

ISLAMIC ASTROLABISTS
AND THEIR WORKS

by

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ALBERT KUNDIG

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To
PAUL WITTEK
IN FRIENDSHIP

PREFACE

Definitions. In the following pages we shall understand by "astrolabists" those makers of astrolabes, quadrants, celestial globes, sun-dials, compasses and qibla indicators who lived and worked in Islamic countries West of India prior to A.D. 1830. Makers of other scientific instruments such as *mudd*-measures, scales, and surgical implements will be dealt with in the volume dealing with metal workers in general. Indian masters are on principle excluded, for reasons explained in my *Islamic architects and their works*, pp. 11/12.

Transcription and translation. The transcription of Oriental words is the same as in the *Islamic architects* just quoted. On the whole it is a simplified version of that used by the Royal Asiatic Society and the Encyclopaedia of Islam. In transcribing Turkish words an effort was made to distinguish between the old and the new system when rendering names and technical terms. The latter, whether Arabic, Persian or Turkish, are usually given in brackets and follow closely the English ones. If there is a discrepancy in meaning between the English and the Oriental phrase, the former represents the archaeological evidence, and the latter the version of an inscription or literary source.

Bibliography. The bibliographies which follow biographical notes about astrolabists deal primarily with the objects, not with the men. References to Oriental sources from which the biographical details have been culled are given in the text of the bibliography of either the earliest or the most important instrument of each master.

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May I repeat my appeal to all those who possess, are in charge of or know of Islamic scientific instruments not mentioned in the following pages, to publish their material as soon as they can, or, should this prove impossible, to let me have photographs or rubbings of these objects?

L. A. M.

INTRODUCTION

Terminology of signatures. Makers of astrolabes are introduced by a variety of terms, the most common being *ṣana'ahu*,¹ or less often *ṣana'ahâ*. In all cases in which we can follow up details of the life of the astrolabist concerned, we learn that he was a professional astronomer, using the word in its widest sense, so as to include mosque officials whose duty was to establish astronomical "moments" (*mu'addil*) or fix the hours of prayer (*muwaqqit*). Chardin assured us in a passage which has become famous,² that in his days, as a rule, Persian astronomers made their instruments themselves, and he ascribed the perfection of Persian astrolabes to this very fact. This statement can be generalized, since we know that many other astronomers living at other times and in other countries did the same.³ Others, like 'Abd al-A'imma the Younger, varied the verb of their signature, and called their work sometimes *ṣana'a*, at other times *namaqa* (decorated) or both. Similarly 'Abd al-Bâqî and 'Abd al-Ghafîr the Elder mentioned *expressis verbis* that they made and decorated their astrolabes. There is even literary evidence⁴ that a man as highly placed as Aḥmad Pasha, governor of Egypt, not only calculated and designed his sun-dials but actually cut them in marble (*ṣinâ'atan wa-ḥaḡran bi-l-izmîr*). Furthermore we know that

¹ The noun, *ṣan'at*, so common on objects of art and in architectural inscriptions, is rare on astrolabes, but it exists (e.g. 'Abdallah b. Sâsî; Ibrâhîm b. Sa'îd; Muḥammad b. Abî Bakr; Muḥammad b. Muḥammad b. Hudhail). With regard to these masters as well as to all the other astrolabists mentioned in this Introduction, cf. The Roll, s.vv.

² *Voyages*, ed. Langlès, 1811, t. IV, p. 332.

³ We are reminded of this, of course, only in cases when these instruments fetched exorbitant prices, like e.g. those of Aḥmad b. Ḥusain b. Bâso or Muḥammad b. Aḥmad al-Mizzî, or were particularly beautiful, like those of Qaiṣar or 'Alî b. Ibrâhîm "Ibn ash-Shâtîr".

⁴ Jabartî, I, p. 187, ll. 3 b-pu.

certain scholars famous for their learning (e.g. Muḥammad al-Ghazûlî) occasionally merely engraved (*naqasha*) instruments calculated by their colleagues. To sum up, we may say that it stands to reason that in the circumstances all those who signed their astrolabes, quadrants, globes or sun-dials should be considered as the actual makers of these instruments, unless we are informed by extraneous sources, or by inscriptions on the objects themselves, that they used to leave the physical part of the work to others.

The second term is *'amila* or *'amal*. It is more difficult to decide what exactly this word means. With the exception of a sultan, not a single man who signed his astrolabe in this way is known from literature. Some of the astrolabes thus signed are as beautiful as any of their time and country (e.g. 'Abd al-Ghafûr, 'Alî b. Şâdiq, 'Umar b. Yûsuf, 'Uthmân b. 'Abdallah). Some are plain (Muşţafâ Ayyûbî), others give the impression that the signatures were not an organic part of the engraving, perhaps not even contemporary (Faḍl 'Alî, Ibrâhîm al-Muftî). The statement, "this is one of the objects made (*'umila*) for the library of . . . constructed (*şana'ahu*) by Sahl" which seems to offer a clue, should not be pressed at all, since this is a unique case; nowhere else do we find both phrases in one inscription.

Certain astrolabists used to number their instruments, "opus xth" using the word *'amal* for "opus". So far as these astrolabes are also dated, they allow us to judge the speed with which they were made. Hâjjî 'Alî, for instance, made his second instrument in A.H.1203, his third in A.H.1205, his thirteenth in A.H.1208.

A curious feature of the Muslim astrolabist is his pride in his work. Apart from the usual self-deprecatory formulae like "the sinful servant" (*al-'abd al-athîm*), "the contemptible servant" (*al-'abd al-ḥaqîr*), "the least of students" (*aqall at-ṭalaba*), "the repentant servant of God" (*al-'abd al-khâdim an-nâdim*), "one who is in need of the mercy of his Lord" (*al-muḥtâj ilâ raḥmat rabbihi*), "the dust of the threshold of [the sanctuary of Imâm] Riẓâ" (*turâb 'atabat Riẓâ*), and many others of this kind, we find on scientific instruments also quite different expressions. The earliest signature of Ibrâhîm b. Sa'îd begins "Among the

objects skilfully made" (*mimmâ aḥkama şan'atahu*) and his younger contemporary Muḥammad b. Sa'îd uses exactly the same phrase; 'Alî b. Ibrâhîm "Ibn ash-Shâtîr" lays stress on the novelty of his instrument by saying that he "constructed and invented it" (*ibtakarahu*). Shukr Allah Mukhliş underlines his having calculated as well as constructed his astrolabe himself (*'ilmî wa-'amalî*).

The choice of words habitually used not in connection with making metal objects, but with writing, is even more striking than the self-assurance of these last formulae. A verb like *namaqa*, which according to dictionaries should be translated "he wrote", is used on Sefevid astrolabes exclusively in the sense of "he decorated", similarly the word *raqama* stands in the language of astrolabists for "he engraved" only. Muḥammad Muḥsin went even a step further and to make his point quite clear signed "WROTE and engraved" (*katabahu wa-raqamahu*). I am well aware of the fact that *namaqa* and *tanmîq* are occasionally used in the same sense outside the circle of astrolabists, and that *raqama* became in course of time the ordinary word for *pinxit* in signatures of Persian miniaturists, but there can be little doubt that the latter followed rather than initiated the fashion set by the decorators of astrolabes.

Similarly we find expressions like "composition" (*taşnîf*) for the making of a sun-dial ('Alî b. Ibrâhîm) or "composed" (*allaḥa*) for the construction of an astrolabe (Aḥmad b. Ibrâhîm), terms as a rule reserved for the work of authors of books. This is all part and parcel of the desire of successful artists and artisans to appear as "gentlemen" and not as mere craftsmen. For a similar case among architects, cf. my *Islamic Architects*, p. 24.

Emplacement of signatures. The position of the signatures varied almost as much as the terms used in them. Although at certain periods and in certain countries, the relative positions of the signatures of the astrolabist and the decorator were more or less fixed, it is impossible to establish a rule that would apply even to one master, let alone to one workshop or one generation, without immediately having to quote a series of exceptions. But, broadly speaking, one could summarize the position as follows.

On the whole the astrolabists signed their instruments on the back¹. The bracket was either left empty, or ornamented or adorned with quranic inscriptions. If it contained an inscription (or inscriptions) with personal names, then the face was reserved either for the name of the patron or for a eulogy on the reigning sovereign, or for a combination of both. It is characteristic of this spirit that in the few cases in which an inscription of this kind extended over both sides of the astrolabe, it began on the back with the name of the astrolabist and continued on the front with the name of the "really important" person, namely the patron, or the reigning sultan or the teacher of the astrolabist².

The makers of the earliest extant astrolabes, i.e. those of the fourth century of the Hijra, engraved their signatures on various parts of their instruments, without any visible preference. It is only in the course of the fifth century (for which we can compare eight astrolabes, all made in Spain), that the signature appeared more or less regularly on the upper half of the back, across the space above the square of shadows, either in a straight line or in a circular one. Nothing has survived from that period in Persia, but in the sixth century (including an astrolabe made in A. H. 496) Isfahan astrolabists began signing across the lower half, below the square of shadows. During the first half of the 7th century Spain showed a preference for signatures on the bracket (due perhaps to the preponderance of astrolabes made by one master, Muḥammad b. Fattūḥ), whereas the North African astrolabists continued till the first third of the 8th century, to sign across the upper half of the back, as did

¹ So far as my material allows to judge there are only three exceptions to this rule, viz. Muḥammad b. Muḥammad b. Hudhail of Murcia (A.H. 650), Aḥmad b. 'Umar (A.H. 933), and Muṣṭafà Ayyūbī, somewhere in the Ottoman Empire (A.H. 1110).

² Cf. e.g. 'Abd al-Karīm al-Miṣrī (A.H. 625), as-Sahl (A.H. 698 at the latest) or Ḥusain b. 'Alī (A.H. 709), without quoting, of course, those instances when one cannot be sure that the name of the patron was engraved at the same time as that of the master. Even in the astrolabe of Aḥmad b. Khalaf, where his — as well as Ja'far's — name figures on the same side (the back), Aḥmad's name appears on the outer circular margin, whereas Ja'far's is more prominently displayed on the bracket.

the Spanish masters in the previous century. The Syro-Egyptian and Persian astrolabes of that period are so few and so differentiated that at the present state of our knowledge one should not attempt to classify them.

It is only since the middle of the 11th century of the Hijra — and by that time astrolabes still extant were produced almost exclusively in Persia and its cultural dependencies — that we see a new development. Starting within the precincts of the square of shadows, the signature moved soon below it and for the next two centuries appeared as a rule in a cartouche. If the maker and the decorator of the instrument were two different persons, the name of the decorator was placed in a separate cartouche, below the signature of the maker¹. The few North African astrolabes which have survived from that period, show such a lack of uniformity that we can safely discard them.

Form of dates. As a rule dates are given in letters, centuries first, decades second, single years third. There seems to be only one exception to this, viz. the case of Aḥmad b. Ḥusain al-Bāṣo. On his astrolabe, dated 709, the sequence is the one usual in literary Arabic, the unit coming first and the century last. His other instruments conform to the common practice of his fellow astrolabists. Since — contrary to usage on monumental inscriptions and coins — Cufic letters on astrolabes are quite commonly provided with diacritical points, the hazards of mistaken interpretation are very slight, although nobody would deny that they exist. In the tenth (sixteenth) century letters were generally replaced by figures, more especially in the Maghrib, but the oldest example is much earlier, viz. 695 ('Umar b. Yūsuf). It is only exceptionally that on a Muslim astrolabe the date is indicated in words (e.g. 'Abd al-Ghafūr; Aḥmad and Muḥammad, sons of Ibrāhīm; Ḥasan b. 'Alī; Muḥammad Ṣaffār; Muḥammad Amīn II, in the last case both in words and figures).

¹ There are, of course, many exceptions. Some astrolabists occasionally left the cartouche out, some moved the cartouche back into the square of shadows, on one occasion the name of the decorator appeared in a cartouche below the square of shadows and the name of the astrolabist on the outer circular margin underneath it (Khalīl Muḥammad XV).

The era is, of course, that of the Hijra, even if it is not specified. But in a relatively high number of Persian signatures¹ the Yezdegerd era is used besides the Muhammadan one, and occasionally the Seleucid one ("era of Alexander") as well. There seems to be not a single instrument inscribed in Arabic letters dated — even additionally — according to the Christian era,² or "since the years of Adam" or "since the creation of the world" (following either Jewish or Christian reckoning) or solely in accordance with any other lesser chronological system used in the lands of Islam.³ This is particularly surprising with regard to the Ilkhanids, patrons of astronomers, and more especially of the Observatory of Marâgha, whose era one would expect to find on the — astonishingly few — instruments which have survived from that time.

The trustworthiness of dates. But in whichever form the date is expressed, it is our only reliable help in assigning an instrument to a short limited period. For this purpose circumstantial evidence, such as the invocation of the name of the ruler, or the dedication to a patron (if and when he can be identified), or a proprietor's mark, can be even less depended on than in other cases. Although a great number of astrolabes, as well as other scientific instruments, were without any doubt made to order, a great many must have been made without it and kept in stock

¹ It is possible that there is an exception, viz. Muḥammad b. Muḥammad al-Ḥāshimī, the constructor of a globe, now in the Bibliothèque Nationale, Paris. He was born in Mecca, and there is nothing to indicate that he was Persian by race or education. A second case, namely that of the astrolabe of Maḥmūd b. 'Alī b. Yusha' which at first glance also looks like an exception, cannot be seriously considered as such. Maḥmūd's nisba appears in the form [. . .]rī; this was completed and read as Miṣrī; the name of the patron, al-Ḥasan b. 'Alī ash-Shadīd, was taken as being identical with Abu-l-Ḥasan 'Alī b. Muḥammad, the vizier of Baybars I, and, consequently, the astrolabe was attributed to Egypt. Needless to say this is no more than a flight of fancy.

² One should expect it the more so since on many Arab astrolabes names of months appear in a Christian garb.

³ There is one case of the Jalālid era (Muḥammad Muḥsin) having been used together with the Hijra, Yezdegerd and Seleucid ones, and one of Malikshāh's (Maḥmūd b. 'Alī b. Yusha') used in conjunction with the same three eras.

until a buyer presented himself. In most of these cases the bracket must have been left blank so that the name of the future buyer could be engraved on the empty surface. That this is not a mere guess is best proved by the fact that quite a few astrolabes have survived which show such blank brackets, e.g. 'Abd al-A'imma XX, 'Abd al-'Alī IV, 'Alī b. Ṣādiq VI, Ja'far b. 'Umar IV, Khalīl Muḥammad XVII.

Consequently, if there is a discrepancy between the period during which a well-known astrolabist worked and that during which the patron mentioned on the instrument lived and flourished, we can safely ignore the latter as having any bearing on the date of the astrolabe. A good case in point is the astrolabe of 'Abd-al-A'imma the Elder, whose signature is dated A.H. 986, but whose instrument prominently displays the name of Shah 'Abbās who did not ascend the throne until three years later. The simplest and most obvious explanation is that 'Abd al-A'imma made his astrolabe at the date indicated, kept the magnificent instrument in storage during the troubled years before the accession of 'Abbās I and engraved the dedication at a suitable moment years later.

Some went even further and were complaisant enough to leave blank the cartouche below the square of shadows, a place traditionally reserved for the signature of the astrolabist or the decorator. It would have been easy, therefore, for anybody so inclined to insert his own name as the maker of the object. Cf. e.g. pl. XXIV.

A case in point which does not affect the date is an astrolabe in the Hermitage (VC 939). The front part of the bracket was left blank, on the back of the bracket appears the signature of the astrolabist (*ṣana'ahu Khalīl Muḥammad*), in a cartouche below the square of shadows the signature of the decorator (*wa-namaqahu al-'abd 'Abd al-A'imma*). It is quite unusual to join in this way the names of two masters who are mentioned separately and thus make one out of two widely separated cartouches. But looking more closely one can see that the lower one has been tampered with; between the letters of the word *al-'abd* are still clear traces of the word *ṣana'ahu*, which was obviously erased when the astrolabe received its second signature. This must have been done quite amicably (conceivably the prominent display of Khalīl's

name on the bracket was even intended to be a kind of dedication), since 'Abd al-A'imma engraved both signatures himself. A similar distribution of the two signatures but without the erasure and without the incriminating *wa* can be seen on an astrolabe in the collection of M. N. E. Landau, Paris (cf. s.v. Khalîl Muḥammad, No. XVIII).

Such practice will not make us discard all signatures as potential fakes, but merely make us cautious. As a rule it is quite easy to discern a modern or relatively modern signature from an old one, more especially if it appears on an astrolabe considerably older (cf. e.g. García Franco, *Catálogo*, pl. 8). It is more difficult to decide whenever the lapse of time was relatively short.

Characteristics of signatures. Signatures of Islamic astrolabists are particularly free of mannerisms, as well as of distinctive features for that matter. Whenever a greater number of astrolabes made by the same person allow us to make comparisons, we observe changes in the way the masters wrote their names which demonstrate beyond doubt that the vast majority of them made no attempt to establish a kind of trade-mark by signing their instruments always in the same manner. Just as the place of signature changed, so did the type of script, from quick (not to say negligent) to elaborate and careful. Even the formulae (apart from those which had to be changed for reasons of fact) did not remain always the same. Shams ad-dîn Muḥammad Ṣaffâr signed four instruments beginning each time with the phrase "finished the making of this astrolabe" (*qad faragha min ṣan'at hadhâ-l-aṣṭurlâb*), on the fifth he left the first four words out, although the missing words deprived the signature of the essential verb.¹ Khalîl Muḥammad, 'Abd al-A'imma and many others changed considerably the text of their signatures. The more remarkable, therefore, is the fact that after Ja'far b. 'Umar adopted a

¹ I am grateful to Mr. Maddison who very kindly examined this astrolabe, at present in the Museum of the History of Science in Oxford, especially from this point of view. He confirmed that the operative words are not hidden by the alidade and that it was unlikely that they could have figured on the bracket and been erased at a later date.

curious form of the final *yâ* for his *nisba*, his son and even his grandson retained it in their signatures. 'Alî b. Ṣâdiq had a peculiar way of invariably misplacing a letter in the name of his father, which characterizes his signature as much as the screw-like paraph does that of Dickens. Muḥammad b. Aḥmad al-Mizzî wrote the *yâ* of his *nisba* in a way which gave some Orientalists the impression that it stands for two letters (*hamza* and *yâ*). Muḥammad al-Khâdim al-Yazdî had such an unmistakable way of abbreviating the word *al-'abd* in his signature on some of his astrolabes, that it alone is almost as good as a trade-mark. Yet, all these, and several more one could quote, are exceptions, and the rule is that the signatures vary.

The background of astrolabists. The connection between astrolabists and metal workers in general can be presupposed *a priori*, since—as we saw—most of them used to make their astrolabes themselves. This is confirmed by the appellatives of the masters or those of their fathers. Leaving names like *qarastûnî* alone, we find some like al-Ibrî, Ibn an-Naqqâsh, Ṣaffâr and Ibn aṣ-Ṣaffâr, or Ibn an-Naḥḥâs abounding even among those astronomers who are not known as makers of instruments. This worked both ways, since we have also metal objects which are in no way connected with either astronomy or science in general, yet on the evidence of their inscriptions we know that they were made by astronomers (again using the word in a wide sense so as to include all "time-measurers") or their sons, such as the little bronze jug made by 'Alî b. *muwaqqit* al-Isfîrâ'inî.¹ Similarly, we read that time-keepers (*mîqâtiyya*) in Yemen constructed an automaton, a bronze candlestick with the figure of a man who was made to pronounce a few words of greetings, every day at dawn. A gift of the Royal house of Yemen to the Ayyubid al-Malik al-Kâmil Muḥammad (1218-1238) it disappeared from the Egyptian treasury in the days of Muḥammad b. Qalâûn (1294-1341).²

¹ Formerly in the Peytel collection, *Meisterwerke*, pl. 151; Wiet, *L'exposition persane de 1931*, p. 32, pl. V.

² Ibn Iyâs, I, p. 78, ll. 16-20; Herz, *Catalogue*, 1906, p. 168, without reference.

ROLL OF ASTROLABISTS

'ABD AL-A'IMMA THE ELDER

'Abd al-A'imma the Elder, an astrolabist who flourished during the third quarter of the 10th (16th) century, is known by one instrument only, although it is possible that some of the undated astrolabes listed here among those made by 'Abd al-A'imma the Younger, *q.v.*, are really his work. In 986 (1578/9) he made (*ṣana'ahu*) an astrolabe, formerly in the collection of Mr. Hakim, London, present owner unknown. With regard to the discrepancy between the date of this instrument and the inscription on the bracket which affirms that it was made during the reign of Shah 'Abbās (who did not ascend the throne until three years later) see Introduction, p. 19.

'ABD AL-A'IMMA THE YOUNGER

'Abd al-A'imma the Younger, an astrolabist who lived at the end of the 17th and beginning of the 18th century is known by several astrolabes and other scientific instruments. It is possible, perhaps even probable, that some of the undated objects listed here were in reality made by 'Abd al-A'imma the Elder, *q. v.*

I. In 1100 (1688/9) he made an astrolabe, present owner unknown. Bibl.: R. Murdoch Smith, *Persian art*, 2nd ed., 1876, p. 71; Mittwoch, *apud* Sarre, *Erzeugnisse islam. Kunst. I. Metall*, 1906, p. 82.

II. In 1117 (1705/6) he made an astrolabe, now in the collection of M. Charliat, Paris.

III. In 1121 (1709/10) he made an astrolabe, now in the Allen Memorial Art Museum, Oberlin College (No. 45.35).

IV. In 1121 (1709/10) he made an astrolabe, formerly in the Ernest Kanzler collection, now in the Detroit Institute of Arts.

Bibl.: Weibel, Persian astrolabe, *Bull. Detroit Instit. of Arts*, 1946, pp. 59-61, ill.; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 84.

V. In 1124 (1712) he made an astrolabe for Ḥâjjî Isma'îl Beg, director of the arsenal (*jabbâdâr bâshî*), now in the Lewis Evans collection, in the Museum of the History of Science, Oxford.

Bibl.: Gunther, 1932, pp. 151-153, No. 38, figs. 73-75, pl. XXXVII; Aga-Oglu, *op. laud.*, pp. 83 f.

VI. In 1127 (1715) he made an astrolabe, now in the Victoria and Albert Museum (No. 458-1888). [In collaboration with B. W. Robinson.]

Bibl.: Roberts-Austen, Alloys, *Jour. Soc. of Arts*, 1893, fig. 1 on p. 1010; Christie, *Legacy of Islam*, 1931, p. 115, fig. 16 (here attributed to 'Abd al-Ḥamîd); Gunther, 1932, p. 148, No. 34; Weibel, Persian Astrolabe, *Bull. Detroit Inst. of Arts*, 1946, p. 61; Wingham, *Report*, 1892, p. 16, No. 19.

VII. In 1132 (1719/20) he made and decorated (*ṣana'ahu wa-namaqahu*) an astrolabe for the Prince 'Alîqulî, now in the collection of M. N. E. Landau, Paris.

In a note to his article (p. 84), Aga-Oglu mentioned three more astrolabes of 'Abd al-A'imma, dated 1089, 1115, 1124 resp. Unfortunately, he did not say where he saw them. At unspecified dates 'Abd al-A'imma made (*ṣana'ahu*) several more astrolabes, of which the following have come to our notice:

VIII. One, formerly in the Meyerhof collection, Cairo.

Bibl.: Wiet, *Exposition d'art persan*, 1935, p. 68, No. M. 93; *Morancé Album*, pl. 50; Wiet, *Epigraphie, MIE*, 1935, p. 19.

IX. One, formerly in the Harari collection, now in the Museum of Islamic Art, Cairo.

Bibl.: Wiet, *Epigraphie, MIE*, 1935, p. 19.

X. One, now in the Musée Alaoui, Le Bardo, Tunis.

XI. One, now in the Evans collection, in the Museum of the History of Science, Oxford. Cf. pl. XXI *a*.

Bibl.: Gunther, 1932, p. 149, No. 35.

XII. One, originally made for Rustam Khân Dunbalî b. 'Alî Khân, now in the Evans collection, in the Museum of the History of Science, Oxford. Cf. pl. XXI *b*.

Bibl.: Gunther, 1932, pp. 149 f., No. 36.

XIII. One, in the Chadenat collection, La Ferté-Bernard.

Bibl.: *Expos. des instr.*, Paris, 1936, p. 35, No. 262.

XIV. Nic. de Khanykov had in his private collection an astrolabe signed by 'Abd al-A'imma, apparently undated.

Bibl.: Khanykov, Lettre à M. Dorn, *Bull. hist. phil.*, 1855, col. 173 = *Mél. As.*, 1856, II, p. 453.

XV. One, made for Mirza Isma'îl, formerly in the S. V. Hoffman collection, now in the collection of Mr. Eugene A. Hoffman, West Tisbury.

Bibl.: Gunther, 1932, p. 154, No. 39.

XVI. One, once in the possession of Sayyid Bahadur Shah, Lahore.

XVII. One, now in the Museum of Fine Arts, Boston (No. 42, 303).

Bibl.: Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83, ill.

XVIII. One, now in the National Maritime Museum, Greenwich (A. 14-36. 1). Cf. pl. XX.

XIX. One, now in the Hermitage Museum, Leningrad (VC. 941).

Bibl.: Unpublished (?). It may be identical with the one once in the Khanykov collection, *vide supra*, No. XIV.

XX. One, presented by Prince 'Alî Qulî Mîrzâ to the Observatoire in Paris.

Bibl.: Sédillot, Description, *Annales de l'Observ. de Paris, Mémoires*, 1868, pp. 164-71; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 84.

XXI. At an unspecified date he made an astrolabe for Mahdî Qulî, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, p. 154, No. 40.

XXII. At an unspecified date he made and decorated (*şana'ahu wa-namaqahu*) an astrolabe, formerly in the collection of Sir William Townley, now in the Lewis Evans collection in the Museum of the History of Science, Oxford. As pointed out by Aga-Oglu, what Knobel read as the date is really the word *şana'ahu*.

Bibl.: Gunther, 1932, pp. 125 f., No. 11, pl. XXIX; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, 1947, p. 83.

XXIII. He also made and decorated an astrolabe now in the collection of M. Claudius Côte, Lyons.

XXIV. At an unspecified date he designed (*namaqahu*) astrolabes made (*şana'ahu*) by other scholars. One signed by Muḥammad Amîn b. Muḥammad Ṭâhir, is now in the City Art Museum of St. Louis.

