regulus	$\alpha$ Leonis	8° of Leo	0°
15	الاعزل	Spica	$\alpha$ Virginis	12° of Libra	-5°
16	القلب	Antares	$\alpha$ Scorpii	0° of Sagittarius	-24°
17	ذنب الجدي	Deneb Algedi	$\delta$ Capricorni	4° of Aquarius	-21°



FIGURE 11 Rete of the Verona astrolabe

The back features construction markings.

**Pin and horse:** the pin and horse are missing. The instrument is currently kept together by means of a modern pin.

**Plates:** there are 2 plates, one original and one replacement. The plates feature almucantars every 3 degrees, azimuths every 5 degrees, unequal hours, prayer lines, and are marked *المشرق* (east) and *المغرب* (west). The notch to hold the tabs of the plates (both located at the throne) does not seem capable of accommodating more than two plates.



FIGURE 12 Plate 1a

1.1 *Plate 1a*

لعرض قوطبة لـح For the latitude of Cordoba,  $38^{\circ} 30'$

There are some very lightly scratched markings above the latitude inscription. The central one is in Hebrew and appears to read קארד[א]בע, “Cordoba.” To the right and the left of this inscription, also scratched very lightly are “36” on the left-hand side and “36,5” on the right-hand side, both in Western numerals. Below the Tropic of Cancer in the seventh unequal hour, another inscription reads “36” in Western numerals. Below it, just below the Equator, another very faintly scratched line might be interpreted as Hebrew letters, possibly spelling the word שביעי, “seventh.”

Almucantars are given for every 3 degrees. On the left-hand side they are labelled twice in Abjad numerals facing outwards (up to  $36^{\circ}$  in the inner line



and up to 34° in the outer line) and then once going down along the 50° azimuth. On the right-hand side they are also labelled twice in Abjad numerals facing inwards (up to 39° in the inner line and up to 36° in the outer line) and then once going down along the 50° azimuth.

Azimuths are given for every 5 degrees 0–90° for each of the four quarters created by the meridian line and the colure line. These are labelled every 5 degrees in Abjad numerals: 5–90° below the horizon line, 5–30° above the horizon line, and 35–90° below the Tropic of Capricorn, facing outwards on the left-hand side, and inwards on the right-hand side.

Unequal hours are given and labelled in Abjad numerals twice, between the Tropic of Cancer and the Equator, and a second time below the Equator (with the exception of 10 which is placed above it to make space for the label of the prayer line) (also note that number 4 د, is engraved in two different calligraphic styles). They are also labelled in words between the Equator and the Tropic of Capricorn:

---

عشر	الحادية عشر	العاشرة	التاسعة	الثامنة	السابعة	السادسة	الخامسة	الرابعة	الثالثة	الثانية	الاولى
The	The	The	The	The	The	The	The	The	The	The	The
twelfth	eleventh	tenth	ninth	eighth	seventh	sixth	fifth	fourth	third	second	first

---

East and West are marked **المغرب** and **المشرق**.

There are four prayer lines, all marked below the horizon line. They are labelled as follows:

- خط الزوال Line of the midday prayer
- الظهر Early afternoon prayer
- العصر Afternoon prayer
- انصر العصر End time of the afternoon prayer

1.2 *Plate 1b*

عرض طليطلة م For the latitude of Toledo, 40°

There are some very lightly scratched markings above the latitude inscription, one reading “39” on the left-hand side, and one reading “39 0” on the right-hand side in Western numerals.

Almucantars are given for every 3 degrees. They are labelled in Abjad numerals twice on the left-hand side facing outwards and twice on right-hand side



FIGURE 13 Plate 1b

facing inwards, going up to going up to  $42^\circ$  in the inner line and  $39^\circ$  in the outer line. The numeration continues along the meridian line from  $42^\circ$  to  $90^\circ$ . The  $18^\circ$  almucantar is hatched.

Azimuths are given for every 5 degrees  $0-90^\circ$  for each of the four quarters created by the meridian line and the colure line. These are labelled every 5 degrees in Abjad numerals:  $5-90^\circ$  below the horizon line,  $5-30^\circ$  above the horizon line, and  $35-90^\circ$  below the Tropic of Capricorn, facing outwards on the left-hand side, and inwards on the right-hand side.