Bibl.: C. P. D(avis), Muhammedan Metal Work, *Bull. of the City Art Mus. of St. Louis*, Oct. 1926, p. 53, ill.

XXV. The other, signed by Khalîl Muḥammad, is now in the Hermitage Museum, Leningrad (VC. 939).

XXVI. Also at an unspecified date he made a compass, formerly in the Harari collection, now in the Museum of Islamic Art, Cairo.

Bibl.: Wiet, Epigraphie, *MIE*, 1935, p. 19.

Two astrolabes show the name of 'Abd al-A'imma, without specifying whether he made or decorated them, viz.:

XXVII. One, formerly in the Clay collection, now in the Museum of the History of Science, Oxford (C. 580).

XXVIII. The other was formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, p. 151, No. 37.

'ABD AL-'ALÎ

'Abd al-'Alî b. Muḥammad Rafî' al-Juz'î,¹ is known by seven instruments.

I. In (1)119 (1707/8) he made (*şana'ahu*) an astrolabe, now in the Molla Feeroze Library, Bombay.

Bibl.: Rehatsek, Labours, *Journal of the Bombay Branch of the Royal Asiatic Society*, 1875, vol. XI, pp. 327-329, figs. 2-11; Kharegat, *Astrolabes*, 1950, pp. 55-74, ill., esp. p. 59, fig. 10.

II. In Sha'bân 1124 (1712/3) he finished (*şana'ahu*) an astrolabe for Shâh Ḥusain aṣ-Ṣafawî, formerly in the Sloane collection, now in the British Museum. It was decorated (*namaqahu*) by Muḥammad Bâqir who described himself as the brother of the maker (*şâni'*).²

Bibl.: Morley, *Description*, 1856, esp. p. 31, pls. I, XVII; da Schio, *Di due astrol.*, 1880, pp. 56 f., No. 23; Franks, 'Instruments', 1896, p. 183; Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 227; Gunther, 1932, pp. 147 f., No. 33, esp. pls. I, XVII; Michel, *Traité*, 1947, pp. 180, 184.

III. In 1126 (1714) he made an astrolabe, engraved (*namaqahu*) by his brother Muḥammad Bâqir (cf. No. 11). It is now in the Musée Archéologique, Teheran.

IV. At unspecified dates, he made (*şana'ahu*) at least three astrolabes, one of them again decorated (*namaqahu*) by Muḥammad Bâqir. It is now in the Kunsthist. Museum, Wien (No. 9839). Cf. pl. XXII.

V. A second astrolabe, once in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Exposition . . . Liège*, 1939, p. 60, No. 319; id., *Expos. Bruxelles*, 1945, p. 8, A. 8; id., *Traité*, 1947, pl. XVII; Josten, *Instruments*, 1954, p. 12, No. 11.

¹ The word can be read in several ways: Ḥarbî, Jarbî, etc.

² The famous astrolabist and maecenas who had an astrolabe made for himself in 1070 (1659) (cf. s. v. Muḥammad Mahdî) is obviously another man.

VI. A third is now also in the Billmeir collection. [In collaboration with F. R. Maddison.]

VII. A fourth, now in the Evans collection in the Museum of the History of Science, Oxford, without date (despite Gunther's reading A.H. 874), but at the back of the rete there is a date, viz. 1119 (1707/8).

Bibl.: Gunther, 1932, pp. 123-125, No. 10, pl. XXVIII.

'ABDALLAH B. MUḤAMMAD AMÎN

'Abdallah b. Muḥammad Amîn, in 1127 (1715) made an astrolabe, now in the collection of Messrs Maggs Bros., London. The date seems to indicate that 'Abdallah might have been the son of either Muḥammad Amîn or Muḥammad Amîn b. Muḥammad Ṭâhir (p. 63).

'ABDALLAH B. SÂSÎ

Abu-ṭ-Ṭayyib 'Abdallah b. Sâsî al-falakî, an astronomer from Safi in Morocco, in 1099 (1687/8) made (*ṣan'at*) an astrolabe, now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, pp. 290 f., No. 145, fig. 134, pl. LXIV; Renaud, *Quelques constructeurs*, *Isis*, 1942, p. 23; Michel, *Traité*, 1947, p. 180.

'ABD AL-BÂQÎ

Sayyid 'Abd al-Bâqî b. Sayyid Ḥusain in 1204 (1789/90) made and decorated (*ṣana'ahu wa-namaqahu*) an astrolabe, formerly in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Expos. Bruxelles*, 1945, p. 8, A. 11; id., *Exposition . . . Liège*, 1939, p. 60, No. 320; id., *Traité*, 1947, pl. XIX; Josten, *Instruments*, 1912, pp. 12 f., No. 12.

'ABD AL-GHAFÛR

'Abd al-Ghafûr in Rajab 1095 (beg. 14th June, 1684) made and decorated (*ṣana'ahu wa-namaqahu*) an astrolabe, once in the Marling collection, now in the Victoria and Albert Museum (826-1928).

'ABD AL-GHAFÛR B. MUḤAMMAD SA'ÎD

'Abd al-Ghafûr b. Muḥammad Sa'îd is known by two astrolabes.

I. In 1198 (1783/4) he made (*'amal*) an astrolabe, formerly in the S. V. Hoffman collection.

Bibl. Gunther, 1932, pp. 166 f., No. 55, fig. 81, pls. XLII, XLIII; Michel, *Traité*, 1947, p. 180.

II. At an unspecified date¹ he² made (*'amal*) an astrolabe, now in the Hermitage Museum, Leningrad (VC. 510).

'ABD AL-KARÎM

'Abd al-Karîm, in 1216 (1801/2) engraved (?) an astrolabe, made by Ṣâdiq, *q.v.*, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 164 f., No. 53, fig. 80; Michel, *Traité*, 1947, p. 180.

'ABD AL-KARÎM AL-MIŞRÎ

'Abd al-Karîm al-Miṣrî, an astrolabist, worked for the last Ayyubid al-Malik al-Ashraf Mûsà, the first Mamluk Sultan al-Malik al-Mu'izz Aybak and an amir (?) Shihâb ad-dîn.

¹ Apparently it was the intention of the master to engrave it on the back of the bracket as he did on the first astrolabe. However, he left the instrument unfinished, having marked only the lines and the arabesques on the border.

² Although only the second astrolabe shows the name of the father, in view of very many common features of the two instruments, there can be no doubt that both are the work of one man.

I. In 625 (1227/8) he made (*ṣana'ahu*) an astrolabe shown in the Paris Exhibition of 1900, formerly in the collection of Comtesse de l'Espinasse, now in the Evans collection in the Museum of the History of Science, Oxford. He signed it al-Malikî al-Ashrafî al-aṣṭurlâbî.

Bibl.: Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 227; *Musée Rétrospectif*, 1900, pp. 21 f., No. 27, pl. I, fig. 2; Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, I, pp. 233-236, pls. LIII, LIV; *Rép.*, X, 1939, pp. 260 f., No. 3989; Hartner, *Survey*, 1939, III, fig. 851 on p. 2548; Michel, *Traité*, 1947, p. 183; Barrett, *Islamic Metalwork*, 1949, p. XVI, n. 3; *Brief guide to the Museum . . . of Science, Oxford*, 1949, p. 14.

II. In 633¹ (1235/6) he made (*ṣana'ahu*) a planispheric astrolabe in Cairo, now in the British Museum. Cf. pl. XII b.

Bibl.: Morley, *Description*, 1856, pp. 47 f.; Dorn, *Drei Instrumente*, 1865, p. 3; Lane-Poole, *Art of the Saracens*, 1888, p. 213; Franks, 'Instruments', 1896, p. 182; van Berchem, Notes, III, *JA*, 1904, I, p. 32, n. 2; Mittwoch, *apud* Sarre, *Erzeugnisse islam. Kunst. I. Metall*, 1906, p. 81; Kühnel, Globus, *Mitt. aus d. Sächs. Kunstsamml.*, 1911, p. 22; Evans, *l. cit.*, 1911, p. 227; Gunther, *Early science in Oxford*, 1923, II, p. 191; Migeon, *Manuel*, 2nd ed., 1927, II, p. 58; Wiet, *Cuivres*, 1932, Append. p. 172, No. 45; Gunther, 1932, pp. 236 f., pl. LV; Hauteœur et Wiet, 1932, p. 90; Harari, *Survey*, 1939, III, p. 2518, n. 7; *Rép.*, XI, 1941, p. 54, No. 4080; Michel, *Traité*, 1947, p. 183; Barrett, *Islamic Metalwork*, 1949, pp. XVI, XXII, pls. 19 f; da Schio, *Due astrol.*, 1880, p. 56, No. 22.

¹ The date of this instrument, viz. A.H. 633, presented a little problem for anyone who knew that in that year no sultan called al-Malik al-Ashraf or al-Malik al-Mu'izz ruled in Egypt, where this astrolabe was made. Furthermore, it might have been easily realized that no Ayyubid sultan was ever called al-Mu'izz, and that the instrument, therefore, belongs to the Mamluk period. Max van Berchem rightly concluded that the date was wrong and suggested that the instrument could have been made only during the years 648-650, the only period when two sultans each bearing one of these names ruled in Cairo. An examination of the original proves beyond doubt that the lower part of the signature, as a matter of fact anything except the first two lines, was erased and re-engraved and that, consequently, neither the date nor the titles of the two sultans can be relied upon. But in fairness it ought to be pointed out that the one and only letter of the re-engraved part which looks as if it had been left intact is the letter *lâm*, representing the figure 30 in the date. Cf. pl. XII b.

'ABD AL-QÂDIR

'Abd al-Qâdir b. Abî Ṭâhir, in or after 913 (1507/8), made a sun-dial at the Mausoleum of the Amîr Kabîr, Cairo.

Bibl.: van Berchem, Notes, II, *JA*, 1892, p. 390, n. 1; *CIA. Eg.*, I, 1894-1903, p. 593.

'ABD AR-RAḤÎM

'Abd ar-Raḥîm, at an unspecified date made (*'amal*) an astrolabe, formerly in the Michel collection, now in that of M. R. Greppin, Brussels.

Bibl.: Michel, *Exposition . . . Liège*, 1939, p. 60, No. 321; id., *Expos. Bruxelles*, 1945, p. 8, A. 9; id., *Traité*, 1947, pl. XVIII.

'ABD AR-RAḤMÂN

Ḥâfiẓ 'Abd ar-Raḥmân in 1186 (1772/3) designed (*rasama*) a sun-dial for the Sulaimaniyye-Mosque, Istanbul.

Bibl.: Ünver, Cadrans solaires, *Archives d'hist. des sciences*, 1954, p. 257, fig. 2.

'ABD AR-RAḤMÂN B. BURHÂN

'Abd ar-Raḥmân b. Burhân of Mosul, in 718 (1318/9) made (*'amal*) a celestial sphere, now in the Chadenat collection.

Bibl.: *Expos. des instr.*, Paris, 1936, p. 2, No. 11.

'ABD AR-RAḤMÂN B. YÛSUF

'Abd ar-Raḥmân b. Yûsuf, in 598 (1202/3) made an astrolabe in Damascus, now in the Victoria and Albert Museum, London (No. 504, 1888).

Bibl.: Roberts-Austen, Alloys, *Journal Soc. of Arts*, 1893, vol. 41, p. 1009; Gunther, 1932, p. 233, No. 102; *Rép.*, IX, 1937, p. 238, No. 3542; Reich et Wiet, 1939, p. 200; *Rép.*, XIII, 1944, pp. 149 f., No. 5012; Wingham, *Report*, 1892, p. 11, No. 9.

'ABDÎ

'Abdî, in 1125 (1713) designed (*rasamahu*) an astrolabe now in the possession of Bay Fahri Imrek, Balikesir.

ABÛ BAKR B. YÛSUF

Abû Bakr b. Yûsuf, an astrolabist of the early 7th (13th) century, worked in Marrakesh.

I. In 605 (1208/9) he made (*şana'ahu*) an astrolabe, now in the Observatory of Strasbourg.

Bibl.: Sarrus, Description, *Mém. de la Soc. du Mus. d'hist. nat.*, Strasbourg, 1853, pp. 1-32, esp. p. 8, pls. 1-6; Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 226; Gunther, *Early science in Oxford*, 1923, II, p. 191; Boffito, *Strumenti*, 1929, p. 13, pls. 11 f; Gunther, 1932, pp. 263-267, figs. 125 f; *Expos. des instr.*, Paris, 1936, p. 34, No. 252; *Rép.*, X, 1939, p. 25, No. 3636; Renaud, Quelques constructeurs, *Isis*, 1942, p. 21; Michel, *Traité*, 1947, p. 180; Mieli, *Panorama*, 1952, p. 132, figs. 16 f.

II. In 613 (1216/7) he made an astrolabe, once in the Dominican monastery of Toulouse, then in the collection of the astronomer Vidal l'Hermophile, then in that of the Société Archéologique du Midi, and now in the Musée Saint-Raymond of Toulouse. It was exhibited at the Exposition d'antiquités, d'objets d'art et de peinture ancienne, Toulouse, 1858, No. 80.

Bibl.: de Rey-Pailhade, Astrol. arabe de l'an 613, *Bull. de géogr. hist.*, 1890, pp. 217 f.; id., *Bull. de la Soc. archéol. du Midi*, April-July 1890, p. 53, Nov. 1890-March 1891, pp. 27 f., 60 f.; *Bulletin municipal*, Toulouse, 1934, p. 1020, No. 224/12; 1939, p. 605, ill.; Michel, *Traité*, 1947, p. 180.

III. A similar instrument, once in the Marcel collection, seems to have been missing for over ninety years.

Bibl.: Sédillot, *Instrum.*, 1841, p. 35; id., *Matériaux*, 1845, p. 341; Jomard, *Monuments*, 1854, pl. III; Dorn, *Drei Instrum.*, 1865, p. 3, No. 15; da Schio, *Due astrol.*, 1880, p. 56; van Berchem, Notes II, *JA*, 1892, I, p. 390.

IV. In 615 (1218/9) he made an astrolabe, once in the collection of Baron de Larrey, present owner unknown.

Bibl.: Sédillot, *Instruments*, 1841, pp. 173, 175-177; id., *Matériaux*, 1845, I, pp. 342, 344-347; Sarrus, *op. laud.*, 1853, p. 2; Woepcke, Paris . . . Astrolabium, *Bull. Ac. St. Petersb.*, 1864, col. 220, n.; Dorn, *Drei Instr.*, 1865, pp. 3, 83; Janér, Astrolabio, *Mus. Esp. de Ant.*, 1874, p. 560; da Schio, *Di due astrol.*, 1880, p. 56, No. 14; Sauvage et de Rey-Pailhade, Une mère d'astrolabe, *JA*, 1893, p. 15, n. 1; Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 227; Gunther, 1932, pp. 267 f., No. 125; *Rép.*, X, 1939, p. 149, No. 3813; Renaud, Quelques constructeurs, *Isis*, 1942, p. 21; Kharegat, *Astrolabes*, 1950, pp. 88 f.

ABU-L-QÂSIM B. 'ABD AR-RAĤMÂN

Abu-l-Qâsim b. 'Abd ar-Raĥmân b. Ḥasan, at an unspecified date made (*istaşna'ahu wa-staşwarahu*) a celestial globe of brass, now in the Molla Feeroze Library, Bombay.

Bibl.: Rehatsek, Labours, *Journal, Bombay Branch of the R. As. Soc.*, 1875, pp. 329 f.

ABU-L-QÂSIM B. ḤASAN

Abu-l-Qâsim b. Ḥasan ash-Shaddâd, worked in Tunis, where in 746 (1345/6) he made (*şana'ahâ*) a gnomon, now in the Musée Lavigerie, Carthage.

Bibl.: *CRAIBL*, 29.1.1926, pp. 30 f.; Ryckmans et Moreau, Gnomon, *Muséon*, 1926, p. 33, 1 pl.

ABU-Ṭ-ṬÂHIR

Abu-ṭ-Ṭâhir, in 749 (1348/9) made (*şana'ahu*) an ivory gnomon for Shaikh Shihâb ad-dîn Aĥmad b. 'Abdallah, known as Ibn al-Aqnâ' (?), now in the Benaki Museum, Athens.

Bibl.: *Exposition d'art musulman*, Alexandria 1925, p. 87, No. 441; *Morancé Album*, p. 9, pl. 4; Meyerhof, Kunstaustellung, *Islam*, 1927, p. 152; Schmalzl, *Quadranten*, 1929, p. 31, n. 1; *Guide, Benaki Museum*, 1936, p. 79, No. 28; Reich et Wiet, 1939, p. 202.

AḤMAD

Aḥmad, in 1228 (1813) made an astrolabe for Sultan Muḥammad, formerly in the collection of W. S. W. Vaux, present owner unknown. Bibl.: Morley, *Description*, 1856, pp. 39-41, pls. XX f.; da Schio, *Due astrol.*, 1880, p. 57, No. 27; Gunther, 1932, p. 215, pls. XX f.

AḤMAD B. 'ABD AR-RAḤMÂN

Aḥmad b. 'Abd ar-Raḥmân ad-Dahmânî, in 854 (1450/1) made a quadrant, now in the Museo Arqueológico Nacional, Madrid (Electrotype, Science Museum, London, 1877-5).

Bibl.: Atchison, *Catalogue of a loan coll.*, 1877, p. 397, No. 1775 a; *Catal.*, *Expos. hist. europea*, 1893, No. 253; Franks, 'Instruments', 1896, p. 183; Alvarez-Ossorio, *Una visita*, 1925, p. 98; García Franco, *Catálogo*, 1945, pp. 371 f., pls. 54 f.; Millás Vallicrosa, *Tres instrumentos, Al-Andalus*, 1947, pp. 61-64, pl. 4.

AḤMAD B. ABÎ BAKR

Shihâb ad-dîn Aḥmad b. Abî Bakr as-Sarrâj al-Ḥamawî, author of several books on scientific instruments and geometrical problems, inventor of a quadrant called *al-muqanṭarât al-yusrâ*, died in or after 729 (1328/9) in Aleppo. In 729¹ he made ('amila) a universal lamina for Muḥammad b. Muḥammad at-Tanûkhî, now in the Benaki Museum, Athens.

Bibl.: Ahlwardt, *Verzeichniss*, Bd. 5, 1893, p. 234, No. 5799, p. 256, No. 5844, p. 264, No. 5859; Suter, *Mathematiker*, 1900, pp. 199 f., No. 508; *Exposition d'art musulm.*, Alexandria 1925, p. 78, No. 401; *Morancé Album*, p. 10, pl. 8; Meyerhof, *Kunstaussstellung, Islam*, 1927, p. 152; Devonshire, *Moslem objects, Burl. Mag.*, Oct. 1928, p. 196, pl. I D; Schmalzl, *Quadranten*, 1929, p. 108; Combe, *Cinq cuivres, BIFAO*, 1931, t. 30, pp. 54-56; Gunther, 1932, p. 285, No. 140, fig. 133; *Guide, Benaki Museum*, 1936, pp. 79 f., No. 30; Reich et Wiet, 1939, p. 201; Sarton, *Introduction*, 1948, III. 2, p. 1525; *GAL*, 2nd ed. 1949, II, p. 155; *Rép.*, XIV, 1954, p. 252, No. 5569.

¹ This date proves that Aḥmad's book about sinus-quadrants, *ad-Durr al-gharîb*, was dedicated to Bayezid I and not to Bayezid II.

AḤMAD B. 'ALÎ

Aḥmad b. 'Alî ash-Sharafi, in 729 (1328/9) while in al-Qal'a (in Spain?) made ('amal) an astrolabe, now in the Statens Sjöhistoriska Museum, Stockholm (Acc. No. S. 1565).

AḤMAD AL-ḤARÎRÎ

Aḥmad al-Ḥarîrî, in 785 (1383) made ('amal) a sun-dial for the Mosque of Qauṣûn, Cairo.

Bibl.: van Berchem, *Notes*, II, *JA*, 1892, I, p. 388; *CIA. Eg.*, I, 1894-1903, p. 179, No. 122, pl. V. 3.

AḤMAD B. ḤASANAIN

Aḥmad b. Ḥasanain b. Baraka,¹ at an unspecified time made an astrolabe, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, p. 289, No. 144; Michel, *Traité*, 1947, p. 181.

AḤMAD B. ḤUSAIN B. BÂŞO

Aḥmad b. Ḥusain b. Bâşo² was *muwaqqit* in the Main Mosque of Granada. He was famous for his instruments, for which people competed in paying high prices (*taghâlâ an-nâs fî athmânihâ*).

I. In 664 (1265/6) he made (*şana'ahu*) an astrolabe, formerly in the Gayangos collection, now in the R. Academia de Historia, Madrid.

¹ In transcribing this name I follow Gunther—or rather his epigraphist D. S. Margoliouth, who seems to be the only Arabist who ever saw this astrolabe—although there can be little doubt that the correct form is Aḥmad b. Ḥusain b. Bâşo, *q.v.*

² His earliest astrolabe is signed Bâş, all the others Bâşo. باصو

Bibl.: Ibn al-Khaṭīb, *Iḥāṭa*, ed. 1319, I, p. 85, ll. 1-10 (where the father is called Ḥasan); Saavedra, *Astrolabios*, *Mus. Esp. Ant.*, 1875, VI, esp. p. 407, pl. 1; da Schio, *Di due astrol.*, 1880, p. 55, No. 15; Gunther, 1932, I, p. 279, No. 132; Renaud, *Tablette, Hespéris*, 1939, p. 157; id., *Quelques constructeurs*, *Isis*, 1942, pp. 21 f.; *Rép.*, XII, 1943, p. 101, No. 4550 bis; García Franco, *Astrolabios*, *Bol. R. Acad. de Historia*, 1955, pp. 298-309, figs. 1-3.

II. In 704 (1304/5) he made (*ṣana'ahu*) another astrolabe, formerly in the Negrotto collection, now in the Società Ligure di Storia Patria, Genova. [In collaboration with C. H. Josten.]

Bibl.: Remondini, *Astrol. arabico*, *Atti IV. Congr. Orient.*, 1880, I, pp. 403-431, 1 pl.; da Schio, *Due astrol.*, 1880, p. 55, No. 13; Taylor, *Diffusion of Greek culture*, IV, *Geogr. Mag.*, 1946, 3 figs., on pp. 68 f.; id., *Root of Europe*, 1952, pp. 48 f., figs. 1-3.

III. In 709¹ (1309/10) he made an astrolabe, formerly in the collection Gauthier, now in that of M. G. Prin, Paris. Cf. pl. VII.

AḤMAD B. IBRĀHĪM

Aḥmad and Muḥammad, sons of Ibrāhīm, makers of astrolabes, of Iṣfahān, in 374 (984/5) or 394 (1003/4) composed (*allaḥa*) an astrolabe, formerly in the Y. Davud collection, now in the Lewis Evans collection, in the Museum of the History of Science, Oxford.

Bibl.: Gunther, *Catalogue*, 1919, p. 24, No. 53a; id., *Early science in Oxford*, 1923, II, pp. 21, 189, 191, 199; id., *Instruments*, 1925, p. 13; Christie, *Legacy of Islam*, 1931, p. 115; Gunther, 1932, I, pp. 114-116, No. 3, pls. XXII, XXIII; id., *The old Ashmolean*, 1933, p. 34; *Rép.*, V, 1934, pp. 141 f., No. 1902; Gunther, *Handbook*, 1935, p. 34; Harari, *Survey*, 1939, III, p. 2518; Hartner, *ibid.*, p. 2532, pl. 1397; Weibel, *Persian Astrolabe*, *Bull. Detroit Inst. of Arts*, 1946, p. 60; Aga-Oglu, *Two astrolabes*, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83, n. 3; *Brief guide to the Museum . . . of Science, Oxford*, 1949, p. 14, pl. II; Williamson, *Early instrum.*, *Connoisseur*, 1920, p. 227.

¹ The number is given in two letters ٧٠٩ and remains a unique example of a date on an astrolabe expressed in letters, in which the century was placed at the end.

AḤMAD B. KHALAF

Aḥmad b. Khalaf, a disciple (*ghulām*) of 'Alī b. 'Īsā, at the end of the third or beginning of the fourth century of the Hijra made (*ṣana'ahu*) an astrolabe for the Caliph Ja'far b. Muktafi billah, formerly in the Barbier collection, now in the Bibliothèque Nationale, Paris (Ge. A. 324).

Bibl.: Ibn an-Nadīm, *Fihrist*, p. 284, l. ult.; Sabin Berthelot, *Extrait . . .* 1840, p. 13; *L'Institut*, IIe section, Sciences hist. etc., June 1840, No. 54, p. 68; Sédillot, *Instr. astr.*, 1841, pp. 150, 172-174; Sédillot, *Matériaux*, 1845, I, pp. 339, 341-344; Dorn, *Drei Instr.*, 1865, p. 3; Janér, *Astrolabio*, *Mus. Esp. de Ant.*, 1874, pp. 559 f.; da Schio, *Di due astrol.*, 1880, pp. 55 f., No. 18; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 225; Vallée, *Notice*, 1912, p. 7, No. 307; Gunther, *Early Science in Oxford*, 1923, pp. 190 f.; de la Roncière, *Découverte*, 1924, I, pl. III; Cheikho, *Kitāb al-'amal bi-l-aṣṭurlāb*, *Al-Machriq*, 1913, pp. 30 f.; Wiet, *Cuivres*, 1932, p. 163, App. No. 3; *Rép.*, III, 1932, p. 32, No. 853; Gunther, 1932, pp. 113, 230, 232, No. 99, pl. LII; Hartner, *Survey*, 1939, III, p. 2532, n. 4; Michel, *Traité*, 1947, p. 181; *Bibl. Nat.*, *Notice*, p. 7, No. 376.

AḤMAD B. MUḤAMMAD

Aḥmad b. Muḥammad *an-naqqāsh*, in 472 (1079/80) made (*ṣana'ahu*) an astrolabe at Saragossa, now in the Germanisches Museum, Nürnberg (W. J. 353). Cf. pl. III.

Bibl.: van Berchem, *Notes II, JA*, 1892, I, p. 391.

AḤMAD B. MUḤAMMAD B. IBRAHĪM

Aḥmad b. Muḥammad b. Ibrāhīm, in 1116 (1704/5) made an astrolabe in Fez, present owner unknown.

Bibl.: Marçais, *L'Exposition . . . d'Alger*, 1905, publ. 1906, p. 30, pl. XX, 4.

AḤMAD B. MUḤAMMAD AL-LAMṬÎ

Aḥmad b. Muḥammad al-Lamṭî,¹ in Dhu-l-Qa'da 747 (Feb.-March 1347) made (*ṣana'ahâ*) a sun-dial which was later transferred to the Mosque of Sîdî al-Ḥalwî at Tlemcen.

Bibl.: Bargès, *Tlemcen*, 1859, pp. 420 f.; Brosselard, *Inscr. arabes*, *Revue Afr.*, 1859/60, t. IV, pp. 323 f.; W. Marçais, *Six inscr.*, *Bull. arch.*, 1902, p. 545; W. et G. Marçais, *Les monuments arabes de Tlemcen*, 1903, pp. 38, 290-294, facs. on p. 291; Bel, Trouvailles, *Revue Afr.*, 1905, t. 49, pp. 230 f.; Berque, *Art Antique*, 1930, p. 84.

AḤMAD PASHA

Aḥmad Pasha, governor of Egypt, since 1161 (1748) calculated and designed (*râsimuhâ wa-ḥâsibuhâ*) several sun-dials (*mizwala*), in 1163 (1750) two for the al-Azhar-Mosque (one of them now in the Museum of Islamic Art, Cairo), another for the Jâmi' al-Imâm ash-Shâfi'î, and a third for the Mashhad as-Sâdât al-Wafâ'iyya.

Bibl.: Jabartî, I, pp. 186-8; 'Alî Pasha Mubâarak, *Al-Khiṭaṭ at-Tauḥīqiyya*, IV, p. 17, l. 13-18, l. 1.; Herz, *Catalogue*, 1906, p. 35, No. 108; Wiet, *CIA. Eg.*, II, 1930, No. 576, pp. 122-124, pl. III, No. 1; Ḥasan 'Abd al-Wahhâb, *Masâjid*, 1946, I, p. 59.

AḤMAD B. AS-SARRÂJ

Cf. s.v. Aḥmad b. Abî Bakr.

AḤMAD B. 'UMAR

Aḥmad b. 'Umar al-Kabbî(?) in 933 (1526/7) made (*'amal*) an astrolabe, now in the collection of Mr. R. S. Newall, at present on loan in the Whipple Museum, Cambridge. [In collaboration with Derek J. Price.]

Bibl.: Gunther, *Cat. exhib. Cambridge*, 1936, p. 13, No. 61.

¹ I.e. of the Berber tribe Lamṭa.

'ALÎ

Ḥâjjî 'Alî, an astrolabist of the early 13th (late 18th) century, is known as the maker of seven instruments.

I. In 1203 (1788/9) he made an astrolabe, formerly in the Bassermann-Jordan collection.

Bibl.: Gunther, 1932, No. 27, p. 142, fig. 69; Michel, *Traité*, 1947, p. 182.

II. In the same year he made (*ṣana'ahu*) an astrolabe, his second work, now at the R. Acad. of Science, Stockholm.

III. In 1205 (?) (1790/1) he made (*ṣana'ahu*) his third astrolabe, formerly in the collection of H. Swainson Cowper.

Bibl.: Cowper, *Turkish Arabia*, 1894, pp. 469-75, esp. p. 471.

IV. In 1207 (1792/3) he made an astrolabe, now in the Benaki Museum, Athens.

Bibl.: *Guide Benaki Museum*, 1936, p. 79, No. 29.

V. In 1208 (1793/4) he made (*ṣana'ahu*) his thirteenth astrolabe, now in the National Maritime Museum, Greenwich (A. 13-36. 12). Cf. pl. XXIII.

VI. At an unspecified date he made his fifteenth astrolabe, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 155 f., No. 42, pls. XXXIX-XLI; Michel, *Traité*, 1947, p. 182.

VII. At an unspecified date he made an astrolabe, formerly in the Sir John Findlay collection, now in the R. Scottish Museum, Edinburgh.

Bibl.: Gunther, 1932, p. 155, No. 41.

'ALÎ B. AḤMAD

Abu-l-Ḥasan 'Alî b. Aḥmad at-Tilimsânî, *al-mu'addil*,¹ *muwaqqit*² of Abû 'Inân, finished on 14th Jumâdâ I, 758 (6th May, 1357) the great clock of the Madrasat Abî 'Inân (Bû'anâniyya) in Fez.

Bibl.: 'Alî al-Jaznâ'î, *Zahrat el-Âs*, ed. Bel, 1923, p. 40, ll. pu f. (of the Arabic text), p. 96 (of the trsl.); Péretié, Medrasas, *Arch. Maroc.*, 1912, p. 282; Bel, *Inscriptions de Fès*, 1919, pp. 275-279, fig. 58; Montet, Maison aux treize coupes, *Bull. de la Soc. de geogr. d'Alger* etc., 1923, pp. 182-185, ill.; Ricard, L'horloge, *ibid.*, 1924, pp. 248-254, esp. p. 253, 2 figs.; Ricard, *Maroc* (Guide Bleu), 5th ed., 1936, p. 311; Michel, Service, *Ciel et Terre*, 1952, p. 176, fig. 1; Needham, *Science*, I, 1954, p. 204.

'ALÎ B. IBRÂHÎM "IBN ASH-SHÂṬIR"

Abu-l-Ḥasan 'Alâ' ad-dîn 'Alî b. Ibrâhîm b. Muḥammad b. al-Himâm al-Anṣârî, known as "Ibn ash-Shâṭir", was born in Rabî' I, 704 (began 2nd Oct., 1304). An orphan since childhood, he was brought up by his grandfather, who taught him the art of making ivory mosaics (*taṭ'im al-âj*). In 714 (1314/5) he went to Alexandria in order to study and then lived in Syria and Egypt. For several years he served as *muwaqqit* at the Umayyad Mosque in Damascus. As a scientist he was the disciple of his uncle 'Alî b. Ibrâhîm Ibn ash-Shâṭir. His skill in making his own instruments and his ability in ivory mosaics, which earned him the appellation "the incrustator" (*al-muṭa'im*) is especially mentioned by chroniclers. A prolific author of works about scientific instruments, astronomy and mathematics, he died in Rabî' I, 777 (August 1375).

I. In 738 (1337/8) he made (*ṣana'ahâ wa-btakarahâ*) an astrolabe for Shaikh 'Alî b. Muḥammad ad-Darbandî, formerly in the Harari collection.

Bibl.: Ibn Ḥajar, *Durar*, III, p. 9, No. 14; Qalqashandî, *Ṣubḥ*, III, p. 251, ll. 14-16, VI, pp. 234, ll. 10-12, 253, ll. 11-13; Ibn Taghrîbirdî, *Manḥal*, s.v., MS Bibl. Nat.

¹ An expert in the establishment of astronomical "moments".

² Official who fixes the exact hours of prayer.

Ar. 2071, fo. 111 b-112 a, ed. Wiet, p. 225, No. 1536; Ḥajjî Khalîfa, *Lexicon biogr.*, ed. Flügel, 1842, III, p. 494, ll. 6 f., p. 557, l. 3; id., *Kashf az-zunûn*, ed. Flügel, III, 1842, pp. 467, No. 6460, p. 557, No. 6934; *Shadharât adh-dhahab*, 1351, VI, p. 252, ll. 7-15; Morley, *Description*, 1856, pp. 3, 50; Ahlwardt, *Verzeichniss*, Bd. 5, 1893, p. 243, No. 5816; Suter, *Mathematiker*, 1900, p. 168, No. 416; *Nachträge*, 1902, p. 177; *GAL*, 2nd ed., 1949, p. 156; Jurjî Zaidân, *Ta'rîkh at-tamaddun*, 1904, t. III, p. 251; Siddiqi, Construction of clocks, *Islam. Culture*, 1927, p. 249; Wiedemann, Ibn al-Schâṭir, *Beiträge*, 79, 1928, pp. 317-326; Schmalzl, *Quadranten*, 1929, pp. 100-108; Hauteceœur et Wiet, 1932, p. 89; Reich et Wiet, 1939, p. 202; *Rép.*, XV, 1955, No. 5726.

II. The same year he made another astrolabe for the same man, acquired by Jomard for the Bibliothèque Nationale, Paris.

Bibl.: *Bibl. Nat. Notice*, 1889, p. 7, No. 390; da Schio, *Di due astrol.*, 1880, p. 60, No. 6; Sédillot, *Instr. astron.*, 1841, pp. 191-194; Sédillot, *Matériaux*, 1845, pp. 354-357; Dorn, *Drei Instr.*, 1865, p. 3; Gunther, 1932, p. 287, No. 142; Reich et Wiet, 1939, p. 202; Michel, *Traité*, 1947, p. 181; Sarton, *Introduction*, 1948, III, 2, pp. 1524-1526; *Rép.*, XV, 1955, No. 5727.

III. In 767 (1365/6) while *muwaqqit* in Damascus, he made a sun-dial¹ with a qibla indicator² by order of Mangalî Bughâ al-Ashrafî ash-Shamsî, then Viceroy of Syria. In the main inscription, his work is characterized as "composition" (*taṣnîf*), and introduced by the words *ṣana'ahu wa-btakarahu* ("made it and created for the first time") obviously in order to indicate its unusual square form. Acquired by Shaikh Aḥmad b. Ṭâhâzâde in the 18th century, in 1939 the sun-dial was still in the library of the Madrasa Aḥmadiyya, founded by him in Aleppo.

Bibl.: Reich et Wiet, Astrolabe syrien, *BIFAO*, 1939, pp. 195-202, pl. XXIII, ill.; Millás Vallicrosa, Tres instrumentos, *Al-Andalus*, 1947, p. 60; Sarton, *Introduction*, 1948, III, 2, pp. 1524-26; Maḥmûd Rizq Salîm, *'Aṣr salaṭîn al-Mamâlîk*, 1952, t. IV (= II, 2), p. 148, No. 384.

¹ I am grateful to Dr. D. J. Price for having called my attention to the fact that the object is not an astrolabe, but a sun-dial.

² He called it *ṣandûq al-yawâqit*.

'ALÎ B. IBRÂHÎM B. MUḤAMMAD

'Alî b. Ibrâhîm b. Muḥammad b. Abî Muḥammad b. Ibrâhîm in 726 (1326) signed (*ṣana'ahu*) an astrolabe, formerly in the collection of Comte de Pertuis, Beyrouth, now in the Observatoire, Paris.

Bibl.: Gunther, 1932, I, p. 121, No. 6, fig. 62; Reich et Wiet, 1939, p. 201; Michel, *Traité*, 1947, p. 181; *Rép.*, XIV, 1954, p. 226, No. 5533; Collangettes, 'Ilm an-nujûm, *Al-Machriq*, 1900, p. 982, and pl. facing it.

'ALÎ B. MUḤAMMAD

'Alî b. Muḥammad b.¹ . . . b. Faraj in 1010 (? 1601/2) made (*ṣana'ahu*) an astrolabe, now in the collection of the Urdu College, Karachi.

'ALÎ B. MUḤAMMAD AL-AZDÎ

Masters (*mu'allimâni*) Abu-l-Ḥasan 'Alî and Abû 'Abdallah Muḥammad, sons of Muḥammad al-Azdî known as "Fallûs", in 950 (1543/4) made (*ṣana'ahu*) an astrolabe under the supervision of the faqîh Abû 'Abdallah Muḥammad aṣ-Ṣaghîr b. al-Ḥajj, formerly in the collection of Francesco Cengia, later in the da Schio collection, Valdagno, and now in the Osservatorio Astronomico, Rome (No. 694).

Bibl.: da Schio, *Di due astr.*, 1880, esp. pp. 26, 48, 54, pl. 2; id., *Sur deux astrol.*, *Atti IV. Congr. Orient.*, 1880, p. 367 f.; Gunther, 1932, pp. 293-297, No. 148, figs. 135-138; Renaud, *Tablette, Hespéris*, 1939, p. 158; id., *Quelques constructeurs, Isis*, 1942, p. 23; da Schio, *Due strum.*, *Atti Ist. Veneto*, 1874/5, pp. 1399-1401.

'ALÎ AL-QÛSHJÎ

'Alâ' ad-dîn 'Alî b. Muḥammad al-Qûshjî, the son of a falconer in the service of Ulugh Beg, studied in Samarqand, especially mathematics

¹ The name of the grandfather is illegible on the reproduction I saw.

under Qâḏîzâde ar-Rûmî, travelled, and on his return became Qâḏîzâde's successor as third director of the Samarqand Observatory. As such he finished the astronomical tables, called *az-Zîj al-jadîd*. After the death of Ulugh Beg (1449) he lived in Tabriz, later in Istanbul, first as Uzun Ḥasan's ambassador, from 877 (1472/3) onwards in the service of Mehmed II. Author of several books on astronomy and mathematics, in 878 (1473/4) he made a sun-dial for the university (*kulliye*) founded by Mehmed II in Istanbul. Died there the 5th Sha'bân 879 (15th Dec., 1474).

Bibl.: Ḥâjjî Khalîfa, *Lexicon*, III, p. 438; Tashköprüzâde, *Shaqâ'iq*, I, pp. 249-255; Woepcke, *JA*, 1862, pp. 120 f.; Suter, *Mathematiker*, 1900, pp. 178 f., No. 438; Babinger, *Geschichtsschreiber*, 1927, pp. 29 f.; Ünver, *Fatih külliyesi*, 1946, p. 232; id., *Ali Kuşci*, 1948 (and Sarton's review, *Isis*, 1949, p. 131); id., *Cadrans solaires, Archives d'hist. des sciences*, 1954, pp. 257, 259, fig. 1; *GAL*, 2nd ed., 1949, II, p. 235; *EI*, s.v., Engl. ed., I, p. 290; Adnan, *Science, Archeion*, 1937, pp. 361 f.; Mieli, *Science arabe*, 1938, p. 267.

'ALÎ B. ŞÂDIQ

Ḥâjjî 'Alî b. Şâdiq Qummî is known by at least six instruments, none of them dated, all of them signed '*amal*'.

I. An astrolabe, once in the Mercator collection.

Bibl.: *Catalogue de la collection Mercator*, Paris [1928], pp. 36 f., No. 164; Gunther, 1932, p. 163, n. 1.

II. Another, now in the collection of Mr. O. V. Watney, Cornbury Park, Oxfordshire.

III. A third, formerly in the Holden-White collection, now in the Fitzwilliam Museum, Cambridge. Cf. pl. XXIV.

IV. A fourth, sold with the Mc Vitty collection at the Parke-Bernet Galleries, auction of Jan. 22 and 23, 1954, *Catalogue* p. 10, No. 57, is perhaps identical with No. 1 (*vide supra*).

V, VI. Two astrolabes, formerly in the Harari collection, of which one is later than the foregoing five, since he signed it Ḥājī for the first time. [In collaboration with D. S. Rice.]

‘ALĪ B. ASH-SHIHĀB

‘Alī b. ash-Shihāb, in 735 (1334/5) made (*ṣana’ahu*) a quadrant for Shaikh Shams ad-dīn b. Sa’īd, then Chief Muezzin of the Mosque of the Umayyads in Damascus. It was engraved (*naqsh*) by Muḥammad b. al-Ghazūlī, *q.v.* Acquired by Sprenger for W. H. Morley, it is now in the British Museum (62.12.27.1).

Bibl.: Morley, Quadrant, *JRAS*, 1860, pp. 322-330, esp. p. 328, 4 pls.; Franks, ‘Instruments’, 1896, p. 183; Schmalzl, *Quadranten*, 1929, pp. 37 f., figs. 6 a, 6 b; Gunther, 1932, p. 243; Reich et Wiet, 1939, p. 202; Michel, *Traité*, 1947, p. 182; *Rép.*, XV, 1955, No. 5671; Anthiaume et Sottas, 1910, pp. 73, 104.

AUḤAD B. MUḤAMMAD

Auḥad b. Muḥammad b. Muḥammad b. Jamāl al-Auḥadī, known as (*al-mashhūr bi*) ‘Abdallah Auliyā’, in 890 (1485) made (*ṣana’ahu*) an astrolabe for Tāj ad-daula wa-d-dunyā wa-d-dīn Jān ‘Alī, now in the British Museum (64.12.21.1).

Bibl.: Franks, *Proc. Soc. Antiq. London*, 1864, p. 27; da Schio, *Di due astrol.*, 1880, p. 57, No. 25; Franks, ‘Instruments’, 1896, p. 183; Gunther, 1932, p. 246, No. 112.

BAIRĀM

Bairām b. Ilyās in 990 (1582) made a compass in a flat ivory box, now in the British Museum (1921, 6-25.1). Cf. pl. XVI a.

FADL ‘ALĪ

Faḍl ‘Alī made (*‘amal*) an astrolabe, formerly in the Roussel collection, now in the Evans collection in the Museum of the History of Science, Oxford. Cf. pl. XXV.

Bibl.: Roussel, *Sale Catalogue*, 1911, p. 44, No. 205; Gunther, 1932, pp. 158 f., No. 46; Michel, *Traité*, 1947, p. 182.

ḤĀMID B. ‘ALĪ

Abu-r-Rabī’ Ḥāmid b. ‘Alī al-Wāsiṭī was a disciple (*ghulām*) of ‘Alī b. Aḥmad *al-muhandis*, who in turn was a disciple of Khaffī, *q.v.*, who in turn was a disciple of ‘Alī b. ‘Īsā. He became famous for his instruments and is mentioned together with ‘Alī b. ‘Īsā. In 348 (959/60) he made (*ṣana’ahu*) an astrolabe for Sharaf ad-dīn Aḥmad b. Muḥammad b. Munajjā b. Ḥājī b. Muḥammad as-Sa’dī al-Miṣrī az-Zankalūnī. Formerly in the Museo Borgiano, Velletri, the astrolabe is now in the Museo Nazionale, Palermo.

Bibl.: Ibn an-Nadīm, *Fihrist*, ed. Flügel, p. 285, l. 8; ‘Alī b. ‘Abd ar-Raḥmān b. Yūnis, az-Zij al-Kabīr, ed. Caussin, *Notices et Extraits*, 1804, VII, pp. 54, 55, ll. 11 f.; Mortillaro, *Illustrazione*, 1848, esp. pp. 24 f. and pl. facing p. 12; id., *Opere*, IV, 1848, pp. 110-135, esp. p. 131, pl. fac. p. 118; Amari, *Musulmani di Sicilia*, 1854, I, pp. XXVI f., ed. Nallino, 1933, I, p. 24; da Schio, *Di due astrol.*, 1880, p. 53; Suter, *Mathematiker*, 1900, p. 40, No. 76; Salinas, *Guida*, 1882, p. 35, 1901, p. 48; Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 225; Gunther, *Early Science in Oxford*, 1923, II, p. 191; Gunther, 1932, p. 230, No. 100; Caldo, *Astrolabi di Palermo, Coelum*, 1938, pp. 104-106, figs. 1, 2; Michel, *Traité*, 1947, p. 181; Zinner, *Frühste Form*, XXX. *Bericht d. Nat. Ges. Bamberg*, 1947, p. 15.

ḤĀMID B. AL-KHIḌR

Ḥāmid b. al-Khiḍr an-Najdī, in 774¹ (1372/3) made (*ṣana’ahu*) an astrolabe, in 1929 in the possession of Messrs. Moradoff & Sons.

Bibl.: Gunther, 1932, p. 245, No. 111, figs. 118, 119; Michel, *Traité*, 1947, p. 181.

¹ This figure is obviously wrong. The signature, unfortunately copied in a modern handwriting, is dated clearly س ع د , which in Oriental script can stand only for س ع د , i.e. A.H. 374. If the astrolabe were of North-African origin—and the small portions reproduced in Gunther’s book do not justify such an assumption—the same letters would stand for 1074 (1663/4), a date much too late. Since this astrolabe has disappeared, a decision is impossible.

HÂMID B. MAĤMÛD

Hâmid b. Maĥmûd al-Işfahânî, in 547 (1152/3) made (*şana'ahu*) an astrolabe, formerly in the Samuel V. Hoffman collection. Cf. Muĥammad b. Hâmid.

Bibl.: Gunther, 1932, p. 117, No. 4, pl. XXIV; Wiet, *Epigraphie, MIE*, 1935, p. 14, n. 1; *Rép.*, VIII, 1937, p. 263, No. 3157; *Survey*, 1939, III, p. 2535, n. 1; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83, n. 3.

HAMZA

Hamza, in 1245 (1829/30) made an astrolabe, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 170 f., No. 59, fig. 84.

HASAN B. AĤMAD

Al-Ĥasan b. Aĥmad al-Baṭṭûṭî in 1106 (1597/8) made (*şana'ahu*) an astrolabe, now in the Museum of Islamic Art, Cairo. [In collaboration with F. R. Maddison.] Cf. Muĥammad b. Aĥmad al-Baṭṭûṭî.

HASAN B. 'ALÎ

Ĥasan b. 'Alî, in 681 (1282/3) made an astrolabe in Cairo, now in the Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Evans, Some astrolabes, *Arch. Journal*, 1911, p. 228; Gunther, *Early science in Oxford*, 1923, II, p. 191; id., *Instruments*, 1925, p. 15; id., *Astrolabes of the world*, 1932, pp. 239 f., No. 107, fig. 116; id., *The Old Ashmolean*, 1933, p. 36; id., *Handbook*, 1935, p. 36; Michel, *Traité*, 1947, p. 183; *Rép.*, XIII, 1944, p. 5, No. 4808.

HASAN GEVREKZÂDE

Gevrekzâde Ĥasan Efendi, called *hakîmbâşî*, in 1207 (1792/3) made a sun-dial for the Mosque of Aĥmad Pasha, Top Kapu, Istanbul.

Bibl.: Ünver, *Cadrans solaires, Archives d'hist. des sciences*, 1954, p. 258.

HASAN AL-ĤASANÎ

Ĥasan al-Ĥasanî al-Karânî al-Ĥusainî, in 1088 (1677/8) made (*şana'ahu*) an astrolabe, formerly in the d'Allemagne collection, Paris.

Bibl.: d'Allemagne, *Du Khorassan*, 1911, p. 195, ill.; id., *La maison*, 1948, t. I, p. 136, t. II, pl. CL; *Exposition des instr.*, Paris, 1936, p. 34, No. 255.

HASAN AŞ-ŞÂ'IGH

Ĥasan aş-Şâ'igh, in 812 (1409/10) made a sun-dial for the Ĥasan Pasha Mosque in Konya.

Bibl.: Löytved, *Konia*, 1907, pp. 80, 98; Ünver, *Cadrans solaires, Archives Int. d'hist. des sciences*, 1954, p. 258.

HASAN AŞ-ŞAWWÂF

Ĥasan aş-Şawwâf, in 1182 (1768/9) made (*'amal*) a sun-dial for the Sinân Pasha Mosque, Bûlâq.

Bibl.: Ĥasan 'Abd al-Wahhâb, *Masâjid*, 1946, I, p. 305, ill.

HASAN AṬ-ṬUBNÎ

Ĥasan aṭ-Ṭubnî,¹ a disciple of Shaikh Badr ad-dîn al-Mâridînî, is most likely identical with al-Ĥasan b. Khalîl b. 'Alî al-Karâdisî aṭ-Ṭubnî (of Ṭubna in Algeria), muezzin at the Ashrafiyya in Cairo. Born 823 (1420), he wrote several books, one about sun-dials. Died 887 (1482/3). In Rabî' I, 871 (beg. 11th Oct., 1466), he made (*'amal*) a sun-dial for the Madrasat Aynâl, Cairo.

Bibl.: van Berchem, *Notes*, II, *JA*, 1892, I, p. 389; *CIA. Eg.*, I, 1894-1903, p. 407; Suter, *Mathematiker*, 1900, pp. 180, 221, No. 442; *GAL*, 2nd ed., 1949, p. 160.

¹ This appellation could be—and was—read aṭ-Ṭayyibî.

ḤUSAIN B. 'ALÎ

Al-Ḥusain b. 'Alî in 709 (1309/10) made (*ṣana'ahu*) an astrolabe for Abu-l-'Abbâs b. Shaikh Abû 'Abdallah, formerly in the Holden-White collection, now in the Fitzwilliam Museum, Cambridge. Cf. pls. VIII, IX.

ḤUSAIN SHÂMÎ

Ḥusain Shâmî, at an unspecified date made a sun-dial for the Sultan Aḥmad Mosque, Istanbul.

Bibl.: Ünver, Cadrans solaires, *Archives d'hist. des sciences*, 1954, p. 257.

IBN ASH-SHÂṬIR

Cf. 'Alî b. Ibrâhîm.

IBRAHÎM B. 'ABD AL-KARÎM

Ibrâhîm b. 'Abd al-Karîm, at an unspecified date made (*ṣana'ahu*) an astrolabe, now in the Museo Nazionale, Palermo.

Bibl.: Mortillaro, in *Atti della R. Accademia di Scienze, Lettere e Belle Arti di Palermo*, vol. 19, p. 12, fig. 5; Caldo, *Astrolabi di Palermo, Coelum*, 1938, pp. 106 f., figs. 5-7.

IBRÂHÎM AD-DIMASHQÎ

Ibrâhîm ad-Dimashqî, in 669 (1270/1) made an astrolabe, now in the British Museum (No. 90, 3-15, 3). Cf. pl. VI a.

Bibl.: Franks, 'Instruments', 1896, p. 182; Gunther, 1932, p. 238, No. 106; *Rép.*, XII, 1943, p. 151, No. 4627.

IBRÂHÎM AL-FARAḌÎ AL-KURDÎ

Ibrâhîm al-Faraḍî al-Kurdî, in 1201 (1786/7) made a sun-dial for the mausoleum of Ḥâjj Aḥmad Pasha al-Jazzâr, in the compound of his mosque, at Acre.

IBRÂHÎM B. ḤUSAIN

Ibrâhîm b. Sharaf ad-dîn Ḥusain, in 1051 (1641/2) supposedly made an astrolabe for 'Abd ar-Razzâq Gilânî, now in the Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 228, pl. V; Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, pp. 135 f., No. 19, pl. XXXIII; Michel, *Traité*, 1947, p. 180.

IBRAHÎM AL-MÂLÎ

Ibrâhîm al-Mâlî, a disciple (*min talâmîdh*) of Ḥâfiẓ Ḥusain, residing (*sâkin*) in the Aya Sofia Mosque, in 1179 (1765/6) made a sun-dial and qibla indicator, formerly in the Sprenger collection, now in the West-deutsche Bibliothek, Marburg.

IBRÂHÎM AL-MUFTÎ

Ibrâhîm al-Muftî, in 1120 (1708/9) made (*'amal*) an astrolabe, now in the Musée de la Vie Wallonne, Liège (No. 37).