Unequal hours are given and labelled in Abjad numerals between the Tropic of Cancer and the Equator and in words between the Equator and the Tropic of Capricorn:

عشر الثاني عشر	الحادي عشر	العاشرة	التاسعة	الثامنة	السابعة	السادسة	الخامسة	الرابعة	الثالثة	الثانية	الاولى
The twelfth	The eleventh	The tenth	The ninth	The eighth	The seventh	The sixth	The fifth	The fourth	The third	The second	The first

East and West are marked *المشرق* and *المغرب*.

There are four prayer lines, all marked below the horizon line. They are labelled as follows:

خط الزوال	Line of the midday prayer
الظهر	Early afternoon prayer
العصر	Afternoon prayer
اخر العصر	End time of the afternoon prayer

### 1.3 *Plate 2a*

لعرض ل ساعات بيج نوح For latitude  $30^\circ$ , hours 13h 58m

There are some very lightly scratched markings above the latitude inscription, reading “30” three times in Western numerals.

Almucantars are given for every 3 degrees. On the left-hand side they are labelled twice in Abjad numerals facing outwards (up to  $42^\circ$  in the inner line and up to  $39^\circ$  in the outer line) and then once going down along the  $50^\circ$  azimuth. On the right-hand side they are also labelled twice in Abjad numerals facing inwards (up to  $48^\circ$  in the inner line and up to  $42^\circ$  in the outer line) and then once going down along the  $50^\circ$  azimuth.

Azimuths are given for every 5 degrees  $0-90^\circ$  for each of the four quarters created by the meridian line and the colure line. These are labelled every 5 degrees in Abjad numerals:  $5-90^\circ$  below the horizon line,  $5-30^\circ$  above the horizon line, and  $35-90^\circ$  below the Tropic of Capricorn, facing outwards on the left-hand side, and inwards on the right-hand side. On the left-hand side there are traces of a previously incorrect numeration, partly smoothed to erase it and partly amended.

Unequal hours are given and labelled in Abjad numerals twice, between the Tropic of Cancer and the Equator, a second time in below the Equator. They are also labelled in words between the Equator and the Tropic of Capricorn:



FIGURE 14 Plate 2a

الاولي	الثانيه	الثالثه	الرابعه	الخامسه	السادسه	السابعه	الثامنه	التاسعه	العاشره	الحاديه عشر	الثانيه عشر
The first	The second	The third	The fourth	The fifth	The sixth	The seventh	The eighth	The ninth	The tenth	The eleventh	The twelfth

East and West are marked **المشرق** and **المغرب**.

There are three dotted prayer lines, all marked below the horizon line. They are labelled as follows:

- مطلع فجر      Early morning prayer
- قوس العصر      Arc of the afternoon prayer
- مغيب الشفق      Sunset prayer



FIGURE 15 Plate 2b

1.4 Plate 2b

לערוש לה For latitude 35°

There is an inscription in Hebrew engraved above the latitude number:

ל"ד וחצי 34 and a half

There are some very lightly scratched markings below the latitude inscription reading “34” in Western numerals.

Almucantars are given for every 3 degrees. They are labelled in Abjad numerals up to 39° on each side and then along the meridian line from 42° to 90°. The 18°, 36°, and 54° almucantars are hatched.

Azimuths are given for every 5 degrees  $0-90^\circ$  for each of the four quarters created by the meridian line and the colure line. These are labelled every 5 degrees in Abjad numerals on the left-hand side starting from the Equator and going along Tropic of Capricorn, on the right-hand side from  $5-30^\circ$  above the horizon line and from  $35-90^\circ$  below the Tropic of Capricorn.

Unequal hours are given and labelled in Abjad numerals twice, between the Tropic of Cancer and the Equator and a second time between the Equator and the Tropic of Capricorn.

East and West are marked *المشرق* and *المغرب*.

There are two, poorly engraved, prayer lines marked below the horizon line and not labelled.

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