Bibl.: Michel, *Exposition, Bruxelles*, 1945, p. 8, A. 7; id., *Traité*, 1947, p. 183, pl. XX; id., *Catalogue... du Musée de la Vie Wallonne*, 1953, p. 18, fig. 11.

IBRAHÎM B. MUḤAMMAD

Ibrahîm b. Muḥammad b. ar-Raqqâm,¹ in 720 (1320/1) made (*ṣana'ahu*) an astrolabe in the Wâdî Esh (=Guadix), formerly in the Gayangos collection, now in the Real Academia de Historia, Madrid.

Bibl.: Saavedra, *Astrolabios*, *Mus. Esp. Ant.*, 1875, t. VI, esp. p. 406, pl. 1; da Schio, *Di due astrol.*, 1880, p. 55, No. 16; Gunther, 1932, p. 280, No. 136; Michel, *Traité*, 1947, p. 183; García Franco, *Astrolabios*, *Bol. Acad. de Historia*, 1955, pp. 309-311, figs. 4-6.

IBRÂHÎM B. AN-NU'MÂN

Ibrâhîm b. an-Nu'mân, in 673 (? 1274/5) made an astrolabe, now in Madrid (?).

Bibl.: Gunther, 1932, I, p. 278, No. 131; *Rép.*, XII, 1943, p. 189, No. 4683; Michel, *Traité*, 1947, p. 183.

IBRAHÎM B. SA'ÎD

Ibrâhîm b. Sa'îd (who once signed b. Aṣbagh al-Anṣârî) *al-Wazzân* (or *al-Mawâzînî*) as-Sahlî (i.e. from the Valencia plain) lived in Toledo and in Valencia. In 478 (1085) (perhaps from that year onwards) his son Muḥammad worked together with him.

I. In Sha'bân 459 (beg. 17th June, 1067) he made (*aḥkama ṣan'atahu*) an astrolabe in Toledo, formerly in the collection of D. Faustino de Borbón, then in the Gabinete de Antigüedades de la Biblioteca Real, now in the Archaeol. Museum, Madrid, electrotype in the Science Museum, London (No. 1877-6).

¹ He is obviously the father of the well known astronomer Abû 'Abdallah Muḥammad b. Ibrahîm, of Murcia, who lived in Granada and died there in Ṣafar 715 (beg. 7th May, 1315). Cf. Casiri, *Bibl. Arab. Hispana*, 1770, II, p. 82; Leclerc, *Méd. ar.*, 1876, II, p. 251; Suter, *Mathematiker*, 1900, p. 159, No. 388; Renaud, *Additions*, *Isis*, 1932, p. 173; Sánchez-Pérez, *Biografías*, 1921, p. 109, No. 123; *GAL*, Suppl., II, 1938, p. 378.

Bibl.: Saavedra, *Astrolabios árabes*, *Mus. Esp. Ant.*, 1875, t. VI, esp. p. 402, pl. 1; Atchison, *Catalogue of a loan coll.*, 1877, p. 392, No. 1757 c; da Schio, *Di due astrol.*, 1880, p. 55, No. 14; Le Bon, *Civilisation des Arabes*, 1884, pp. 492 f., figs. 228 f.; Franks, 'Instruments', 1896, p. 182; R. Amador de los Rios, *Monumentos arquít. de España*, Toledo, 1905, I, pp. 139 f., ill.; Calvert, *Toledo*, 1907, pl. 443; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226; Gunther, *Early science in Oxford*, 1923, II, p. 191; Lambert, *Tolède*, 1925, p. 22; Millás Vallicrosa, *Assaig*, 1931, pp. 66-71, pl. IV; Christie, *Legacy of Islam*, 1931, p. 115, fig. 15; Gunther, 1932, pp. 252 f., No. 117; Millás Vallicrosa, *Introducción*, *Isis*, 1932, p. 258; *Rép.*, VII, 1936, pp. 162 f., No. 2658; García Franco, *Catálogo*, 1945, pp. 231-235, esp. p. 232, 427, No. 12, pls. 23 f.; *Enciclopedia Universal Ilustr. Europeo-Amer.*, s.v. Astrolabio, t. 6, fig. 2 on p. 795; Zinner, *Früheste Form*, *XXX. Ber. d. Nat. Ges. Bamberg*, 1947, p. 16; Michel, *Traité*, 1947, p. 185; Millás Vallicrosa, *Estudios . . . de la ciencia española*, 1949, p. 34; Janér, *Astrolabio*, *Mus. Esp. de Ant.*, 1874, p. 559; Collangettes, 'Ilm an-nujûm, *Al-Machriq*, 1900, p. 837.

II. In Shawwâl 460 (August 1068) he made (*ṣana'ahu*) another astrolabe in Toledo, now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226, pls. I, II; Gunther, *Catalogue*, 1919, p. 24, No. 53 b; id., *Early Science in Oxford*, 1923, II, pp. 191, 199; id., *Instruments*, 1925, p. 16; Millás Vallicrosa, *Assaig*, 1931, p. 55; Gunther, 1932, pp. 253-256, No. 118, fig. 121, pl. LX; Gunther, *The Old Ashmolean*, 1933, p. 37; id., *Handbook*, 1935, p. 37; *Rép.*, VII, 1936, p. 166, No. 2663; Michel, *Traité*, 1947, p. 185; Millás Vallicrosa, *Estudios . . . de la ciencia españ.*, 1949, p. 34; Williamson, *Early instr.*, *Connoisseur*, 1920, vol. 56, p. 227.

III. In Rajab 463 (beg. 4th April, 1071) he made (*ṣana'ahu*) an astrolabe in Valencia, now in the Museo Astronomico, Rome (No. 688).

Bibl.: Amari, *Descrizione*, *Boll. It. degli St. Or.*, 1876, I, p. 127; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226; Gunther, 1932, I, p. 263; *Rép.*, IX, 1937, pp. 50 f., No. 3273.

IV. On the 1st Ṣafar 478 (28th May, 1085), together with his son Muḥammad, he finished (*ṣana'a . . . ṣa-tammāt*) a celestial globe with its stand (*kursî*) for the Vizier Abû 'Îsà b. Labbûn, formerly in the Belluomini collection, now in the Museo di Storia della Scienza, Florence.

Bibl.: Lasinio, *Globo celeste*, *Boll. Ital. Studii Orient.*, 1877, I, pp. 307-309; Meucci, Extract, *Monthly Notices, R. Astron. Soc.*, 1877, p. 426; Meucci, *Globo*, 1878, esp. pp. 10 f., pls. I, II; Fiorini-Günther, 1895, p. 15; Fiorini, *Sfere*, 1899, pp. 28-31; Kühnel, *Globus, Mitt. d. sächs. Kunstsam.*, 1911, p. 23; Stevenson, *Globes*, 1921, I, pp. 28 f.; Millás Vallicrosa, *Assaig*, 1931, pp. 55-65, pl. III; Sarton, *Introduction*, 1931, II, 2, p. 1014; v. Klüber, *Himmelsglobus*, 1935, pp. 1, 12, fig. 11; *Rép.*, VII, 1936, pp. 208 f., No. 2727; Millás Vallicrosa, *Estudios . . . de la ciencia esp.*, 1949, pp. 32-34, pl. I; Bonelli, *Catalogo . . . Firenze*, 1954, pp. 44 f., No. 2712; Boffito, *Strumenti*, 1929, pp. 20, 181; Remeis, *Älteste Himmelskugel, Sirius*, 1879, pp. 62-65; Mieli, *Science Arabe*, 1938, p. 154; id., *Panorama*, 1952, p. 170.

V. Towards the end of 478 (1086) he made (*ṣan'at*) an astrolabe, now in the Staatl. Kunstsammlungen, Kassel; electrotype in the Science Museum, London (1877-8).

Bibl.: Atchison, *Catalogue of loan coll.*, 1877, p. 393, No. 1760; da Schio, *Due astrol.*, 1880, pp. 58 f., No. 39; Franks, 'Instruments', 1896, p. 182; Gunther, 1932, I, p. 263, No. 121; *Rép.*, VII, 1936, p. 229, No. 2751; Zinner, *Früheste Form, XXX. Ber. d. Nat. Ges. Bamberg*, 1947, p. 16.

VI. In 490 (? 1097) he made an astrolabe, once in the Museo Kircheriano in Rome.

Bibl.: Gunther, *Early science in Oxford*, 1923, II, p. 191; Millás Vallicrosa, *Assaig*, 1931, p. 55.

VII. In 493 (? 1099/1100) he made an astrolabe, once in the Museo Kircheriano, Rome.

Bibl.: da Schio, *Due astrol.*, 1880, p. 54, No. 4; Gunther, 1932, p. 263, No. 123 (dated 1197).

ʾĪSÀ

Abu-l-Faraj ʾĪsà, disciple (*tilmîdh*) of al-Qâsim¹ b. Hibat Allah al-Aṣṭurlâbî, in 554 (1159) made (*ṣan'at*) an altitude sun-dial² for the

¹ Written al-Qasim. Casanova (p. 285) identified his father with the famous astrolabist who died in 534 (Ibn Khallikân, ed. Bûlâq, 1299, II, pp. 244 f.).

² I am grateful to Dr. D.J. Price for having called my attention to the fact that the object is a sun-dial and not a watch.

Zengid Nûr ad-dîn Maḥmûd, formerly in the Durighello collection, now in the Cabinet des Médailles, Bibliothèque Nationale, Paris.

Bibl.: van Berchem, Notes, III, *JA*, 1904, I, p. 31, n. 1; van Berchem-Strzygowski, *Amida*, 1910, p. 125; van Berchem, Arabische Inschriften, *Meisterwerke*, 1912, I, p. 4; Casanova, Montre, *Syria*, 1923, pp. 282-299, esp. pp. 282-285, and pl. XLV; Hourticq, *Encycl. des Beaux-Arts*, 1925, I, p. 170, ill.; Migeon, *Manuel*, 1927, II, p. 39; Wiet, *Cuivres*, 1932, p. 165, No. 16; *Rép.*, IX, 1937, pp. 18 f., No. 3228; Elisséeff, Titulature de Nûr ad-dîn, *BEO*, 1952-54, p. 159.

ISMA'ÎL

Isma'îl, a *muwaqqit*, in 1193 (1779) made a sun-dial for the Laleli-Mosque, Istanbul. He is perhaps identical with I. Khalîfazâde, *q.v.*

Bibl.: Ünver, Cadrans solaires, *Archives d'hist. des sciences*, 1954, p. 257.

ISMA'ÎL KHALÎFAZÂDE

Isma'îl Khalîfazâde, in 1177 (1763/4) made a sun-dial for the Mosque of Ḥakîmoghlu 'Alî Pasha, Istanbul.

Bibl.: Ünver, Cadrans solaires, *Archives d'hist. des sciences*, 1954, p. 257.

JA'FAR B. 'UMAR

Ja'far b. 'Umar b. Daulatshâh al-Kirmânî, a member of a well-known family of astrolabists, is known by at least five instruments. Cf. also his son Muḥammad b. Ja'far and his grandson Maḥmûd b. Jalâl.

I. In 755 (1354) he made (*ṣana'ahu*) an astrolabe, now in the collection of M. G. Prin, Paris. Cf. pl. X.

II. In 757 (? 1356) he made an astrolabe, now in the Maritime Museum, Greenwich (A. 8-36. 13).

III. In 764 (1362/3) he made (*ṣana'ahu*) a globe, now in the Lewis Evans collection in the Museum of the History of Science, Oxford (No. 2900). Cf. pl. XI.

Bibl.: Gunther, *Instruments*, 1925, pp. 49 f.; id., *The Old Ashmolean*, 1933, pp. 89 f.; id., *Handbook*, 1935, pp. 89 f.; Harari, *Survey*, 1939, III, p. 2518; *Brief guide to the Museum . . . of Science, Oxford*, 1949, p. 22.

IV. In 774 (1372/3) he made (*şana'ahu*) an astrolabe, formerly in the Samuel V. Hoffman collection, now in the collection of Mr. Eugene A. Hoffman, West Tisbury.

Bibl.: Gunther, 1932, pp. 128 f., No. 15, figs. 63-65.

V. In 790 (1388) he made (*şana'ahu*) an astrolabe, formerly in the Carrapit collection, now in the Indian Museum, Calcutta.

Bibl.: Gunther, 1932, p. 130, No. 16, figs. 66 f.

KHAFÎF

Khafîf, a disciple (*ghulâm*) of 'Alî b. 'Îsâ, at an unspecified date during the 3rd (9th) century, made an astrolabe apparently for Aḥmad *al-munajjim* as-Sinjârî, formerly in the Landau collection, Paris, now in the Billmeir collection, London. On palaeographical grounds it seems likely that the inscription on the front of the bracket stating that the astrolabe was made for Aḥmad *al-munajjim* is considerably later than the signature. Otherwise it would be tempting to see in this Aḥmad the father of 'Alî b. Aḥmad *al-muhandis*, who according to the *Fihrist* (p. 285, l. 2) was an apprentice of Khafîf. Cf. pl. I.

Bibl.: Ibn an-Nadîm, *Fihrist*, ed. Flügel, p. 284, l. ult.; Michel, *Exposition . . . Liège*, 1939, p. 57, No. 307; id., *Traité*, 1947, p. 181.

KHALÎL MUḤAMMAD

Khalîl Muḥammad¹ b. Ḥasan 'Alî, was an astrolabist of the late 11th and early 12th (second half of the 17th and beginning of the 18th)

¹ The question whether his name was Muḥammad Khalîl or Khalîl Muḥammad can be considered as settled in favour of the second form. In addition to epigraphical grounds, invoked by Wiet, *Epigraphie, MIE*, 1935, p. 14, there is the evidence of his signature on the astrolabe in the Victoria and Albert Museum (M.38—1916), where he signed Ibn Ḥasan 'Alî Khalîl, omitting Muḥammad altogether.

centuries. Chardin met his father in Işfahân and praised him for his learning.¹

I. In 1093 (1682) he made (*şana'ahu*) an astrolabe, decorated (*namaqahu*) by Muḥammad Bâqir Işfahânî, for Mîrzâ Muḥammad Amîn b. Mîrzâ Muḥammad Rizâ, now in the Hermitage, Leningrad (VC. 1044).

II. In 1094 (1683) he made (*şana'ahu*) an astrolabe, also decorated (*namaqahu*) by Muḥammad Bâqir Işfahânî, now in the Observatoire, Paris.

III. In 1095 (1684) he made (*şana'ahu*) an astrolabe, also decorated (*namaqahu*) by Muḥammad Bâqir al-Işfahânî (!), now in the Deutsches Museum, München.

IV. In 1106 (1694/5) he made (*şana'ahu*) an astrolabe, now in the Musée Archéologique, Teheran.

V. In 1119 (1707/8) he made another astrolabe, according to Said-Ruete, apud Gunther, *l. cit.*, signed more fully as having been made at Isfahan, once in the Said-Ruete collection. Here too the name of Muḥammad Bâqir is mentioned, probably as the decorator, and not as the owner (*pace* Said-Ruete).

Bibl.: Gunther, I, 1932, p. 131, No. 17; Wiet, *Epigraphie, MIE*, 1935, pp. 13 f.; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83; Michel, *Traité*, 1947, p. 184.

VI. In the same year he made (*şana'ahu*) another astrolabe, decorated (*namaqahu*) by Muḥammad Bâqir Işfahânî, now in the National Maritime Museum, Greenwich (A. 4-36. 2).

VII. At a date read as 912 (1506/7) (obviously wrong and to be verified with the original) he made (*şana'ahu*) an astrolabe, decorated (*namaqahu*) by Muḥammad Bâqir Işfahânî, formerly in the Harari collection.

Bibl.: *Cat. Exhib. Persian Art*, 1931, 3rd ed., p. 194, No. 309 G; Gunther, I, 1932, p. 127, No. 14; Wiet, *Exposition d'art persan*, 1935, p. 66, No. M. 76; Wiet, *Epigraphie, MIE*, 1935, pp. 12 f., fig. 2; *Survey*, VI, pl. 1400 B; Michel, *Traité*, 1947, p. 183.

¹ *Voyages*, ed. Langlès, 1811, t. IV, p. 333.

VIII. At an unspecified date he made an astrolabe, engraved (*naqashahu*) by Muḥammad Bâqir Işfahânî, formerly in the Khawwam collection, Cairo.

Bibl.: Wiet, *Epigraphie*, *MIE*, 1935, pp. 13 f., No. 30, fig. 3; Wiet, *Exposition*, 1935, p. 66, No. M. 77.

IX. At an unspecified date, during the reign of the Safavid Shâh Ḥusain (1694-1722), he made an astrolabe, decorated (*namaqahu*) by 'Abd al-A'imma b. 'Abd al-Ḥusain, formerly in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Exposition . . . Liège*, 1939, p. 60, No. 318; id., *Méthodes, Ciel et Terre*, 1941, p. 496, n. 19; id., *Traité*, 1947, pp. 156, 184, figs. 16 a, b, pl. XVI; Josten, *Instruments*, 1954, p. 12, No. 7; Anon., *Instruments, Connaissance des arts*, Déc. 1952, p. 51.

X. At an unspecified date, also during the reign of Shah Ḥusain, he made (*şana'ahu*) an astrolabe, decorated (*namaqahu*) by 'Abd al-A'imma, now in the Billmeir collection.

Bibl.: Josten, *Instruments*, 1954, p. 12, No. 8.

XI. At an unspecified date, also during the reign of Shah Ḥusain, he made (*şana'ahu*) an astrolabe, decorated (*namaqahu*) by 'Abd al-A'imma, formerly in the Malcolm Gardner collection.

XII. At unspecified dates he made (*şana'ahu*) several more astrolabes, most likely decorated by himself. One is now in the collection of M. Georges Charliat, Paris.

XIII. Another, formerly in the Ross collection, now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Gunther, 1932, pp. 157 f., No. 45, pl. XXXVIII; Aga-Oglu, *Two astrolabes*, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83.

XIV. A third, now in the Museum of Fine Arts, Boston (No. 42. 304).

Bibl.: Aga-Oglu, *Two astrolabes*, *Bull. Mus. Fine Arts*, Boston, 1947, pp. 81-83, ill.

XV. At an unspecified date he made an astrolabe, decorated (*namaqahu*) by Muḥammad Mahdî al-Yazdî b. Muḥammad Amîn, now in the Victoria and Albert Museum (M. 38-1916).

XVI. At unspecified dates he made (*şana'ahu*) at least four more astrolabes, decorated (*namaqahu*) by 'Abd al-A'imma. One formerly in the Michel collection, is now in the Billmeir collection.

Bibl.: Josten, *Instruments*, 1954, p. 12, No. 9.

XVII. Another, now in the collection of M. Marcel Destombes, Paris.

XVIII. A third, now in the collection of M. N. E. Landau, Paris.

Bibl.: Maggs, *Bibl. nautica*, 1938, p. 214, No. 2988, pl. XVI.

XIX. A fourth, now in the Hermitage, Leningrad (VC. 939).

MAHDÎ YAZDÎ

Ḥajjî Mahdî Yazdî is perhaps¹ the maker of an astrolabe, now in the Maritime Museum (Greenwich, A. 20-36.20). He may or may not be identical with Muḥammad Mahdî Yazdî, although the latter never called himself Ḥâjjî.

MAḤMÛD B. 'ALÎ

Maḥmûd b. 'Alî b. Yûsha' al-[. . .]rî, in 669 (1270/1) made (*şana'ahu*) an astrolabe for al-Ḥasan b. 'Alî ash-Shadîd, formerly in the collection of Prof. Wilson.

Bibl.: Morley, *Description*, 1586, pp. 5, 32-34; Dorn, *Drei Instr.*, 1865, p. 3; da Schio, *Di due astrol.*, 1880, p. 56, No. 21; Gunther, 1932, p. 186, No. 67; *Rép.*, XII, 1943, pp. 151 f., No. 4628.

MAḤMÛD B. ḤASAN

Maḥmûd b. Ḥasan an-Nîshî designed (*rasamahu*) two sun-dials for the Mosque of Muḥammad Bey Abu-dh-dhahab in the Maidân al-Azhar,

¹ I include him with a great deal of hesitation. On the one hand, there is no indication expressis verbis, such as *şana'ahu* or *'amilahu*, that he made it; on the other hand the signature has been not merely retouched, but engraved anew, and liberties may have been taken with the original text.

Cairo, one dated the 1st Jumâdâ I, 1188 (10th July, 1774), the other the 18th Jumâdâ of the same year.

Bibl.: Ḥasan 'Abd al-Wahhab, *Masâjid*, 1946, I, p. 356, ill.

MAḤMÛD B. JALÂL

Maḥmûd b. Jalâl b. Ja'far al-Aṣṭurlâbî in 889 (1484) made (*ṣana'ahu*) an astrolabe, now in the Topkapu Sarayı Müzesi, Istanbul. We can establish the following genealogical tree:

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Daulatshâh
|
'Umar
|
Ja'far 755-790
|
Muḥammad "Jalâl" 834
|
Maḥmûd 889

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The signatures of Muḥammad and Maḥmûd are both characterized by a curiously shaped final "yâ" of the word *aṣṭurlâbî*, imitating the paraph of al-Kirmânî in Ja'far's signature of A. H. 790. Cf. pls. XIIa, XIV.

MAḤMÛD B. SHAUKA

Maḥmûd b. Shauka (?) al-Baghdâdî in 694 (1294/5) made (*ṣana'ahu*) an astrolabe, now in the National Maritime Museum, Greenwich (A. 15-36. 15).

MUḤAMMAD

Muḥammad, some time after 684 (1285/6), made a sun-dial, on the outside of the madrasa and mausoleum of Qalâûn, Cairo.

Bibl.: *CIA. Eg.*, I, 1894-1903, p. 140.

MUḤAMMAD 'ABD AL-HÂDÎ

Muḥammad 'Abd al-Hâdî aṣ-Ṣafadî, in 1140 (1727/8) designed (*hadhâ rasm*) a quadrant, formerly in the Lee collection, at Hartwell Manor, Buckinghamshire, now in the Science Museum, London (1918. 262).

MUḤAMMAD B. ABÎ BAKR

Muḥammad b. Abî Bakr b. Muḥammad ar-Râshidî al-Ibarî al-Iṣfahânî, also known as Muḥammad b. Abî Bakr al-Fârisî, in 618 (1221/2) made (*ṣana'ahu*) an astrolabe with a geared calender movement, formerly in the Heilbronner collection, now in the Lewis Evans collection in the Museum of the History of Science, Oxford. Died in 629 (1231/2).

Bibl.: Ḥâjjî Khalîfa, VI, p. 176; Lee, Notice, *Transact. Cambridge Philos. Soc.*, 1822, pp. 249-265; Suter, *Mathematiker*, 1900, p. 139, No. 349; Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, I, pp. 118-120, No. 5, pls. XXV f.; *Rép.*, X, 1939, p. 187, No. 3874; Harari, *Survey*, 1939, III, p. 2518, pls. 1312, D, E, 1398; Michel, *Traité*, 1947, p. 184; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83, n. 3.

MUḤAMMAD ABU-L-FADL

Muḥammad Abu-l-Faḍl, at an unspecified date designed (*rasama*) a quadrant, now in the Musée Alaoui, Le Bardo, Tunis. Cf. pl. XXVI.

MUḤAMMAD B. ABÎ-L-QÂSIM

Muḥammad b. Abî-l-Qâsim b. Bakrân an-Najjâr al-Iṣfahânî aṣ-Ṣâlihânî in 496 (1102/3) made (*ṣana'ahu*) an astrolabe, formerly in the collection of Principe Don Tommaso Corsini, now in the Museo di Storia della Scienza, Florence (No. 1105). Cf. pl. IV a.

Bibl.: *Boll. ital. degli Studii orientali*, 1877-1882, II, p. 228, No. 24; Gunther, 1932, p. 263; *Rép.* VIII, 1937, pp. 54 f., No. 2889; *Survey*, 1939, III, p. 2535, n. 1; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83, n. 3; Bonelli, *Catalogo . . . Firenze*, 1954, pp. 61 f., No. 1105; Boffiti, *Strumenti*, 1929, p. 182; Bonelli, *Bellissimo museo, Civiltà d. macchine*, 1955, p. 77, ill.; da Schio, *Di due astrol.*, 1880, p. 54, No. 3.

MUḤAMMAD B. AḤMAD

Muḥammad b. Aḥmad al-Baṭṭūṭī, an astrolabist of the 12th (18th) century, who lived in North Africa, is known by nine works.

I. In 1136 (1723/4) he made (*ṣāni'*) an astrolabe, formerly in the Michel collection, now in the collection of M. René Greppin, Brussels.

II. In 1137 (1724/5) he made (*ṣana'ahu*) an astrolabe, now in the collection of Prof. Henri Terrasse, Rabat.

Bibl.: Renaud, *Quelques constructeurs*, *Isis*, 1942, p. 22, ill.

III. In 1138 (1725/6) he made an astrolabe, now in the Main Mosque of Fez-Jadīd.

Bibl.: Renaud, *l. cit.*, p. 22.

IV. In 1141 (1728/9) he made an astrolabe, now in the Lewis Evans collection in the History of Science Museum, Oxford.

Bibl.: Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 228, pls. III, IV; Gunther, *Early science in Oxford*, 1923, II, p. 191; id., *Instruments*, 1925, p. 16; Gunther, 1932, p. 292, No. 147; id., *The Old Ashmolean*, 1933, p. 37; id., *Handbook*, 1935, p. 37; Renaud, *Quelques constructeurs*, *Isis*, 1942, p. 22; Michel, *Traité*, 1947, p. 184.

V. In 1141 (1728/9) he made an astrolabe, now in the Batha Museum, Fez (No. 20993).

Bibl.: Renaud, *l. cit.*, p. 22.

VI. In 1142 (1729/30) he made (*'amal*) a quadrant, formerly in the collection of Ruiz Orsatti, now in the Biblioteca General, Tetuán.

Bibl.: Ruiz Orsatti, *Astronomia, Mauritania*, 1940, pp. 27-30; Millás Vallicrosa, *Tres instrumentos, Al-Andalus*, 1947, pp. 56-61, pl. 3.

VII. In 1146 (1733/4) he made an astrolabe, formerly in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Service, Ciel et Terre*, 1952, p. 177, figs. 2, 3; Josten, *Instruments*, 1954, p. 13, No. 13.

VIII. In 1148 (1735/6) he made an astrolabe, now in the collection of M. M. Meyer, Paris.

IX. In 1150 (1737/8) he made an astrolabe, now in the National Maritime Museum, Greenwich (A.1-35. 1).

MUḤAMMAD B. AḤMAD AL-MIZZÎ

Abû 'Abdallah Shams ad-dîn Muḥammad b. Aḥmad b. 'Abd ar-Raḥîm al-Mizzî, born 690 (1291), studied in Cairo under Ibn al-Akfânî, lived in Damascus first as *muwaqqit* of the *rabwa* and then of the Umayyad Mosque. Author of several works about astrolabes and quadrants. His quadrants sold for 2 dinars and more, his astrolabes for 10 dinars and more. Died in Damascus early in 750 (1349).

I. In 727 (1326/7) he made (*ṣana'ahu*) a quadrant, now in the Museum of Islamic Art, Cairo (No. 3092).

Bibl.: Herz, *Catalogue*, 2nd ed., 1906, pp. 200 f., No. 103; Schmalzl, *Quadranten*, 1929, p. 41, n. 1; Combe, *Cinq cuivres, BIFAO*, 1931, p. 56; Reich et Wiet, 1939, pp. 200 f.; GAL, 2nd ed. 1949, II, pp. 155 f.; *Rép.*, XIV, 1954, p. 231, No. 5542.

II. In 727 (1326/7) he made (*ṣana'ahu*) a quadrant, now in the British Museum (95.11-16. 1). Cf. pl. VI b.

III. In 734 (1333/4), while in Damascus, he made a quadrant for Nâsir ad-dîn Muḥammad b. 'Abdallah b. 'Abd ar-Raḥîm, formerly in the collection of Clot Bey, now in the Public Library, Leningrad.

Bibl.: Ibn Ḥajar, *Durar*, III, p. 325, No. 873; Ṣafadî, *Nakt al-himyân*, p. 244; Ḥajjî Khalîfa, *Lexicon*, I, p. 323, ll. 1 f.; Sédillot, *Mémoire*, 1841, p. 93; Dorn, *Drei Instrumente*, 1865, pp. 2, 16-26, esp. p. 18, pls. I, II; Ahlwardt, *Verzeichniss*, Bd. 5, 1893, p. 253, No. 5839; Suter, *Mathematiker*, 1900, p. 165, No. 406; GAL, 2nd ed., 1949, II, pp. 155 f.; Schmalzl, *Quadranten*, 1929, pp. 33-37, figs. 5, 13 a; Hitti, *Catalog Garrett coll.*, 1938, Nos. 2040, 2182; Reich et Wiet, 1939, pp. 200 f.; Sarton, *Introduction*, III, 1947, pp. 696 f.; Millás Vallicrosa, *Tres instrumentos, Al-Andalus*, 1947, p. 60; *Rép.*, XV, 1955, No. 5655; da Schio, *Di due astrol.*, 1880, p. 57, No. 29; Renaud, *Additions, Isis*, 1932, p. 173.

IV. In 734 (1333/4) he made (*ṣana'ahu*) a quadrant, once in the Octavius Morgan collection, now in the British Museum (88. 12-1. 276). Cf. pl. VI c.

Bibl.: Franks, 'Instruments', 1896, p. 183.

MUḤAMMAD AKBAR

Muḥammad Akbar is known by two astrolabes.

I. In 1234 (1818/9) he made an astrolabe for Maḥmūd Mīrzâ Qājār, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 169 f., No. 58, fig. 83, pl. XLIV.

II. In 1236 (1820/1) he made (*ṣana'ahu*) an astrolabe, formerly in the T. H. Court collection, now in the Whipple Museum, Cambridge (No. 599).

MUḤAMMAD B. 'ALĪ

Muḥammad b. 'Alī b. Rustum al-Khurāsānī as-Sa'ātī, after 564 (1168/9) rebuilt the big clock at the Bāb Jairūn of the Mosque of the Umayyads in Damascus, which had been burnt down in 562 (1166/7). When, for various reasons, the clock became unworkable, his son Fakhr ad-dīn Riḍwān b. Muḥammad, author of a book on astronomical clocks, repaired and improved it.

Bibl.: de Sacy, *Relation* . . . par Abdallatif, 1810, pp. 578 f.; Ibn Jubair, ed. de Goeje, 1907, pp. 270, l. 3-271, l. 5; Wiedemann-Hauser, *Uhren*, 1915, esp. pp. 167-178; Ungerer, *Horloges*, 1931, p. 24; Meyerhof, *Legacy of Islam*, 1931, p. 342; *GAL*, 2nd ed., 1943, I, p. 625; Usher, *Inventions*, 1954, p. 191, fig. 55; Ibn Abī Uṣaibi'a, 'Uyūn, 1884, II, p. 183 f.; al-Maqqarī, *Analectes*, ed. Dozy et al., I, pp. 718, l. 18-719, l. 11; Collangettes, 'Ilm an-nujūm, *Al-Machriq*, 1900, pp. 985 f.; Wiedemann, Beiträge III, *Sitz. Ber. d. Phys. Med. Soc.*, Erlangen, 1905, pp. 231 f., 258 f.; Siddiqi, *Clocks*, *Isl. Culture*, 1927, pp. 247 f.; Chapuis et Gélis, 1928, p. 62.

MUḤAMMAD AMÎN

Muḥammad Amîn is known by two instruments. It is difficult to decide whether he is identical with Muḥammad Amîn b. Muḥammad Ṭāhir, since none of the latter's astrolabes is dated.

I. In 1086 (1675/6) he made (*ṣana'ahu*) an astrolabe, formerly in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Exposition* . . . Liège, 1939, p. 60, No. 317; *Expos. Bruxelles*, 1945, p. 8, A. 5; Michel, *Traité*, 1947, pl. XXII; Josten, *Instruments*, 1954, p. 12, No. 10.

II. In 1097 (1685/6) he made (*ṣana'ahu*) a brass astrolabe by order of Rukn ad-dīn b. Shāh Rukh Shādhī (?), now in the collection of Mr. E. S. David, Long Island City.

MUḤAMMAD AMÎN B. AMÎRZÂ KHÂN

Muḥammad Amîn b. Amîrzâ Khân an-Nakha'ī al-Qummī, in 996 (beg. 2nd Dec. 1587) made an astrolabe, formerly in the Michel collection, now in the Billmeir collection.

Bibl.: Michel, *Exposition* . . . Liège, 1939, p. 59, No. 314; *Exposit. Bruxelles*, 1945, p. 7, A. 2; Michel, *Traité*, 1947, p. 183, pl. XIV; Josten, *Instruments*, 1954, p. 11, No. 2.

MUḤAMMAD AMÎN B. MUḤAMMAD ṬĀHIR

Muḥammad Amîn b. Muḥammad Ṭāhir is known by three astrolabes.

I. At an unspecified date he made an astrolabe, decorated (*namaqahu*) by 'Abd al-A'imma, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 145 f., No. 31, pls. XXXIX-XLI; Michel, *Traité*, 1947, p. 183; Aga-Oglu, Two astrolabes, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83.

II. About the same time he made (*ṣana'ahu*) another, also decorated (*namaqahu*) by 'Abd al-A'imma, supposed to have come from Herat, now in the Indian Museum, Calcutta.

Bibl.: Kaye, *Observatories*, 1918, p. 16, pls. III. 9, 12, IV. 15-16; id., *Guide*, 1920, p. 21; Gunther, 1932, p. 146, No. 32, figs. 71 f.; Michel, *Méthodes de tracé, Ciel et Terre*, 1941, p. 496, n. 19; id., *Traité*, 1947, p. 183; Aga-Oglu, *Two astrolabes*, *Bull. Mus. Fine Arts*, Boston, 1947, p. 83.

III. At an unspecified date he made (*ṣana'ahu*) a third, designed (*namaqahu*) also by 'Abd al-A'imma, now in the City Art Museum of St. Louis.

Bibl.: C. P. Davis, *Muhammedan Metal Work*, *Bull. of the City Art Mus. of St. Louis*, Oct. 1926, p. 53, ill.

MUHAMMAD ASHRAF

Muhammad Ashraf in 1215 (1800/1) made a globe, formerly in the Harari collection. [In collaboration with D. S. Rice.]

MUHAMMAD BÂQIR

Muhammad Bâqir Iṣfahânî decorated several astrolabes, cf. s.vv. 'Abd al-'Alî and Khalîl Muhammad.

MUHAMMAD B. FATTÛḤ

Muhammad b. Fattûḥ al-Khamâ'irî, a Spanish astrolabist, is known by at least eight works.

I. In 609 (1212/3) he made (*ṣana'ahu*) an astrolabe in Seville, in 1873 in the collection of H. Sauvaire, who acquired it in Cairo, present owner unknown.

Bibl.: Sauvaire et de Rey-Pailhade, *Une mère d'astrolabe arabe*, *JA*, 1893, I, pp. 5-125, esp. p. 8, pls. I, II; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226;

Kaye, *Observatories*, 1918, p. 29, n. 2; Gunther, *Early science in Oxford*, 1923, p. 191; Levi-Provençal, *Inscr. arabes*, 1931, p. 197, No. 223; Gunther, 1932, pp. 269 f., No. 127; Wiet, *Epigraphie, MIE*, 1935, p. 14, n. 1; Renaud, *Les Ibn Bâso, Hespéris*, 1937, pp. 7, n. 2, 8; *Rép.*, X, 1939, pp. 73 f., No. 3704; Renaud, *Quelques constructeurs, Isis*, 1942, p. 21; Kharegat, *Astrolabes*, 1950, p. 84; Anthiaume et Sottas, 1910, pp. 104, 141, 149.

II. In 613 (1216/7) he made (*ṣana'a*) an azaphea (*ṣafîḥa*) in Seville, formerly in the Cengia collection, then in the da Schio collection at Valdagno, now in the Osservatorio Astronomico, Rome (No. 694^{II}).

Bibl.: da Schio, *Sur deux astrol.*, *Atti IV Congr. Orient.*, 1880, p. 368; id., *Di due astrolabi*, 1880, esp. pp. 39, 49, 59, pl. 6; Sauvaire et de Rey-Pailhade, *op. laud.*, *JA*, 1893, p. 8, n. 3; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226; Nallino, *Astrolabio, Enciclopedia Ital.*, s.v., 1930, fig. on p. 97; Levi-Provençal, *Inscr. arabes*, 1931, No. 224; Gunther, 1932, I, pp. 270-273, No. 127 A, figs. 127 f.; Wiet, *Epigraphie, MIE*, 1935, p. 14, n. 1; Renaud, *Tablette, Hespéris*, 1939, p. 157, pl. I; *Rép.*, X, 1939, p. 130, No. 3787, p. 139, No. 3799; Renaud, *Quelques constructeurs, Isis*, 1942, p. 21; Millás Vallicrosa, *Ejemplar de azafea, Al-Andalus*, 1944, p. 112; García Franco, *Catálogo*, 1945, pp. 155, 318; Kharegat, *Astrolabes*, 1950, p. 84, n. 3; da Schio, *Due strumenti, Atti Ist. Venet.*, 1874/5, pp. 1399-1401.

III. In 615 (1218/9) he made (*ṣana'a*) an azaphea (*ṣafîḥa*) in Seville, formerly in the Schultz collection, later in the Bibliothèque Nationale, Paris.

Bibl.: Sédillot, *Instr. astr.*, 1841, pp. 36, 184, n. 2; id., *Matériaux*, 1845, pp. 353 f.; Wœpcke, *Paris . . . Astrolabium*, *Bull. Ac. St. Pétersb.*, 1864, cols. 220-227, esp. 222; Dorn, *Drei Instr.*, 1865, pp. 3, 83; da Schio, *Di due astrol.*, 1880, p. 59, No. 5; id., *Sur deux astr.*, *Atti IV. Congr. Orient.*, 1880, pp. 368 f.; *Bibl. Nat.*, *Notice*, 1889, p. 7, No. 389; Sauvaire et de Rey-Pailhade, *Une mère, JA*, 1893, p. 8, n. 3; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226; Levi-Provençal, 1931, p. 197, No. 225; Gunther, 1932, p. 274, No. 128; Wiet, *Epigraphie, MIE*, 1935, p. 14, n. 1; *Rép.*, X, 1939, pp. 148 f., No. 3811; Renaud, *Quelques constructeurs, Isis*, 1942, p. 21; Millás Vallicrosa, *Ejemplar de azafea, Andalus*, 1944, pp. 111 f.; Kharegat, *Astrolabes*, 1950, p. 84, n. 3; García Franco, *Catálogo*, 1945, p. 318.

IV. In 615 (1218/9) he made (*ṣana'a*) an astrolabe in Seville, now in the collection of Cattaoui Pasha, Cairo.

Bibl.: *Rép.*, X, 1939, p. 149, No. 3812.

V. In 618 (1221/2) he made (*ṣana'ahu*) an astrolabe in Seville, now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Evans, Some astrolabes, *Archaeol. Journal*, 1911, p. 227; Gunther, *Early science in Oxford*, 1923, II, p. 191; id., *Instruments*, 1925, p. 16; Gunther, 1932, I, pp. 275 f., No. 129; id., *The Old Ashmolean*, 1933, p. 37; id., *Handbook*, 1935, p. 37; Wiet, Epigraphie, *MIE*, 1935, p. 14, n. 1; *Rép.*, X, 1939, p. 181, No. 3866; Renaud, Quelques constructeurs, *Isis*, 1942, p. 21.

VI. In 621 (1224) he made (*ṣana'a*) an astrolabe in Seville, originally said to have come from the North collection, then in the Knobel collection, now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Evans, Some astrol., *Archaeol. Journal*, 1911, p. 227; Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, I, pp. 276 f., No. 130, pls. LXI, LXII; Wiet, Epigraphie, *MIE*, 1935, p. 14, n. 1; *Rép.*, X, 1939, pp. 207 f., No. 3905; Michel, *Exposition . . . Liège*, 1939, p. 58, No. 308; id., *Traité*, 1947, p. 184; Davis, Early scient. instrum., *Ill. London News*, May 29, 1954, p. 924.

VII. In 628 (1230/1) he made another astrolabe in Seville, formerly in the Harari collection.

Bibl.: *Rép.*, XI, 1941, pp. 14 f., No. 4024; Zinner, Früheste Form, *XXX. Ber. d. Nat. Ges.*, Bamberg, 1947, p. 16.

VIII. In 634 (1236/7) he made (*ṣana'ahu*) another astrolabe in Seville, formerly in the Mensing collection, now in the Adler Planetarium, Chicago.

Bibl.: Gunther, 1932, I, p. 300, No. 153, pl. LXVI; Wiet, Epigraphie, *MIE*, 1935, p. 14, n. 1; *Rép.*, X, 1939, pp. 138 f., No. 3798; Renaud, Quelques constructeurs, *Isis*, 1942, p. 21.

MUḤAMMAD B. AL-GHAZŪLĪ

Shams ad-dīn Muḥammad b. al-Ghazūlī, author of several books about the astrolabe and other scientific instruments, in 735 (1334/5)

engraved (*naqsh*) a quadrant made by 'Alī b. ash-Shihâb, *q. v.* Died in or after 746 (1345/6).

Bibl.: Ahlwardt, *Verzeichniss*, Bd. 5, 1893, p. 234, No. 5799, p. 252, Nos. 5837 f.; Suter, *Mathematiker*, 1900, p. 166, No. 412; Schmalzl, *Quadranten*, 1929, p. 108.

MUḤAMMAD AL-ḤABBÂK

Abû 'Abdallah Muḥammad al-Ḥabbâk at-Tilimsânî, *al-mu'addil*, in 670 (1271/2) fixed the qibla of the Madrasa Ya'qûbiyya, Fez; in 685 (1286/7) constructed a water clock in the Qarawiyyîn Mosque, stated still (1919) to exist, although without its accessories.

Bibl.: Bel, *Inscriptions de Fès*, 1919, p. 279, n.; Al-Jaznâ'î, *Zahrat el-Âs*, ed. Bel, 1923, pp. 37, l. pu-38, l. 2, 75, ll. 1 f. of the Arabic text, pp. 91 f., 160 of the translation.

MUḤAMMAD B. ḤÂMID

Muḥammad b. Ḥâmid b. Maḥmûd al-Işfahânî is known by two astrolabes.

I. In the sixth decade of the sixth century he made (*ṣana'ahu*) an astrolabe, the first owner of which was Muḥammad Luhrâsb b. Afrasiâb ad-Dailamî *al-mu'adhdhin*. Now in the Top Kapu Sarayı Müzesi, Istanbul. Cf. pl. V. See also Ḥâmid b. Maḥmûd.

II. In 553 (1158) or 558 (1163) he made another astrolabe, formerly in the collection of Mr. Hakim, London.

MUḤAMMAD HÂSHIM

Muḥammad Hâshim Narâfi, in 1187 (1773/4) made (*ṣana'ahu*) an astrolabe, present owner unknown. Photo in the Museum of the History of Science, Oxford.

MUḤAMMAD B. HILÂL

Muḥammad b. Hilâl al-Munajjim al-Mauṣilî, in 674 (1275/6) made (*ṣana'ahu*) a celestial globe, formerly in the collection of Sir John Malcolm, for some time deposited in the R. Asiatic Society, and now in the British Museum, London (No. 71.3.1.1).

Bibl.: Dorn, Description, *Transactions of the R. Asiatic Society*, 1830, II, pp. 371-392, pls. A, B; Sédillot, *Instruments*, 1841, p. 116; Sédillot, *Matériaux*, I, 1845, p. 334; Dorn, *Drei Inst.*, 1865, p. 1; Meucci, *Globo*, 1878, p. 6; Casanova, *Sphère*, *MMAF*, 1892, pp. 314, 316, 330; Franks, 'Instruments', 1896, p. 182; Fiorini, *Sfere*, 1899, p. 37; Kühnel, *Globus*, *Mitt. d. sächs. Kunstsamml.*, 1911, pp. 22 f.; Stevenson, *Globes*, 1921, I, pp. 29 f., fig. 13; Sartori, 1931, II, 2, p. 1014; Gunther, 1932, p. 238; Upton, Manuscript, *Metr. Mus. Stud.*, 1933, vol. 4, fig. 6; v. Klüber, *Himmelsglobus*, 1935, pp. 1, 12 f., figs. 12 f.; Kühnel, *Mosulbronzen*, *Jhbch. d. Pr. Kunstsam.*, 1939, p. 11; *Rép.*, XII, 1943, p. 205, No. 4708; Barrett, *Islamic Metalwork*, 1949, pp. XII f.; Kratchkovskaya, *Epigrafika*, *Sov. Vostokov.*, 1949, p. 292; Mieli, *Panorama*, 1952, p. 170; Rice, Metalwork, III, *Bull. School of Orient. and Afr. Studies*, p. 230; Wittstein, *Fragmente*, *Ztschft f. Math. u. Physik*, 1892, p. 118; Mieli, *Science Arabe*, 1938, p. 154.

MUḤAMMAD B. IBRÂHÎM

Cf. Aḥmad b. Ibrâhîm.

MUḤAMMAD B. JA'FAR

Muḥammad b. Ja'far b. 'Umar *al-aṣṭurlâbî*, known as (*al-mulaqqab*) al-Jalâl, in 834 (1430/1) made a globe, now in the British Museum (96.3-23.1). Cf. pl. XII a. See also Ja'far b. 'Umar b. Daulatshâh al-Kirmâni and Maḥmûd b. Jalâl.

MUḤAMMAD KARÎM

Muḥammad Karîm, in 1133 (1720/1) made (*ṣana'ahu*) an astrolabe of wood, covered with papier maché, for Âqâ Qanbar 'Alî, formerly

in the Asiatic Museum, now in the Hermitage Museum, Leningrad (VP. 856).

Bibl.: Khanykov, Extrait d'une lettre, *Bull. hist. phil.*, 1856, t. 13, cols. 177-179 (= *Mél. As.*, 1856, II, pp. 508 f.); Dorn, *Drei Instrum.*, 1865, p. 2; da Schio, *Di due astrol.*, 1880, p. 58, No. 32.

MUḤAMMAD KARÎM

Muḥammad Karîm, in 1231 (1815/6) made (*'amal*) a bronze globe, now in the Victoria and Albert Museum, London (24-1882).

MUḤAMMAD KHALÎL

For Muḥammad Khalîl cf. Khalîl Muḥammad.

MUḤAMMAD KHÂZIN

Muḥammad Khâzin(?), in 1122 (1710/1) made (*ṣana'ahu*) an astrolabe for Ḥâjjî Muḥammad Sharîf, formerly in the Antique Art Galleries, London, now in the Whipple Museum, Cambridge (No. 1147).

MUḤAMMAD B. KHUTLUKH

Muḥammad b. Khutlukh al-Mauṣilî, in 639 (1241/2) made (*ṣan'at*) a prognostication table, formerly in the Posno collection, now in the British Museum (No. 1888.5-26.1).

Bibl.: Lavoix, *Galer. or. du Trocadéro*, *GBA*, 1878, II, p. 783; id., *Collection Goupil*, *GBA*, 1885, II, p. 298; Lane-Poole, *Saladin*, 1898, pl. facing p. 44; van Berchem, *Notes III*, *JA*, 1904, I, p. 30; Mittwoch apud Sarre, *Erzeugnisse Islam. Kunst. I. Metall*, 1906, p. 81; Kühnel, *Globus*, *Mitt. aus d. sächs. Kunstsamml.*, 1911, p. 22; Hourticq, *Encycl. des Beaux-Arts*, 1925, I, p. 170; Migeon, *Manuel*, 1927, II, p. 50; Wiet, *Cuivres*, 1932, p. 173, App. No. 50; id., *L'Exposition d'art persan*, *Syria*, 1932, p. 79; Kühnel, *Mosulbronzen*, *Jahrbuch d. Pr. Kunstsamml.*, 1939, p. 10; *Rép.*, XI, 1942, p. 135, No. 4202; Barrett, *Islamic Metalwork*, 1949, pp. XII, XXII, pls. 16 f.; D. S. Rice, *Metalwork*, III, *Bull. School of Orient. and Afr. Studies*, 1953, p. 230.

MUHAMMAD MAHDÎ

Muhammad Mahdî al-khâdim al-Yazdî, son of Muhammad Amîn, is known as the maker or decorator of at least fourteen astrolabes.

I. In 1070 (1659/60) he made (*şana'ahu*) an astrolabe for Muhammad Bâqir Işfahânî, in 1856 in the collection of John Williams, then in that of John Couch-Adams, about 1892 acquired by the Ethnographical Museum, Cambridge, now in the Whipple Museum, Cambridge (No. 1001). This is apparently the only dated instrument signed by him as an astrolabist, cf. also No. XII.

Bibl.: Morley, *Description*, 1856, pp. 48 f., ill.; Dorn, *Drei Instr.*, 1865, p. 3; Gunther, 1932, I, pp. 136 f., No. 20; Wiet, *Epigraphie, MIE*, 1935, p. 13; Gunther, *Cat. of a Loan Exhib.* . . . Cambridge, 1936, p. 13, No. 60; Michel, *Description, Ciel et Terre*, 1936, p. 206; Gunther, *Science in Cambridge*, 1937, pp. 186 f., No. 183, ill.; Michel, *Traité*, 1947, p. 185.

II. Another was formerly in the Malcolm Gardner collection. Cf. pl. XVII.

III. A third, formerly in the Clay collection, is now in the Museum of the History of Science, Oxford (No. C.579).

IV. In 1059 (1649/50) he decorated (*namaqahu*) an astrolabe, present owner unknown.

Bibl.: Donaldson, *Nomenclature, Isl. Culture*, 1945, p. 49, figs. 1-6.

V. VI. At unspecified dates he decorated (*namaqahu*) six astrolabes, two, formerly in the Michel collection, are now in the Billmeir collection.

Bibl. of the first: Michel, *Description, Ciel et Terre*, 1936, esp. p. 206 and fig. 2; id., *Exposition* . . . Liège, 1939, p. 59, No. 316; *Exposition Bruxelles*, 1945, p. 7, A. 4; Michel, *Traité*, 1947, p. 185, pl. XV; Josten, *Instruments*, 1954, pp. 11 f., No. 5, pl. II; id., *Coll. Billmeir, Connoisseur*, Oct. 1954, p. 85, fig.

Bibl. of the second: Josten, *Instruments*, 1954, p. 12, No. 6.

VII. A third, formerly in the S. V. Hoffman collection, is now in the collection of Mr. Eugene A. Hoffman, West Tisbury.

Bibl.: Gunther, 1932, pp. 139 f., No. 25, fig. 68, pl. XXXV; Michel, *Description, Ciel et Terre*, 1936, p. 206; id., *Traité*, 1947, p. 185.

VIII. A fourth is now in the collection of M. N. E. Landau, Paris.

IX. A fifth is now in the Chadenat collection, La Ferté-Bernard.

X. A sixth, formerly in the Rawlinson collection, is now in the Bibliothèque Nationale, Paris (Ge. A. 327).

Bibl.: da Schio, *Di due astrol.*, 1880, p. 56, No. 20; *Bibl. Nat., Notice*, 1889, p. 7, No. 371; Vallée, *Notice*, 1912, p. 46, No. 289.

XI. At an unspecified time he engraved (*naqashahu*) two astrolabes, one is now in the Evans collection in the Museum of History of Science, Oxford.

Bibl.: Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, pp. 121-123, No. 8, pl. XXVII; Michel, *Description, Ciel et Terre*, 1936, p. 206.

XII. A second, formerly in the collection of Claudius J. Rich, is now in the British Museum (1886. 3-17. 1). Cf. pl. XVII.

Bibl.: Franks, 'Instruments', 1896, p. 183; Gunther, 1932, p. 123, No. 9.

XIII. He was the *râqim* and engraver (*naqqâsh*) of an astrolabe constructed by Muhammad Muqîm al-Yazdî, *q. v.*, and dated A. H. 1052.

XIV. An astrolabe, formerly in the S. V. Hoffman collection, is signed by Muhammad Mahdî but without any indication whether it was made or decorated by him. The character of the script and of the decoration differs from all his other signatures.

Bibl.: Gunther, 1932, p. 157, No. 44, pls. XXXIX-XLI; Michel, *Description, Ciel et Terre*, 1936, p. 206; id., *Traité*, 1947, p. 185.

MUHAMMAD B. MAHMÛD

Muhammad b. Maḥmûd, in the course of the 10th century A. D. made a brass quadrant, unearthed during the excavations by the Metropolitan Museum of New York at Nishapur, now in their collection (36. 20. 54). [In collaboration with Florence E. Day.]

MUḤAMMAD B. MAḤMŪD B. 'ALĪ

Muḥammad b. Maḥmūd b. 'Alī aṭ-Ṭabarī al-Aṣṭurlābī, in 684 (1285/6) made (*ṣana'ahu*) a celestial globe, acquired in Cairo by the Mission Archéol. Française, since 1892 in the Louvre Museum.

Bibl.: Casanova, *Sphère céleste*, *MMAF*, 1892, VI, pp. 313-330, 1 pl.; van Berchem, *Notes d'archéologie*, III, *JA*, 1904, I, pp. 29, 38; Migeon, *L'Orient Mus.*, Sculpture, 1922, pp. 20 f., No. 68; Migeon, *Manuel*, 2nd ed., 1927, II, p. 42; v. Klüber, *Himmelsglobus*, 1935, p. 1; Harari, *Survey*, 1939, III, p. 2518; *Rép.*, XIII, 1944, p. 45, No. 4864; Hartner, *Instrum. of Cha-ma-lu-ting*, *Isis*, 1950, p. 190, n. 16.

MUḤAMMAD B. MU'AYYAD

Muḥammad, son of the Damascene astronomer Mu'ayyad ad-dīn al-'Urḍī, who joined the select group of scholars round Naṣīr ad-dīn aṭ-Ṭūsī at Marāgha, although probably born in Damascus, lived in Persia. At an unspecified date, obviously during the last third of the 13th century, he made a celestial globe for the observatory of Marāgha, formerly in the collection of Schloss Moritzburg, now in the Mathematisch-Physikalischer Salon, Dresden.

Bibl.: Hindenburg, *Aus einem Schreiben*, *Astron. Jahrbuch f. d. Jahr 1785*, publ. 1782, pp. 235 f.; Beigel, *Nachricht*, *Astr. Jahrbuch für 1808*, pp. 97-110; Jourdain, *Mémoire*, *Mag. Enc.*, 1809, t. VI, p. 50; Ideler, *Untersuchungen*, 1809, pp. LIX f.; Dorn, *Description*, *Transactions, R. As. Soc.*, 1830, p. 377; Sédillot, *Instruments*, 1841, p. 116; id., *Matériaux*, 1845, I, p. 334; Schier, *Bericht*, *Zeitschrift f. allg. Erdkunde*, 1864, Bd. 16, pp. 494-500; id., *Globus*, 1865, esp. pp. 5-7, with a reprint of his "Bericht" on pp. 65-71; Dorn, *Drei Instrum.*, 1865, p. 1; Drechsler, *D. arab. Himmelsglobus*, 1873, 2nd ed., 1922; Meucci, *Globo*, 1878, p. 6; Casanova, *Sphère*, *MMAF*, 1892, pp. 314, 317, 330; Fiorini-Günther, 1895, p. 15; Fiorini, *Sfere*, 1899, p. 37; Suter, *Nachträge*, 1902, p. 176; Kühnel, *Ausstellung, Islam*, 1910, p. 372; id., *Globus, Mitt. d. sächs. Kunstsamml.*, 1911, pp. 16-23, 3 figs.; *Meisterwerke*, 1912, II, p. VII; Stevenson, *Globes*, 1921, I, pp. 30 f., fig. 14; Engelmann, *Sammlung Mensing*, 1924, p. 11; Boffito, *Strumenti*, 1929, p. 21; Sarton, *Introduction*, II, 2, 1931, pp. 1014 f.; Fox, *Adler Planetarium, Popular Astron.*, 1932, p. 329; id., *Adler Planetarium*, 1933, p. 32; v. Klüber, *Himmelsglobus*, 1935, pp. 1 f., 13, fig. 14;

Mieli, *Science arabe*, 1938, pp. 151, 154; Harari, *Survey*, 1939, III, p. 2518, VI, pl. 1403; *Rép.*, XII, 1943, p. 200, No. 4699; Hartner, *Instrum. of Cha-ma-lu-ting*, *Isis*, 1950, p. 190 and n. 16; Mieli, *Panorama*, 1952, pp. 170 f.; Wilber, *Architecture*, 1955, p. 10; Wittstein, *Fragmente*, *Ztschft f. Math. u. Phys.*, 1892, p. 96.

MUḤAMMAD B. MUḤAMMAD B. AL-'ARABĪ

Abū 'Abdallah Muḥammad b. Muḥammad b. al-'Arabī, between 747 and 749 (1346-48) restored the second clock (*majāna*) of the Qarawiyyīn-Mosque, Fez, constructed by Muḥammad aṣ-Ṣinhājī, *q.v.*, and combined it with a rete (*shabaka*) of an astrolabe.

Bibl.: Al-Jaznā'ī, *Zahrat el-Ās*, ed. Bel, 1923, pp. 39, ll. 2-12 of the Arabic text, pp. 93 f. of the translation.

MUḤAMMAD B. MUḤAMMAD AL-AZDĪ

Cf. s.v. 'Alī b. Muḥammad al-Azdī.

MUḤAMMAD B. MUḤAMMAD AL-HĀSHIMĪ

Jamāl ad-dīn Muḥammad . . . b. Muḥammad al-Hāshimī, born in Mecca, in 981 (1573/4) made (*'amila*) a globe, formerly in the collection de Viel Castel, now in the Bibliothèque Nationale, Paris (Ge. A. 326).

Bibl.: Sédillot, *Instruments*, 1841, pp. 117 ff.; Jomard, *Monuments*, 1854, pl. II, No. 74; Fiorini-Günther, 1895, p. 16; Fiorini, *Sfere*, 1899, p. 37; Vallée, *Notice*, 1912, No. 292, p. 47; Stevenson, *Globes*, 1921, I, p. 31, fig. 15; v. Klüber, *Himmelsglobus*, 1935, p. 2; Berthelot, *Extrait*, 1840, pp. 12 f.

MUḤAMMAD B. MUḤAMMAD B. HUDHAIL

Muḥammad b. Muḥammad b. Hudhail, in 650 (1252/3) made (*ṣan'at*) an azaphea in Murcia, now in the Observatorio Fabra, Barcelona.

Bibl.: García Franco, *Catálogo*, 1945, pp. 313-319, esp. 315, 435, pls. 48 f.; Millás Vallicrosa, *Ejemplar de azafea, Al-Andalus*, 1944, esp. p. 118, pl. 3, 1945, p. 253; id., *Estudios sobre Azarquiel*, 1943-50, pls. VII, VIII; id., *Estudios . . . de la ciencia española*, 1949, pls. III, IV; Mieli, *Panorama*, 1952, figs. 21 f.

MUḤAMMAD B. MUḤAMMAD AL-‘UMARÎ

Muḥammad b. Muḥammad al-‘Umarî, in 1079 (1668/9) made an astrolabe, present owner unknown.

Bibl.: Gunther, 1932, pp. 141 f., No. 26; Michel, *Traité*, 1947, p. 184.

MUḤAMMAD MUḤSIN

Muḥammad Muḥsin b. Muḥammad ‘Alî ash-Sharîf al-Kirmânî in 1195 (1781) engraved (*katabahu wa-râqamahu*) an astrolabe for Luṭf‘alî b. ‘Abd an-Nabî, now in the Chadenat collection, La Ferté-Bernard.

Bibl.: *Expos. des instr.*, Paris 1936, p. 35, No. 263.

MUḤAMMAD MUQÎM AL-YAZDÎ

Muḥammad Muqîm al-Yazdî is known by four astrolabes.

I. In 1052 (1642/3) while in Isfahan, he made (*ṣana‘ahu*) an astrolabe, now in the Musée Archéologique, Teheran. It was engraved (*kâna râqim ḥurûfihi wa-kitâbatihî wa-naqqâsh dhalika kullihî*) by Muḥammad Mahdî al-Yazdî, *q.v.*

II. In 1054 (1644/5) he made (*ṣana‘ahu*) an astrolabe, now in the collection of M. Georges Charliat, Paris.

III. In 1057 (1647) in the presence (or under supervision, *bi-wuqûf*) of Muḥammad Shafî‘, the astronomer (*al-munajjim*) of Janâbâd, he made (*ṣana‘ahu*) an astrolabe for Shâh ‘Abbâs II. It was engraved (*râqamahu*) by Faḍl Allah as-Sabzawârî. Formerly in the family of the Amir of Afghanistan, it is now in the Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Gunther, *Early science in Oxford*, 1923, II, pp. 191, 199; id., *Instruments*, 1925, pp. 14 f.; Gunther, 1932, pp. 132-135, No. 18, pls. XXX-XXXII; Anonymous, *Early instruments*, *Engineering*, May 19, 1933, p. 4 of offprint,

figs. 3 f.; Gunther, *The Old Ashmolean*, 1933, pp. 35 f.; id., *Handbook*, 1935, pp. 35 f.; Harari, *Survey*, 1939, III, p. 2519, VI, pl. 1401; Michel, *Traité*, 1947, p. 185.

IV. At an unspecified date he made (*ṣana‘ahu*) another astrolabe, decorated (*namaqahu*) by Muḥammad Mahdî al-Yazdî, *q.v.*, now in the National Maritime Museum, Greenwich (A. 35-36. 678). Cf. pl. XVIII.

MUḤAMMAD ŞÂDIQ

Muḥammad Şâdiq b. ‘Alînaqî, in 1189¹ (1775/6) made an astrolabe, formerly in the S. V. Hoffman collection.

Bibl.: Gunther, 1932, pp. 163 f., No. 52, fig. 80; Michel, *Traité*, 1947, p. 185.

MUḤAMMAD B. AŞ-ŞAFFÂR

Muḥammad b. aş-Şaffâr,² in 420 (1029), made an astrolabe in Toledo, formerly in the Sprenger collection, later in the Staatsbibliothek, Berlin, now in the Westdeutsche Bibliothek, Marburg a.d.L. Cf. pl. II.

Bibl.: Wœpcke, Berlin . . . *Astrolabium*, *Math. Abh. Akad.*, Berlin, 1858, pp. 1-31, 3 pls., esp. p. 7; Dorn, *Drei Instr.*, 1865, p. 2; da Schio, *Di due astrol.*, 1880, p. 58, No. 37; Evans, *Some astrolabes*, *Archaeol. Journal*, 1911, p. 226; Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, I, pp. 251 f., pl. LIX; *Rép.*, VI, 1935, p. 201, No. 2368; Michel, *Traité*, p. 184; Zinner, *Früheste Form*, XXX. *Ber. d. Nat. Ges. Bamberg*, 1947, pp. 15 f.

MUḤAMMAD ŞAFFÂR

Shams ad-dîn Muḥammad Şaffâr, an astrolabist of the late 9th and early 10th (15th/16th) centuries, is known by five instruments.

¹ This is the date corrected by a later hand, the original had: 1089.

² This word was first read aş-Şâl by Wœpcke and repeated by everybody except Michel (who changed it into aş-Şâlih). Three facts speak in favour of the transcription given above: in this inscription there is nowhere else an interval comparable to that between the *şâd* and the *alif* in this word, there is an otherwise unexplicable circle in the middle of this interval, the last letter looks exactly like any other *râ*.

I. In 882 (1477/8) he made an astrolabe, now in the Museum of Islamic Art, Cairo.

Bibl.: Wiet, Epigraphie, *MIE*, 1935, p. 14, n. 1; Reich et Wiet, 1939, p. 202.

II. In the same year he finished (*faragha min san'at*) another, formerly in the Holden-White collection, now in the Fitzwilliam Museum, Cambridge. Cf. pl. XIII.

III. In 886 (1481/2) he made another astrolabe, stated to have come from the Richard collection, now in the Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Gunther, *Early science in Oxford*, 1923, II, p. 191; Gunther, 1932, I, pp. 241 f., No. 108, pl. LVII; Wiet, Epigraphie, *MIE*, 1935, p. 14, n. 1; Reich et Wiet, 1939, p. 202; Michel, *Traité*, 1947, p. 185.

IV. In 898¹ (1492/3) he made an astrolabe, formerly in the Observatoire de Belgique, now in the Musées Royaux d'art et d'histoire, Bruxelles.

Bibl.: Michel, *Traité*, 1947, p. 185.

V. In 911 (1505/6) he made an astrolabe, now in the Chadenat collection, La Ferté-Bernard.

MUHAMMAD B. SA'ID

Muhammad b. Sa'id as-Šabbân² as-Saraqustî al-Ašturlâbî al-Andalusî, a native of Saragossa, studied mathematics in Egypt, and, according to his own testimony, was much impressed by Jâbir b. Ḥayyân's book on the construction of astrolabes.

¹ The word indicating the decade is neither *sab'in* nor *tis'in*, but the photograph seems to show two points over the *sîn*, which makes *tis'in* more probable than *sab'in*.

² Ibn al-Qiftî and Ibn al-Abbâr call him Ibn al-Mashshâf, i.e. son of the barber. Although the appellation of his father which our astrolabist puts on record in his signature, viz. *šabbân* ("soapman"), indicates a laundryman rather than a barber, there can be little doubt that the meaning is the same.

I. In 466¹ (1073/4) he made an astrolabe, once in the National Museum, Munich (33/243), present owner unknown.

II. Back in Spain, he lived for a time at least in Madînat al-Faraj (Guadalajara) where in 474 (1081/2) he made a brass astrolabe, now in the collection of M. N. E. Landau, Paris.

Bibl.: Ibn al-Qiftî, *Ta'rîkh al-ḥukamâ'*, ed. Lippert, 1903, pp. 160 f.; Ibn al-Abbâr, *Takmila*, 1887, p. 127, No. 447; Casiri, *Bibl. arab. hisp.*, 1760, I, p. 424; Suter, *Mathematiker*, 1900, pp. 104, 215, No. 234; Sánchez-Pérez, *Biografías*, 1921, p. 120, No. 142.

MUHAMMAD AŞ-ŞINHÂJÎ

Abû 'Abdallah Muhammad aş-Şinhâjî *al-mu'addil*, in 717 (1317) constructed the second clock (*majâna*) of the Qarawiyyîn-Mosque, Fez, with voluntary contributions of some Muslims. The divisions were designed (*rasama*) by Abû 'Abdallah Muhammad b. aş-Şaddîniyya al-Qarastûnî. Within a generation the clock fell into disuse and was restored by Muhammad b. Muhammad b. al-'Arabî, *q.v.*

Bibl.: Al-Jaznâ'î, *Zahrat el-Âs*, ed. Bel, 1923, pp. 38, ll. 8-39, l. 2 of the Arabic text, pp. 92 f. of the translation.

MUHAMMAD B. SHADDÂD

Muhammad b. Shaddâd, a North African astrolabist, at an unspecified date made an astrolabe, in 1865 in the Wetzstein collection.

Bibl.: Dorn, *Drei Instr.*, 1865, pp. 115-118, esp. p. 117, ill.

MUHAMMAD SHAFÎ'

For Muhammad Shafî' cf. Muhammad Muqîm al-Yazdî.

¹ It is not impossible, although not very probable either, that the date is 496 (1102/3), the only difference in occidental Arabic script being a dot over the second letter. The photograph which I owe to the kindness of Prof. E. Zinner, was considerably enlarged from a Leica film, and as luck would have it, just at that place it is not very clear.

MUḤAMMAD ṬÂHIR

Muḥammad Ṭâhir is known by two instruments.

I. At an unspecified date he made (*ṣana'ahu*) an astrolabe, decorated (*namaqahu*) by 'Abd al-A'imma the Younger and consequently made about the turn of the 17th century. It is now in the Lewis Evans collection in the Museum of the History of Science, Oxford.

Bibl.: Gunther, 1932, pp. 137 f., No. 21, pl. XXXIV; Michel, *Méthodes, Ciel et Terre*, 1941, p. 496, n. 19; Michel, *Traité*, 1947, p. 185.

II. At an unspecified date he made (*ṣana'ahu*) another astrolabe but apparently decorated it himself. It is now in the Hermitage Museum, Leningrad (VC. 511).

MUḤAMMAD B. YÛSUF

Muḥammad b. Yûsuf b. Ḥâtim, in 638¹ (1240/1) made (*ṣana'a*) an astrolabe, in 1900 in the Heilbronner collection, then in the Mensing collection, now in the Adler Planetarium, Chicago.

Bibl.: *Musée Rétrospect.*, Classe 15, 1900, p. 22, No. 28; Gunther, 1932, p. 300, No. 154, pl. LXVII; Fox, Adler Planetarium, *Popular Astron.*, 1932, fig. 11; id., *Adler Planetarium*, 1933, p. 36, fig. 31; *Rép.*, X, 1939, p. 182, No. 3867; Renaud, *Quelques constructeurs, Isis*, 1942, p. 21.

MUḤAMMAD ZAMÂN

Muḥammad Zamân, an astronomer and astrolabist of Mashhad, flourished during the second half of the 11th (17th) century. He is known by five instruments.

I. In 1051 (1641/2) he made (*ṣana'ahu*) a celestial globe, formerly in the Marling collection, now in the Victoria and Albert Museum (M. 827-1928).

¹ Possibly 618 (1221/2), even less likely 613 or 633.

II. In 1070 (1659/60) he made (*ṣana'ahu*) an astrolabe, in 1925 in the J. B. Petit collection, present owner unknown.

Bibl.: Kharegat, *Astrolabes*, 1950, pp. 3-54, ill., esp. p. 16, fig. 1.

III. In 1088 (1677/8), signing Muḥammad Zamân [son of?] Ḥâjjî Sharaf ad-dîn Ḥasan, he made (*ṣana'ahu*) an astrolabe for Shâh Subhân Qulî Bahâdur Khân, in 1910 in a private collection in Bukhara; now in the Museum of History of the Academy of Science of the Uzbek SS Republic at Tashkend.

Bibl.: Osipov, *Astrolabiya planisfera, Protokoli*, 1910, esp. p. 114, fig. 2; Karî-Niyazov, *Shkola*, 1950, p. 74, figs. 36-38.

IV. At an unspecified date he made (*ṣana'ahu*) a celestial globe, formerly in the Harari collection.

Bibl.: Wiet, *Exposition d'art persan*, 1935, p. 67, No. M. 90; id., *Epigraphie, MIE*, 1935, p. 16.

V. At an unspecified date, signing fully Muḥammad Zamân *al-munajjim al-aṣṭurlâbî* al-Mashhadî, he made (*ṣana'ahu*) an astrolabe, formerly in the Grobba collection (acquired in Baghdad), now in the Islam. Abteilung der Staatl. Museen, Berlin (J. 6919).

Bibl.: Kühnel, *Neuerwerbungen, Berliner Museen*, 1943, Jgg. 64, pp. 33 f., fig. 15.

MUṢṬAFÀ AYYÛBÎ

Muṣṭafà Ayyûbî, an Ottoman astrolabist, is known by two works.

I. In 1110 (1698/9) he made (*'amal*) an astrolabe, now in the collection of Dr. Jacques Schumann, Paris.

II. In 1114¹ (1702/3) he made (*'amal*) an astrolabe, now in the Science Museum, London (1952-226). Cf. pl. XVIII.

Bibl.: Price, *Armillary spheres, Annals of Science*, 1954, p. 183, No. 12.

¹ Written—perhaps by mistake—1014.

QAIŞAR

Shaikh 'Alam ad-dîn Qaişar b. Abî-l-Qâsim b. 'Abd al-Ghanî b. Musâfir, known by the name of Ta'âsîf, of the Hanafite persuasion, was born 574 (1178/9) in Aşfûn (in Upper Egypt). Having worked in his native country and in Syria, he studied music under Shaikh Kamâl ad-dîn Mûsâ b. Yûnis in Mosul, and became famous as an architect and mathematician. On his return to Syria he entered the service of the Ayyubid al-Malik al-Muẓaffar Maḥmûd of Hama. While at his court he built towers in Hama and a mill on the Orontes. The historian Qâḍî Jamâl ad-dîn ibn Wâṣil put it on record that with his help Qaişar constructed a celestial globe, made of wood, and gilt. In 622 (1225) Qaişar made a brass one, by order of the Ayyubid al-Malik al-Kâmil Muḥammad b. Abî Bakr. It was kept for a long time in the Museo Borgiano in Velletri, and is now in the Museo Nazionale, Naples. Died in Damascus, 13th Rajab 649 (1st Oct. 1251).

Bibl.: Abu-l-Fidâ', ed. Reiske, IV, pp. 478, ll. 2-7, 528, ll. 8-13 (ed. Istanbul, 1286, III, pp. 181, ll. 13-19, 195, ll. 7-11); Ibn al-Wardî, *Ta'riḥ*, Cairo 1285, II, p. 188, ll. 20-23; Ibn Abî Uṣaibi'a, ed. A. Müller, 1884, II, pp. 70 f.; Maqrîzî, *Sulûk*, ed. Ziada, I, pp. 232, l. 3, 256, l. 16, 318, n. 3, 382, ll. 11-14; Suyûṭî, *Ḥusn al-muḥâdara*, (ed. 1327) I, p. 233, (ed. 1299) I. 313; v. Murr, *Journal f. Kunstgesch. u. Lit.*, 1787, Th. 15, p. 334; Assemani, *Saggio*, 1787, p. LXV, n. a; id., *Globus*, 1790, pp. LXVII-CCXIX, esp. p. LXXVI, pls. I-III, esp. pl. III; v. Murr, *Inscriptio arabica*, 1790, p. 28; Ideler, *Untersuchungen*, 1809, pp. LVIII f.; Fraehn, *Inscrip. cuficae*, *Mém. de l'Acad. des Sciences*, St. Petersburg, t. VIII, 1820, p. 538, n. 26, 571; reprinted in *Antiq. muh.*, 1822, II, pp. 42 f., n. 26, 75; Dorn, *Description*, *Transac. R. Asiat. Soc.*, 1830, p. 377; Anonymous, Note, *JA*, 1836, I, p. 193; Sédillot, *Instruments*, 1841, p. 116; id., *Matériaux*, 1845, I, p. 334; Dorn, *Drei Instrum.*, 1865, p. 1; Meucci, *Globo*, 1878, p. 6; Rey, *Colonies*, 1883, p. 176; Casanova, *Sphère*, *MMAF*, 1892, VI, pp. 315 f., 330; Karabacek, *Cameo*, 1893, pp. 5, 6, n. 1, 22; Karabacek, *Involutio*, 1896, p. 16, ill.; Casanova, *Citadelle*, *MMAF*, 1897, t. 6, pp. 599 f.; Fiorini, *Sfere*, 1899, pp. 31-33; Schmoranz, *Glass vessels*, 1899, p. 29; Suter, *Mathematiker*, 1900, p. 143, No. 358; id., *Nachträge*, p. 175; Kühnel, *Globus*, *Mitt. a. d. sächs. Kunstsamml.*, 1911, p. 23; Stevenson, *Globes*, 1921, I, p. 29; Boffito, *Strumenti*, 1929, p. 21; Sartori, *Introduction*, 1931, II, 2, p. 1014; Wiet, *Cuivres*, 1932, pp. 170 f., App. No. 40; Hauteœur et Wiet, 1932, p. 125; v. Klüber, *Himmelsglobus*, 1935, p. 1; Mieli,

Science Arabe, 1938, pp. 154 f.; *Rép.*, X, 1939, pp. 221 f., No. 3924; Maḥmûd Rizq Salîm, *Aşr salaṭîn al-Mamâlîk*, 1952, t. IV (= II. 2), p. 8, No. 5; Mieli, *Panorama*, 1952, pp. 170, 178; Wittstein, *Fragmente*, *Ztschft f. Math. u. Phys.*, 1892, p. 96; Kratchkovskaya, *Epigrafika*, *Sov. Vostokov.*, 1949, p. 292.

QÂSIM B. 'ABD AS-SALÂM

Qâsim b. 'Abd as-Salâm at-Tamlî, in 1192 (1778) made (*şan'at*) an astrolabe in Rabat, formerly in the Ruiz Orsatti collection, now in the Biblioteca General at Tetuán.

Bibl.: Ruiz Orsatti, *Astronomía*, *Mauritania*, 1940, pp. 27-30, ill.; Renaud, *Quelques constructeurs*, *Isis*, 1942, p. 23; Millás Vallicrosa, *Tres instrumentos*, *Al-Andalus*, 1947, pp. 49-56, pls. 1, 2.

QÂSIM 'ALÎ

Qâsim 'Alî Qâ'inî in 1093 (1682) made (*şan'at*) an astrolabe, now in the Chadenat collection, La Ferté-Bernard.

RİDWÂN

Rîdwân, in 1082 (1671/2) made a sun-dial for the Yeni Jâmi', Istanbul.

Bibl.: Ünver, *Cadranes solaires*, *Archives d'hist. des sciences*, 1954, p. 257.

RİDWÂN B. 'ABDALLAH

Rîdwân b. 'Abdallah, called Rîdwân Ef. al-Falakî, an astronomer and author of many books, lived in Bulaq, where he died 23rd Jumâdâ I, 1122 (20th July 1710).¹ In Şafar 1113 (beg. 8th July, 1701) assisted (*ishtağala 'alaihi*) by his pupil Yûsuf,² he finished a celestial globe for

¹ Jabartî, I, pp. 74, ll. 18-ult., 114, ll. 22 f., 397, l. 21; Dorn, *Drei Instr.*, 1865, pp. 1, 32-35.

² Yûsuf al-Falakî was a majordomo (*kilârî*) and mamluk of Ḥasan Efendî (Jabartî, I, pp. 74, l. 8 b, 114, l. 12 b).

Hasan Efendî al-Khalwatî ad-Damurdâshî, later *rûznâmejî* in Cairo. Formerly in the collection of Clot Bey, the globe is now in the Public Library, Leningrad. This was one of many richly decorated scientific instruments in which the two cooperated and on which both engraved their names. Despite Jabartî's assertion that Ḥasan Efendî's instruments were made "by the hand" (*bi-yad*) of Riḍwân, the actual engraving seems to have been done to some extent at least by hired workmen.

Bibl.: Dorn, *Drei Instr.*, 1865, No. III, pp. 31-63, esp. pp. 32 f., 94, ill.; Fiorini-Günther, 1895, pp. 16 f.; Kühnel, Globus, *Mitt. sächs. Kunstsamml.*, 1911, p. 23; Stevenson, *Globes*, 1921, I, p. 32; v. Klüber, *Himmelsglobus*, 1935, p. 2.

RIDWÂN B. MUḤAMMAD

Cf. s.v. Muḥammad b. 'Alî.

ŞÂDIQ

Şâdiq, in 1216 (1801/2) made an astrolabe for 'Abdallah b. Muḥammad Naşîr ar-Riḍawî, engraved (?) by 'Abd al-Karîm, *q.v.* Perhaps identical with Muḥammad Şâdiq, *q.v.*

Bibl.: Gunther, 1932, pp. 164 f., No. 53, fig. 80; Michel, *Traité*, 1947, p. 180.

AS-SAHL

As-Sahl al-Aşturlâbî an-Naisâbûrî, made (*şana'ahu*) an astrolabe for the library (*khizâna*) of the Ayyubid al-Malik al-Muẓaffar Maḥmûd of Ḥamâ (d. 698/1299), said to have been formerly in the collection of Iohannes Regiomontanus, later in the Nürnberg Library, now in the Germanisches Museum, Nürnberg (W. J. 20).

Bibl.: v. Murr, *Memorab. Bibl.*, Norimbergae, 1786-88, pars I, p. 10, tab. 7, pars II, pp. 317 f., 321, ill.; id., *Journal f. Kunstgesch. u. Litt.*, 1787, Th. 15, pp. 333 f., 388; id., *Inscriptio pallii*, 1790, pp. 26-28; A. Th. Hartmann, *Oluf Gerhard Tychsen*, 1820, Bd. II, Abt. II, pp. 152 f.; Fraehn, *Astrolabii Norimb. inscr. cufica*, *Antiq.*

muham., 1822, II, pp. 73-75; Sédillot, *Instruments*, 1841, p. 176, n. 1; Dorn, *Drei Instr.*, 1865, p. 2; da Schio, *Di due astrol.*, 1880, p. 58, No. 38; van Berchem, Notes II, *JA*, 1892, I, p. 391; id., Notes, III, *JA*, 1904, I, p. 28; Hourticq, *Encycl. des Beaux-Arts*, 1925, I, p. 170; Migeon, *Manuel*, 1927, II, p. 42; Wiet, *Cuivres*, 1932, p. 189, App. No. 115; Gunther, 1932, p. 280, No. 137; Reich et Wiet, 1939, p. 201; Harari, *Survey*, 1939, III, p. 2518; *Rép.*, XIII, 1944, p. 187, No. 5066; Kratchkovskaya, *Epigrafika, Sov. Vostokov.*, 1949, p. 292.

SARRÂJ

Sarrâj, a muezzin in Damascus, is known by two instruments.

I. In 626 (1228/9) he made (*şana'ahu*) an astrolabe in Damascus, now in the State Library, Rampur.

Bibl.: Padmakara, *Astrolabes, Journal of the United Prov. Hist. Soc.*, 1928, pp. 1-5, esp. p. 3, pls. I-III, esp. pl. II; Gunther, 1932, p. 247, No. 102 A; *Rép.*, X, 1939, p. 264, No. 3997.

II. In 623 (1226) or 628 (1230/1) he made an astrolabe, also in Damascus, now in the National Maritime Museum, Greenwich (A. 17-36. 17).

SHUKR ALLAH MUKHLIŞ

Shukr Allah Mukhliş Shirwânî, in [8]91 (1486) made (*'ilmî wa-'amalî*) an astrolabe for the Ottoman Sultan Bayezid II, formerly in the Harari collection.

Bibl.: *Exposition d'art musulman*, Alexandria, 1925, pp. 73 f., No. 385; *Morancé Album*, 1925, p. 10, pl. 8; Meyerhof, *Kunstausstellung, Islam*, 1927, p. 152; *Cat. Exh. Persian Art*, 3rd ed., 1931, p. 194, No. 309 E., J.; Gunther, 1932, p. 126, No. 12; Wiet, *Exposition d'art persan*, 1935, p. 65, M. 75; Harari, *Survey*, 1939, III, p. 2518, VI, pl. 1399.

'UMAR

The Rasulid Sultan al-Malik al-Ashraf Mumahhid ad-dîn 'Umar b. Yûsuf b. 'Umar b. 'Alî b. Rasûl al-Muẓaffarî in 695 (1295/6) made

(*'amal . . . mubâsharatan wa-implân*) a brass astrolabe in Yemen, now in the Metropolitan Museum of Art, New York (No. 91.1.535). Died 24th Muḥarram 696 (22nd Nov., 1296).

Bibl.: Dimand, Dated specimens, *Metr. Mus. Studies*, 1928, I, p. 107, fig. 8; Gunther, 1932, I, p. 243; Wiet, *Cuivres*, 1932, pp. 76, 183, App. No. 86; id., *Lampes*, *BIE*, 1932, XIV, p. 118; Day, Dated faience, *Ars Islam.*, 1941, p. 50; *Rép.*, XIII, 1944, pp. 150 f., No. 5014; Khazrajî, *'Uqûd*, ed. M. 'Asal, I, esp. pp. 284-298.

'UTHMÂN

'Uthmân, in 1155 (1742/3) made a sun-dial for the Mosque of Sultan Bayezid, Istanbul.

Bibl.: Ünver, Cadrons solaires, *Archives d'hist. des sciences*, 1954, p. 257.

'UTHMÂN B. 'ABDALLAH

'Uthmân b. 'Abdallah aṣ-ṣaffâr, in 699 (1299/1300) while in Fez, made (*'amal*) an astrolabe, now in the Museo di Storia della Scienza, Florence (No. 1109). Cf. pl. IV b.

Bibl.: Bonelli, *Catalogo . . . Firenze*, 1954, p. 62, No. 1109.

YA'QÛB TAPIERO

Ya'qûb b. Mûsà Ṭâfiruh of Fez, in 716¹ (1316/7) made (*ṣana'ahu*) an astrolabe, now in the Duval collection.

Bibl.: Colin, Un Juif marocain, *Hespéris*, 1936, pp. 183 f.; Renaud, Quelques constructeurs, *Isis*, 1942, p. 22; *Rép.*, XIV, 1954, p. 288, No. 5362 A.

YÛSUF B. ḤÂJJÎ AL-JÎLÂNÎ

Yûsuf b. Ḥâjjî al-Jîlânî, in 929 (1522/3) made an astrolabe, now in the National Maritime Museum, Greenwich (A. 6-36. 11). Cf. pl. XV.

¹ The letters used ستيو conform with the Jewish style of dating, the correct Arabic one is ذيو .

ZARTÂN

Zartân, who obviously lived in Persia, at an unspecified—but fairly recent—date, made (*'amal*) an astrolabe, now in the Musée d'Art et d'Histoire, Geneva. So far as I can see, it is the only one signed on the alidade.

Bibl.: *Les Musées de Genève*, Jan. 1953, p. 2, 2 figs.

ADDITIONS

The "Roll of Astrolabists" was already set in pages when I received a score of new photographs and had a chance of seeing two more collections in Great Britain.¹ This makes a few additions and a correction necessary.

The instruments once in the collection of the late S. V. Hoffman have been divided after his death between his son Mr. Eugene A. Hoffman, his daughter Miss Margaret E. Hoffman and the New-York Historical Society. The "List of Monuments and Collections" shows which object belongs to whom. The most important result is that the photographs prove beyond doubt that Aḥmad b. Ḥasanain b. Baraka never existed, and that the name should be read Aḥmad b. Ḥusain b. Bâso as I tentatively suggested (p. 35, n. 1). A checklist of all the astrolabes now in the museum of the Society was published by H. Maxson Holloway (see Bibliography).

'ABD AL-A'IMMA the ELDER

II. In 989 (1581/2) he made (*'amal*) an astrolabe, now in the collection of Mr. E. S. David, Long Island City.

¹ I take this opportunity to thank Mr. Cyril Wallis, Director, and Mr. Plenderleith, Curator of the R. Scottish Museum, Edinburgh; Maître Henri Larrouy; Prof. G. S. Colin; Dr. R. Ettinghausen; Mr. E. A. Hoffman, Miss M. E. Hoffman and Mr. R. W. G. Vail, Director of the New-York Historical Society, for their kindness in providing me with photos and answering various questions.

'ABD AL-A'IMMA the YOUNGER

XXIX. In 1127 (1715) he made (*ṣana'ahu*) an astrolabe for Muḥammad Khân Bakrân, now in the Freer Gallery of Art, Washington (No. 42.8).

XXX. At an unspecified date he made (*ṣana'ahu*) an astrolabe now in a private collection in England.

XXXI. Also at an unspecified date he made (*ṣana'ahu*) an astrolabe, formerly in the Sir John Findlay collection, now in the R. Scottish Museum, Edinburgh (No. 1925.20).

AḤMAD B. ḤUSAIN B. BÂŞO

IV. In 704 (1304/5) he made (*ṣana'ahu*) an astrolabe, formerly in the S. V. Hoffman collection, now in the museum of the New-York Historical Society, New York.

Bibl.: Gunther, 1932, p. 289, No. 144; Holloway, Checklist, *Annual Rep.*, N.Y. Hist. Soc., 1946, p. 68; Michel, *Traité*, 1947, p. 181.

AḤMAD B. MUḤAMMAD B. HÂRÛN

Aḥmad b. Muḥammad b. Hârûn al-Hadâmî in 728 (1328/9) made (*ṣana'ahu*) an astrolabe in Marrakesh, now in the Dâr Batha Museum at Fez. [Photo in the collection of M. Henri Michel.]

Bibl.: Price, Checklist, *Arch. d'hist. des sciences*, 1955, p. 364.

IBRAHÎM B. MUḤAMMAD AL-BALAWÎ

Ibrâhîm b. Muḥammad al-Balawî in 1098 (1686/7) made (*'amal*) an astrolabe for his professor Shaikh 'Abd al-Wahhâb, known as 'Arab-Zâdeh. It is now in the collection of Maître Larrouy, Toulouse. [In collaboration with Georges S. Colin.]

MUḤAMMAD MAHDÎ AL-YAZDÎ

XV. At an unspecified date he decorated (*namaqahu*) an astrolabe, now in a private collection in London.

MUḤAMMAD ZAMÂN

VI. At an unspecified date ¹ he made (*'amal*) an astrolabe, signing Master (*ustâdh*) Muḥammad Zamân, now in the Freer Gallery of Art, Washington (No. 45.6).

¹ I say it advisedly. Although on the face of the bracket there is a date, viz. 1065 (1683/4), it has been engraved by a different person, and cannot be considered as authentic.

LIST OF MONUMENTS AND COLLECTIONS ¹

Acre, Mosque of Jazzâr Pasha	Ibrâhîm al-Farađî.
Aleppo, Madrasa Aḥmadiyya	‘Alî b. Ibrâhîm Ibn ash-Shâṭir III.
d’Allemagne coll.	Ḥasan al-Ḥasanî.
Athens, Benaki Museum	Abu-ṭ-Ṭâhir; Aḥmad b. Abî Bakr; ‘Alî IV.
Bahadur Shah coll.	‘Abd al-A’imma XVI.
Barbier coll.	Aḥmad b. Khalaf.
Barcelona, Observatorio Fabra	Muḥammad b. Muḥammad b. Hudhail.
Bassermann-Jordan (E. v.) coll.	‘Alî I.
Belluomini coll.	Ibrahîm b. Sa’îd IV.
Berlin, Staatl. Museen	Muḥammad Zamân V.
Billmeir (A. J.) coll.	‘Abd al-‘Alî V, VI; ‘Abd al-Bâqî; Khaffîf; Khalîl Muḥammad IX, X, XVI; Mu- hammad b. Aḥmad al-Baṭṭûṭî VII; Mu- hammad Amîn I; Muḥammad Amîn b. Amîrzâ Khân; Muḥammad Mahdî V, VI.
Bombay, Molla Feeroze Library	‘Abd al-‘Alî I; Abu-l-Qâsim b. ‘Abd ar- Raḥmân.
Borbón (D. Faustino de) coll.	Ibrâhîm b. Sa’îd I.
Borgia coll.	see Velletri.
Boston, Museum of Fine Arts	‘Abd al-A’imma XVII; Khalîl Muḥam- mad XIV.
Brussels, Observatoire	Muḥammad Şaffâr IV.
Brussels, Musées R. d’art et d’histoire	Muḥammad Şaffâr IV.
Bûlâq	see Cairo-Bûlâq
Cairo, Al-Azhar Mosque	Aḥmad Pasha.
Cairo, Madrasa of Aynâl	Ḥasan aṭ-Ṭubnî.
Cairo, Madrasa of Qalâûn	Muḥammad.
Cairo, Mashhad as-Sâdât al-Wafa’iyya	Aḥmad Pasha.
Cairo, Mausoleum of the Amir Kabîr	‘Abd al-Qâdir.

¹ Public collections are listed under the names of towns, private ones under the names of their owners. Objects which have passed into new hands are listed under their original as well as their later proprietors.

Cairo, Mosque of Imâm ash-Shâfi’î	Aḥmad Pasha.
Cairo, Mosque of Muḥammad Bey	Maḥmûd b. Ḥasan.
Cairo, Museum of Islamic Art	‘Abd al-A’imma IX, XXVI; Aḥmad Pasha; Ḥasan b. Aḥmad; Muḥammad b. Aḥmad al-Mizzî I; Muḥammad Şaffâr I.
(cf. also Harari coll.)	
Cairo, Qauṣûn Mosque	Aḥmad al-Ḥarîrî.
Cairo-Bûlâq, Mosque of Sinân Pasha	Ḥasan aṣ-Şawwâf.
Calcutta, India Museum	Ja’far b. ‘Umar V; Muḥammad Amîn b. Muḥammad Ṭâhir II.
Cambridge, Ethnographical Museum	Muḥammad Mahdî I.
Cambridge, Fitzwilliam Museum	‘Alî b. Şâdiq III; Ḥusain b. ‘Alî; Muḥam- mad Şaffâr II.
Cambridge, Whipple Museum	Aḥmad b. ‘Umar; Muḥammad Akbar II; Muḥammad Khâzin; Muḥammad Mah- dî I.
Carrapit (A. J.) coll.	Ja’far b. ‘Umar V.
Carthage, Musée Lavigerie	Abu-l-Qâsim b. Ḥasan.
Cassel	see Kassel.
Cattaoui Pasha coll.	Muḥammad b. Fattûḥ IV.
Cengia (Francesco) coll.	‘Alî b. Muḥammad al-Azdî; Muḥammad b. Fattûḥ II.
Chadenat coll.	‘Abd al-A’imma XIII; ‘Abd ar-Raḥmân b. Burhân; Muḥammad Mahdî IX; Mu- hammad Muḥsin; Muḥammad Şaffâr V; Qâsim ‘Alî.
Charliat (Georges) coll.	‘Abd al-A’imma II; Khalîl Muḥammad XII; Muḥammad Muqîm II.
Chicago, Adler Planetarium	Muḥammad b. Fattûḥ VIII; Muḥammad b. Yûsuf.
Clay coll.	‘Abd al-A’imma XXVIII; Muḥammad Mahdî III.
Clot Bey coll.	Muḥammad b. Aḥmad al-Mizzî III; Riḍwân b. ‘Abdallah.
Corsini (Don Tommaso) coll.	Muḥammad b. Abî-l-Qâsim.
Côte (Claudius) coll.	‘Abd al-A’imma XXIII.
Couch-Adams (John) coll.	Muḥammad Mahdî I.
Cowper (H. Swainson) coll.	‘Alî III.
Court (H. W.) coll.	Muḥammad Akbar II.
Damascus, Bâb Jairûn (clock)	Muḥammad b. ‘Alî.

- David (E. S.) coll. 'Abd al-A'imma the Elder II (Add.); Muḥammad Amīn II.
- Davud (Y.) coll. Aḥmad b. Ibrāhīm.
- Destombes (Marcel) coll. Khalīl Muḥammad XVII.
- Detroit Institute of Arts 'Abd al-A'imma IV.
- Dresden, Math. Physikal. Salon Muḥammad b. Mu'ayyad.
- Durighello coll. 'Īsā.
- Duval coll. Ya'qūb Tapiero.
- Edinburgh, R. Scottish Museum 'Abd al-A'imma XXXI (Add.); 'Alī VII.
- L'Espinasse (Comtesse de) coll. 'Abd al-Karīm al-Miṣrī I.
- Evans (Lewis) coll. see Oxford.
- Fez, Dār Baṭṭa Museum Aḥmad b. Muḥammad b. Hārūn (Add.); Muḥammad b. Aḥmad al-Baṭṭūṭī V.
- Fez, Madrasa Bū'anāniyya (clock) 'Alī b. Aḥmad.
- Fez, Qarawiyyīn Mosque (clock) Muḥammad al-Ḥabbāk; Muḥammad b. Muḥammad al-Arabī; Muḥammad aṣ-Ṣinhājī.
- Fez-Jadīd, Main Mosque Muḥammad b. Aḥmad al-Baṭṭūṭī III.
- Findlay (Sir John) coll. 'Abd al-A'imma XXXI (Add.); 'Alī VII.
- Florence, Museo di Storia della Scienza Ibrāhīm b. Sa'īd IV; Muḥammad b. Abī-l-Qāsim; 'Uthmān b. 'Abdallah.
- Gardner (Malcolm) coll. Khalīl Muḥammad XI; Muḥammad Mahdī II.
- Gayangos (Pascual) coll. Aḥmad b. Ḥusain b. Bāṣo I; Ibrāhīm b. Muḥammad.
- Geneva, Musée d'art et d'histoire Zartān.
- Genoa, Società Ligure di Storia Patria Aḥmad b. Ḥusain b. Bāṣo II.
- Greenwich, National Maritime Museum 'Abd al-A'imma XVIII; 'Alī V; Ja'far b. 'Umar II; Khalīl Muḥammad VI; Mahdī Yazdī; Maḥmūd b. Shauka; Muḥammad b. Aḥmad al-Baṭṭūṭī IX; Muḥammad Muqīm IV; Sarrāj II; Yūsuf b. Ḥājī al-Jilānī.
- Greppin (René) coll. 'Abd ar-Raḥīm; Muḥammad b. Aḥmad al-Baṭṭūṭī I.
- Grobba coll. Muḥammad Zamān V.

- Hakim (M.) coll. 'Abd al-A'imma the Elder; Muḥammad b. Ḥamid II.
- Harari (Ralph A.) coll. 'Abd al-A'imma IX, XXVI; 'Alī b. Ibrāhīm Ibn ash-Shāṭir I; 'Alī b. Ṣādiq V, VI; Khalīl Muḥammad VII; Muḥammad Ashraf; Muḥammad b. Fattūḥ VII; Muḥammad Zamān IV; Shukr Allah Mukhlīṣ.
- Heilbronner coll. Muḥammad b. Abī Bakr; Muḥammad b. Yūsuf.
- Hoffman (Eugene A.) coll. 'Abd al-A'imma XV; Ja'far b. 'Umar IV; Muḥammad Mahdī VII.
- Hoffman (Margaret E.) coll. 'Abd al-A'imma XXVIII; Ḥamza.
- Hoffman (Samuel V.) coll. 'Abd al-A'imma XV, XXI, XXVIII; 'Abd al-Ghafūr b. Muḥammad Sa'īd I; 'Abd al-Karīm; Aḥmad b. Ḥusain b. Bāṣo IV (Add.); 'Alī VI; Ḥamid b. Maḥmūd; Ḥamza; Ja'far b. 'Umar IV; Muḥammad Akbar I; Muḥammad Amīn b. Muḥammad Ṭāhir I; Muḥammad Mahdī VII, XIV; Muḥammad Ṣādiq; Ṣādiq.
- Holden-White coll. 'Alī b. Ṣādiq III; Ḥusain b. 'Alī; Muḥammad Ṣaffār II.
- Imrek (Fahri) coll. 'Abdī.
- Istanbul, Mosque of Aḥmad Pasha Ḥasan Gevrekzāde.
- Istanbul, Mosque of Sultan Aḥmad Ḥusain Shāmī.
- Istanbul, Mosque of Sultan Bayazid 'Uthmān.
- Istanbul, Mosque of Ḥakīmoghlu 'Alī Ismā'īl Khalīfazāde.
- Istanbul, Laleli Mosque Ismā'īl.
- Istanbul, Mosque of Sultan Sulaiman 'Abd ar-Raḥmān.
- Istanbul, Kuliyat Mehmed Fātiḥ 'Alī Qūshjī.
- Istanbul, Yeni Jāmi' Riḍwān.
- Istanbul, Top Kapu Sarayı Müzesi Maḥmūd b. Jalāl; Muḥammad b. Ḥamid I.
- Kanzler (Ernest) coll. 'Abd al-A'imma IV.
- Karachi, Urdu College 'Alī b. Muḥammad.
- Kassel, Staatl. Kunstsammlungen Ibrāhīm b. Sa'īd V.
- Khanykov (Nicolas de) coll. 'Abd al-A'imma XIV.

- Khawwam coll.
Knobel coll.
Konya, Hasan Pasha Mosque
- Landau (Nicolas E.) coll.
- Larrey (Baron de) coll.
Larrouy (Henri) coll.
Lee coll.
Leningrad, Hermitage Museum
- Leningrad, Public Library
- Liège, Musée de la Vie Wallonne
London, British Museum
- London, Science Museum
- London, Victoria and Albert Museum
- Madrid, R. Academia de Historia
- Madrid, Museo Arqueológico Nacional
- Maggs Bros. coll.
Malcolm (Sir John) coll.
Marburg, Westdeutsche Bibliothek
Marcel coll.
Marling coll.
- Khalîl Muḥammad VIII.
Muḥammad b. Fattûḥ VI.
Ḥasan aṣ-Ṣâ'igh.
- 'Abd al-A'imma VII; Khaffî; Khalîl Muḥammad XVIII; Muḥammad Mahdî VIII; Muḥammad b. Sa'îd II.
Abû Bakr b. Yûsuf IV.
Ibrâhîm b. Muḥammad (Add.).
Muḥammad 'Abd al-Hâdî.
'Abd al-A'imma XIX, XXV; 'Abd al-Ghafûr b. Muḥammad Sa'îd II; Khalîl Muḥammad I, XIX; Muḥammad Karîm; Muḥammad Ṭâhir II.
Muḥammad b. Aḥmad al-Mizzî III; Riḍwân b. 'Abdallah.
Ibrâhîm al-Muftî.
'Abd al-'Alî II; 'Abd al-Karîm al-Miṣrî II; 'Alî b. ash-Shihâb; Auḥad b. Muḥammad; Bairâm b. Ilyâs; Ibrâhîm ad-Dimashqî; Muḥammad b. Aḥmad al-Mizzî II, IV; Muḥammad b. Hilâl; Muḥammad b. Ja'far; Muḥammad b. Khutlukh; Muḥammad Mahdî XII.
Muḥammad 'Abd al-Hâdî; Muṣṭafâ Ayyûbî II.
'Abd al-A'imma VI; 'Abd al-Ghafûr; 'Abd ar-Raḥmân b. Yûsuf; Muḥammad Karîm; Khalîl Muḥammad XV; Muḥammad Zamân I.
- Aḥmad b. Ḥusain b. Bâṣo I; Ibrâhîm b. Muḥammad.
Aḥmad b. 'Abd ar-Raḥmân; Ibrâhîm b. an-Nu'mân; Ibrâhîm b. Sa'îd I.
'Abdallah b. Muḥammad Amîn.
Muḥammad b. Hilâl.
Ibrâhîm al-Malî; Muḥammad b. aṣ-Ṣaffâr.
Abû Bakr b. Yûsuf III.
Muḥammad Zamân I.

- Mc Vitty coll.
Mensing coll.
- Mercator coll.
Meyer (Michel) coll.
Meyerhof (Max) coll.
Michel (Henri) coll.
- Moradoff & Sons (coll.)
Morgan (Octavius) coll.
Moritzburg (Schloss) coll.
Morley (W. H.) coll.
Munich, Deutsches Museum
Munich, National Museum
- Naples, Museo Nazionale
Negrotto (Marchese Lazzaro) coll.
New York, Metropolitan Museum of Art
New York, N.Y. Historical Society
- Newall coll.
North coll.
Nürnberg, Germanisches Museum
- Oberlin, Allen Memorial Art Museum
Oxford, Museum of the History of Science
- 'Alî b. Ṣâdiq IV.
Muḥammad b. Fattûḥ VIII; Muḥammad b. Yûsuf.
'Alî b. Ṣâdiq I.
Muḥammad b. Aḥmad al-Baṭṭûṭî VIII.
'Abd al-A'imma VIII.
'Abd al-'Alî V; 'Abd al-Bâqî; 'Abd ar-Raḥîm; Khalîl Muḥammad IX, XVI; Muḥammad b. Aḥmad al-Baṭṭûṭî I, VII; Muḥammad Amîn I; Muḥammad Amîn b. Amîrzâ Khân; Muḥammad Mahdî V, VI.
Ḥâmid b. al-Khiḍr.
Muḥammad b. Aḥmad al-Mizzî IV.
Muḥammad b. Mu'ayyad.
'Alî b. ash-Shihâb.
Khalîl Muḥammad III.
Muḥammad b. Sa'îd I.
- Qaiṣar.
Aḥmad b. Ḥusain b. Bâṣo II.
Muḥammad b. Maḥmûd; 'Umar b. Yûsuf.
'Abd al-A'imma XXI; 'Abd al-Ghafûr b. Muḥammad Sa'îd I; 'Abd al-Karîm; Aḥmad b. Ḥusain b. Bâṣo IV (Add.); 'Alî VI; Ḥâmid b. Maḥmûd; Muḥammad Akbar I; Muḥammad Amîn b. Muḥammad Ṭâhir I; Muḥammad Mahdî XIV; Muḥammad Ṣâdiq; Ṣâdiq.
Aḥmad b. 'Umar.
Muḥammad b. Fattûḥ VI.
Aḥmad b. Muḥammad; as-Sahl.
- 'Abd al-A'imma III.
'Abd al-A'imma V, XI, XII, XXII, XXVII; 'Abd al-'Alî VII; 'Abd al-Karîm al-Miṣrî I; 'Abdallah Sâsî; Aḥmad b. Ibrâhîm; Faḍl 'Alî; Ḥasan b. 'Alî; Ibrâhîm b. Ḥusain; Ibrâhîm b. Sa'îd II; Ja'far b. 'Umar III; Khalîl

- Oxford, Museum of the History of Science (ctd.)
 Muḥammad XIII; Muḥammad b. Abī Bakr; Muḥammad b. Aḥmad al-Baṭṭūṭī IV; Muḥammad b. Fattūḥ V, VI; Muḥammad Maḥdī III, XI; Muḥammad Muqīm III; Muḥammad Ṣaffār III, Muḥammad Ṭāhir I.
- Palermo, Museo Nazionale
 Paris, Louvre Museum
 Paris, Bibliothèque Nationale
 Hāmid b. 'Alī; Ibrāhīm b. 'Abd al-Karīm. Muḥammad b. Maḥmūd b. 'Alī. Aḥmad b. Khalaf; 'Alī b. Ibrāhīm Ibn ash-Shāṭir II; 'Isā; Muḥammad b. Fattūḥ III; Muḥammad b. Muḥammad al-Hāshimī; Muḥammad Maḥdī X. 'Abd al-A'imma XX; 'Alī b. Ibrāhīm b. Muḥammad, Khalīl Muḥammad II. 'Alī b. Ibrāhīm b. Muḥammad. Muḥammad Zamān II. Muḥammad b. Khutlukh. Aḥmad b. Ḥusain b. Bāṣo III; Ja'far b. 'Umar I.
- Paris, Observatoire
 Pertuis (Comte de) coll.
 Petit (J. B.) coll.
 Posno coll.
 Prin (Georges) coll.
 Sarrāj I. Muḥammad Maḥdī X. Muḥammad Maḥdī XII. Muḥammad Ṣaffār III. 'Alī b. Muḥammad al-Azdī; Ibrāhīm b. Sa'īd III; Muḥammad b. Fattūḥ II. Ibrāhīm b. Sa'īd VI, VII. Khalīl b. Muḥammad XIII. Faḍl 'Alī. Khalīl Muḥammad V. Muḥammad b. Aḥmad al-Baṭṭūṭī VI; Qāsim b. 'Abd as-Salām.
- Rampur, State Library
 Rawlinson coll.
 Rich (Claudius) coll.
 Richard coll.
 Rome, Osservatorio Astronomico
 Rome, Museo Kircheriano
 Ross coll.
 Roussel coll.
 Ruete (Said) coll.
 Ruiz Orsatti coll.
 'Abd al-A'imma XXIV; Muḥammad Amīn b. Muḥammad Ṭāhīr III. Muḥammad b. Fattūḥ I. 'Alī b. Muḥammad al-Azdī; Muḥammad b. Fattūḥ II. Muḥammad b. Fattūḥ III.
- St. Louis, City Art Museum
 Sauvaire (Henri) coll.
 Schio (Almerico da) coll.
 Schultz coll.

- Schumann (Jacques) coll.
 Sloane coll.
 Sprenger coll.
 Muṣṭafā Ayyūbī I. 'Abd al-'Alī II. 'Alī b. ash-Shihāb; Ibrāhīm al-Mālī; Muḥammad b. aṣ-Ṣaffār. 'Alī II. Aḥmad b. 'Alī. Abū Bakr b. Yūsuf I.
- Stockholm, Academy of Science
 Stockholm, Statens Sjöhistoriska Museet
 Strasbourg, Observatoire
 Muḥammad Zamān III. 'Abd al-'Alī III; Khalīl Muḥammad IV; Muḥammad Muqīm I. Muḥammad b. Aḥmad al-Baṭṭūṭī II. Muḥammad b. Aḥmad al-Baṭṭūṭī VI; Qāsim b. 'Abd as-Salām. Aḥmad b. Muḥammad al-Lamṭī. Abū Bakr b. Yūsuf II. Abū Bakr b. Yūsuf II. 'Abd al-A'imma XXII. 'Abd al-A'imma X; Muḥammad Abu-l-Faḍl.
- Tashkend, Academy Museum
 Teheran, Musée Archéologique
 Terrasse (Henri) coll.
 Tetuán, Biblioteca General
 Tlemcen, Mosque of Sīdī al-Ḥalwī
 Toulouse, Musée St. Raymond
 Toulouse, Société Archéologique du Midi
 Townley (Sir William) coll.
 Tunis, Musée Alaoui, Le Bardo.
 Aḥmad. Hāmid b. 'Alī; Qaiṣar. Abū Bakr b. Yūsuf II. Muḥammad b. Muḥammad al-Hāshimī. 'Abd al-'Alī IV.
- Vaux (W. S. W.) coll.
 Velletri, Museo Borgiano
 Vidal l'Hermophile coll.
 de Viel Castel coll.
 Vienna, Kunsthistorisches Museum
 Washington, D. C., Freer Gallery of Art
 Watney (O. V.) coll.
 Wetzstein (Consul Joh. Gottfr.) coll.
 Williams (John) coll.
 Wilson coll.
 'Abd al-A'imma XXIX (Add.); Muḥammad Zamān VI (Add.). 'Alī b. Ṣādiq II. Muḥammad b. Shaddād. Muḥammad Maḥdī I. Maḥmūd b. 'Alī.

CHRONOLOGICAL LIST ¹

—	295-320	astrolabe	Aḥmad b. Khalaf
	300	"	Khaffī
	348	"	Ḥamid b. 'Alī
	374 } ?	"	Aḥmad b. Ibrāhīm
	394 }	"	
	420	"	Muḥammad b. aṣ-Ṣaffār
	459	"	Ibrāhīm b. Sa'īd I
	460	"	Ibrāhīm b. Sa'īd II
	463	"	Ibrāhīm b. Sa'īd III
	466	"	Muḥammad b. Sa'īd I
	472	"	Aḥmad b. Muḥammad
	474	"	Muḥammad b. Sa'īd II
	478	globe	Ibrāhīm b. Sa'īd IV
	478	astrolabe	Ibrāhīm b. Sa'īd V
	490 ?	"	Ibrāhīm b. Sa'īd VI
	493 ?	"	Ibrāhīm b. Sa'īd VII
	496	"	Muḥammad b. Abī-l-Qâsim
	547	"	Ḥamid b. Maḥmūd
	55x	"	Muḥammad b. Ḥamid I
	553	"	Muḥammad b. Ḥamid II
	554	sun-dial	'Īsā
+	564	clock	Muḥammad b. 'Alī
	598	astrolabe	'Abd ar-Raḥmān b. Yūsuf
	605	"	Abū Bakr b. Yūsuf I
	609	"	Muḥammad b. Fattūḥ I
	613	"	Muḥammad b. Fattūḥ II
	613	"	Abū Bakr b. Yūsuf II
	613	"	Abū Bakr b. Yūsuf III

¹ All instruments here included are either: (a) directly dated, or (b) datable—with the reserves expressed on pp. 18-20—by the patrons mentioned in the inscriptions, or (c) by the collaborators of either the astrolabist or the decorator. Undated objects by masters known to have constructed dated or datable instruments, are listed immediately after the last datable work and marked *app.* Objects which do not belong to any of these three categories are on principle excluded. The sign (+) before a date means "later than"; the sign (—) means "earlier than"; (Add.) refers to the Additions, pp. 85 f.

	615	astrolabe	Abū Bakr b. Yūsuf IV
	615	"	Muḥammad b. Fattūḥ III
	615	"	Muḥammad b. Fattūḥ IV
	618	"	Muḥammad b. Fattūḥ V
	618	"	Muḥammad b. Abī Bakr
	621	"	Muḥammad b. Fattūḥ VI
	622	globe	Qaiṣar
	623	astrolabe	Sarrāj II
	625	"	'Abd al-Karīm al-Miṣrī I
	626	"	Sarrāj I
	628	"	Muḥammad b. Fattūḥ VII
	633	"	'Abd al-Karīm al-Miṣrī II
	634	"	Muḥammad b. Fattūḥ VIII
	638	"	Muḥammad b. Yūsuf
	639	prognost. table	Muḥammad b. Khutlukh
	650	azaphea	Muḥammad b. Muḥammad
	664	astrolabe	Aḥmad b. Ḥusain b. Bâṣo I
	669	"	Ibrāhīm ad-Dimashqī
	669	"	Maḥmūd b. 'Alī
	673	"	Ibrāhīm b. an-Nu'mān
	674	globe	Muḥammad b. Hilāl
	681	astrolabe	Ḥasan b. 'Alī
	684	globe	Muḥammad b. Maḥmūd b. 'Alī
+	684	sun-dial	Muḥammad
	685	water clock	Muḥammad al-Ḥabbāk
	694	astrolabe	Maḥmūd b. Shauka
	695	"	'Umar
—	698	"	as-Sahl
	699	"	'Uthmān b. 'Abdallah
—	700	globe	Muḥammad b. Mu'ayyad
	704	astrolabe	Aḥmad b. Ḥusain b. Bâṣo II
	704	"	Aḥmad b. Ḥusain b. Bâṣo IV (Add.)
	709	"	Ḥusain b. 'Alī
	709	"	Aḥmad b. Ḥusain b. Bâṣo III
	716	"	Ya'qūb Tapiero
	717	clock	Muḥammad as-Ṣinhâjī
	718	globe	'Abd ar-Raḥmān b. Burhān
	720	astrolabe	Ibrāhīm b. Muḥammad
	726	"	'Alī b. Ibrāhīm b. Muḥammad
	727	quadrant	Muḥammad b. Aḥmad al-Mizzī I

727	quadrant	Muhammad b. Ahmad al-Mizzî II
728	astrolabe	Ahmad b. Muhammad b. Hârûn (Add.)
729	"	Ahmad b. Abî Bakr
729	"	Ahmad b. 'Alî
734	quadrant	Muhammad b. Ahmad al-Mizzî III
734	"	Muhammad b. Ahmad al-Mizzî IV
735	"	'Alî b. ash-Shihâb
738	astrolabe	'Alî b. Ibrâhîm Ibn ash-Shâtîr I
738	"	'Alî b. Ibrâhîm Ibn ash-Shâtîr II
746	sun-dial	Abu-l-Qâsim b. Hasan
747	"	Ahmad b. Muhammad al-Lamî
747-49	clock	Muhammad b. Muhammad b. al-'Arabî
749	sun-dial	Abu-ṭ-Ṭâhir
755	astrolabe	Ja'far b. 'Umar I
757 ?	"	Ja'far b. 'Umar II
758	clock	'Alî b. Ahmad
764	globe	Ja'far b. 'Umar III
767	sun-dial	'Alî b. Ibrâhîm Ibn ash-Shâtîr III
774	astrolabe	Ja'far b. 'Umar IV
774	"	Ḥamid b. al-Khiḍr
785	sun-dial	Ahmad al-Ḥarîrî
790	astrolabe	Ja'far b. 'Umar V
812	sun-dial	Hasan aş-Şâ'igh
834	globe	Muhammad b. Ja'far
854	quadrant	Ahmad b. 'Abd ar-Rahmân
871	sun-dial	Hasan aṭ-Ṭubnî
878	"	'Alî al-Qûshjî
882	astrolabe	Muhammad Şaffâr I
882	"	Muhammad Şaffâr II
886	"	Muhammad Şaffâr III
889	"	Maḥmûd b. Jalâl
890	"	Auḥad b. Muhammad
891	"	Shukr Allah Mukhlîş
898	"	Muhammad Şaffâr IV
911	"	Muhammad Şaffâr V
app. 913	sun-dial	'Abd al-Qâdir
929	astrolabe	Yûsuf b. Ḥâjjî al-Jîlânî
933	"	Ahmad b. 'Umar
950	"	'Alî b. Muhammad al-Azdî
981	globe	Muhammad b. Muhammad al-Hâshimî

986	astrolabe	'Abd al-A'imma the Elder
989	"	'Abd al-A'imma the Elder II (Add.)
990	compass	Bairâm b. Ilyâs
996	astrolabe	Muhammad Amîn b. Amîrzâ Khân
1010	"	'Alî b. Muhammad
1051	globe	Muhammad Zamân I
1051	astrolabe	Ibrâhîm b. Ḥusain
1052	"	Muhammad Muqîm al-Yazdî I
1054	"	Muhammad Muqîm al-Yazdî II
1057	"	Muhammad Muqîm al-Yazdî III
app. 1057	"	Muhammad Muqîm al-Yazdî IV
1059	"	Muhammad Mahdî IV
1070	"	Muhammad Mahdî I
app. 1070	"	Muhammad Mahdî II-III, V-XII, XIV, XV (Add.)
1070	"	Muhammad Zamân II
1079	"	Muhammad b. Muhammad al-'Umarî
1081	sun-dial	Riḍwân
1086	astrolabe	Muhammad Amîn I
1088	"	Hasan al-Ḥasanî
1088	"	Muhammad Zamân III
app. 1088	"	Muhammad Zamân V, VI (App.)
app. 1088	globe	Muhammad Zamân IV
1093	astrolabe	Khalîl Muhammad I
1093	"	Qâsim 'Alî
1094	"	Khalîl Muhammad II
1095	"	Khalîl Muhammad III
1095	"	'Abd al-Ghafûr
1097	"	Muhammad Amîn II
1098	"	Ibrâhîm b. Muhammad al-Balawî (Add.)
1099	"	'Abdallah b. Sâsî
1100	"	'Abd al-A'imma I
1106	"	Khalîl Muhammad IV
1106	"	Hasan b. Ahmad
1110	"	Muṣṭafâ Ayyûbî I
1113	globe	Riḍwân
1114	astrolabe	Muṣṭafâ Ayyûbî II
1116	"	Ahmad b. Muhammad b. Ibrâhîm
1117	"	'Abd al-A'imma II
1119	"	Khalîl Muhammad V

	III9	astrolabe	Khâlîl Muḥammad VI
	III9	"	'Abd al-'Alî I
	III9 ?	"	'Abd al-'Alî VII
<i>app.</i>	III9	"	Khâlîl Muḥammad VII-XIX
	II20	"	Ibrâhîm al-Muftî
	II21	"	'Abd al-A'imma III
	II21	"	'Abd al-A'imma IV
	II22	"	Muḥammad Khâzin
	II24	"	'Abd al-A'imma V
	II24	"	'Abd al-'Alî II
	II25	"	'Abdî
	II26	"	'Abd al-'Alî III
<i>app.</i>	II26	"	'Abd al-'Alî IV-VII
	II27	"	'Abdallah b. Muḥammad Amîn
	II27	"	'Abd al-A'imma VI
	II27	"	'Abd al-A'imma XXIX (Add.)
	II32	"	'Abd al-A'imma VII
<i>app.</i>	II32	"	'Abd al-A'imma VIII-XXVIII, XXX f. (Add.)
	II33	"	Muḥammad Karîm
	II36	"	Muḥammad b. Aḥmad I
	II37	"	Muḥammad b. Aḥmad II
	II38	"	Muḥammad b. Aḥmad III
	II40	quadrant	Muḥammad 'Abd al-Hâdî
	II41	astrolabe	Muḥammad b. Aḥmad IV
	II41	"	Muḥammad b. Aḥmad V
	II42	"	Muḥammad b. Aḥmad VI
+	II46	"	Muḥammad b. Aḥmad VII
	II48	"	Muḥammad b. Aḥmad VIII
	II50	"	Muḥammad b. Aḥmad IX
	II55	sun-dial	'Uthmân
	II63	2 sun-dials	Aḥmad Pasha
	II77	sun-dial	Isma'îl Khalîfazâde
	II79	"	Ibrâhîm al-Mâlî
	II82	"	Ḥasan aş-Şawwâf
	II86	"	'Abd ar-Raḥmân
	II87	astrolabe	Muḥammad Hâshim
	II88	2 sun-dials	Maḥmûd b. Ḥasan
	II89	astrolabe	Muḥammad Şâdiq
	II92	"	Qâsim b. 'Abd as-Salâm

	II93	sun-dial	Isma'îl
	II95	astrolabe	Muḥammad Muḥsin
	II98	"	'Abd al-Ghafûr b. Muḥammad Sa'id I
<i>app.</i>	II98	"	'Abd al-Ghafûr b. Muḥammad Sa'id II
	1201	sun-dial	Ibrâhîm al-Faraḍî al-Kurdî
	1203	astrolabe	'Alî I
	1203	"	'Alî II
	1204	"	'Abd al-Bâqî
	1205	"	'Alî III
	1207	"	'Alî IV
	1207	sun-dial	Ḥasan Gevrekzâde
	1208	astrolabe	'Alî V
<i>app.</i>	1208	"	'Alî VI, VII
	1215	globe	Muḥammad Ashraf
	1216	astrolabe	Şâdiq
	1228	"	Aḥmad
	1231	globe	Muḥammad Karîm
	1234	astrolabe	Muḥammad Akbar I
	1236	"	Muḥammad Akbar II
	1245	"	Ḥamza

Not listed: 'Abd ar-Raḥîm, Abu-l-Qâsim b. 'Abd ar-Raḥmân, 'Alî b. Şâdiq, Faḍl 'Alî, Ḥusain Shâmî, Ibrâhîm b. 'Abd al-Karîm, Maḥdî Yazdî, Muḥammad Abu-l-Faḍl, Muḥammad Amîn b. Muḥammad Ṭâhir I-III, Muḥammad b. Maḥmûd, Muḥammad b. Shaddâd, Muḥammad Ṭâhir I-II, Zartân.

BIBLIOGRAPHY ¹

The following abbreviations should be noted:

BIFAO = Bulletin de l'Institut Français d'Archéologie Orientale du Caire;
CRAIBL = Comptes rendus, Académie des Inscriptions et Belles-Lettres;
EI = The Encyclopaedia of Islam; *JA* = Journal Asiatique; *JRAS* = Journal
of the R. Asiatic Society; *ZDMG* = Zeitschrift der Deutschen Morgenländischen
Gesellschaft.

'Abd al-Wahhâb, Ḥasan: *Al-masâjid al-âthâriyya*. Cairo, 1946.

'Abd al-Ḥayy b. Aḥmad b. al-'Imâd: *Shadharât adh-dhahab fî akhbâr man dhahab*.
Cairo 1350/1 (1931/2).

Abu-l-Fidâ': *Annales Muslemici*, ed. Reiske. Copenhagen, 1789-94.

Aga-Oglu, M.: Two astrolabes of the late Safavid period (in *Bulletin, Museum of
Fine Arts*, Boston, 1947, vol. 45, pp. 79-84).

Ahlwardt, Wilhelm: *Verzeichniss der arabischen Handschriften der Königlichen
Bibliothek zu Berlin*. Band 5. Berlin 1893.

[Alexandria:] *Exposition d'art musulman*. Alexandrie, 1925. The volume of plates,
with a preface by G. Migeon, is quoted as *Morancé Album*.

'Alî b. 'Abdallah b. Abî Zar': *Rauḍ al-Qirṭās. Annales Regum Mauritaniae*, ed.
C. J. Tornberg. Upsaliae 1843-46.

'Alî al-Jaznâ'i: *Zahrât el-Âs*, ed. Alfred Bel. Alger, 1923.

d'Allemagne, Henry-René: *Du Khorassan au pays de Backhtiaris. Trois mois de
voyage en Perse*. Paris, 1911.

— *La maison d'un vieux collectionneur*. Paris, 1948.

Alvarez-Ossorio, Francisco: *Una visita al Museo Arqueológico Nacional*. Madrid,
2nd ed., 1925.

Amador de los Rios y Villalta, Rodrigo: *Monumentos arquitectonicos de España*.
Toledo. I. Madrid, 1905.

¹ Anonymously published catalogues of museums or exhibitions will be found under the names
of towns.

Amari, Michele: Descrizione di lavori orientali con iscrizioni arabiche, esposti nel
Museo artistico e industriale di Roma, altrimenti detto Museo del Medio Evo
(Collegio Romano)... marzo 1876; de' quali alcuni sono proprii del detto Museo,
altri, del Museo Kirkeriano o di privati, vi stanno in deposito (in *Bollettino
italiano degli Studii Orientali*, 1876-1877, serie I, pp. 122-123, 162-166).

— *Storia dei Musulmani di Sicilia*. Firenze 1854-72. Second ed. by C. A. Nallino,
Catania, 1933-1937.

Anonymous: Note sur un globe céleste arabe (in *JA*, 1836, 3^e sér., t. 1, pp. 191-193).

— *Brevi notizie sull' impianto del Museo Copernicano ed Astronomico a Roma*.
Bologna 1887.

— Early instruments at the Old Ashmolean Museum, Oxford (in *Engineering*,
19th May, 1933, pp. 533-536, 10 figs.)

— Les instruments de mesures célestes (in *Connaissance des Arts*, 15th Dec., 1952,
pp. 48-52, ill.)

Anthiaume, Albert, et Jules Sottas: *L'astrolabe-quadrant du Musée des Antiquités
de Rouen*. Paris 1910.

Assemani, Simone: *Saggio sull' origine culto letteratura e costumi degli Arabi*. Padova,
1787.

— *Globus coelestis cufico-arabicus Veliterni Musei Borgiani*. Padua, 1790.

[Athens:] Benaki Museum, Athens. *Guide*. Athens, 1936.

Atchison, A. T.: *Catalogue of the special loan collection of scientific apparatus at the
South Kensington Museum*. Third ed., London, 1877.

Bargès, Jean Joseph L.: *Tlemcen*. Paris, 1859.

Barrett, Douglas: *Islamic metalwork in the British Museum*. London 1949.

Bassermann-Jordan, E. v.: *Geschichte der Zeitmessung und der Uhren*. Berlin und
Leipzig, 1923.

Beigel, G. W. S.: Nachricht von einer arabischen Himmelskugel mit kufischer Schrift,
welche im Curfürstl. Mathematischen Salon zu Dresden aufbewahrt wird (in
Bode's *Astronomisches Jahrbuch für das Jahr 1808*, Berlin, 1805, pp. 97-110).

Bel, Alfred: Trouvailles archéologiques à Tlemcen (in *Revue Africaine*, 1905,
49^e année, pp. 229-236, with 1 fig.).

- Inscriptions arabes de Fès (in *JA*, 1917, 11^e sér., t. 9, pp. 303-329, t. 10, pp. 81-170, 215-267; 1918, 11^e sér., t. 12, pp. 189-276, 337-399; 1919, 11^e sér., t. 13, pp. 5-96, 95 figs.) [Quoted from the offprint.]
- Berchem, Max van: Notes d'archéologie arabe. Deuxième article. Toulounides et Fatimites (in *JA*, 1892, 8^e série, t. 19, pp. 377-407).
- *Matériaux pour un Corpus Inscriptionum Arabicarum*. Première partie. *Egypte*. Le Caire, 1894-1903. Mémoires de la Mission Archéol. Française, t. 19.
- Notes d'archéologie arabe. Troisième article. Etude sur les cuivres damasquinés et les verres émaillés (in *JA*, 1904, 10^e sér., t. 3, pp. 5-96, ill.).
- [and] Josef Strzygowski: *Amida*. Heidelberg, 1910.
- Berque, A.: *Art antique et art musulman*. Alger, 1930.
- Berthelot, Sabin: *Extrait du rapport fait à la Société de Géographie de Paris, à l'assemblée générale du 6 décembre, 1839*. Paris, 1840.
- Bibliothèque Nationale: see s.v. Paris.
- Boffito, Giuseppe: *Gli strumenti della scienza e la scienza degli strumenti*. Firenze, 1929.
- Bonelli, Maria Louisa: *Catalogo degli strumenti del Museo di Storia della Scienza*. Firenze, 1954.
- Un bellissimo museo fiorentino (in *Civiltà delle macchine*, 1955, anno III, pp. 76 f., ill.).
- see also Firenze.
- Brockelmann, Carl: *Geschichte der arabischen Litteratur*. 2nd ed. Leiden, 1943-1949.
- Brosselard, Charles: Les inscriptions arabes de Tlemcen (in *Revue Afric.*, 1858, 3^e ann., pp. 81-94; 1859, pp. 161-172, 241-248, 321-340, 401-419; 4^e an., pp. 1-17, 81-93; 1860, pp. 161-174, 241-258, 321-331).
- [Brussels:] Société Belge d'Astronomie, de Météorologie et de Physique du Globe. *Exposition d'instruments scientifiques et de documents anciens et modernes organisée à l'occasion du 50^e anniversaire de la fondation de la Société*. Catalogue. Bruxelles, Musées Royaux d'Art et d'Histoire, 27 octobre-30 novembre, 1945.
- Caldo, Lorenzo: *Astrolabi del Museo Nazionale di Palermo*, Palermo, 1936. Pubbl. dell' Osservatorio astronomico di Palermo. Memorie, No. 65. Reprinted in *Coelum*, June 1938, vol. 8, pp. 101-108, 8 figs.

- Calvert, Albert F.: *Toledo, an historical and descriptive account of the "City of Generations"*. London, 1907.
- [Cambridge:] University of Cambridge. History of Science Lectures Committee. *A Guide to the Historic Scientific Instruments in the Whipple Museum of the History of Science*. Cambridge, 1949.
- Casanova, Paul: Une sphère céleste de l'an 684 de l'Hégire (in *Mémoires de la Mission Archéologique Française du Caire*, 1892, t. 6, pp. 313-330, 1 pl.).
- Histoire et description de la Citadelle du Caire (*ibid.*, 1894, t. 6, pp. 509-781, 19 pls.).
- La montre du Sultan Noûr ad dîn (554 de l'Hégire = 1159-1160) (in *Syria*, 1923, t. 4, pp. 282-299, 4 figs., pls. XLV-XLVII).
- Casiri, Michael: *Bibliotheca Arabico-Hispana Escorialensis*. Matriti, 1760-1770.
- Catalogues: see Athens, Brussels, Cambridge, Florence, London, Oxford, Paris.
- Chapuis, Alfred, et Edouard Gélis: *Le monde des automates. Etude historique et technique*. Paris, 1928.
- [et] Edmond Droz: *Les automates, figures artificielles d'hommes et d'animaux. Histoire et technique*. Neuchâtel, 1949.
- Chardin, Jean: *Voyages... en Perse et autres lieux de l'Orient...* éd. L. Langlès. Paris, 1811.
- Cheikho, Louis: Kitâb al-'amal bi-l-aşṭurlâb li-'Alî b. 'Îsâ (in *Al-Machriq*, 1913, t. 16, pp. 30-46).
- Christie, A. H.: Islamic minor arts and their influence upon European work (in Sir Thomas Arnold and Alfred Guillaume, *The Legacy of Islam*, 1931, pp. 108-151, ill.).
- CIA: see van Berchem.
- Colin, Georges S.: Un juif marocain du XIV^e siècle constructeur d'astrolabe (in *Hespéris*, 1936, t. 22, pp. 183 f.).
- Collangettes, Maurice: 'Ilm an-nujûm 'alâ 'ahd al-khulafâ' (in *Al-Machriq*, 1900, t. 3, pp. 674-680, 832-839, 982-986, 1119-1127, ill.).
- Combe, Etienne: Cinq cuivres musulmans des XIII^e, XIV^e et XV^e siècles de la collection Benachi (in *BIFAO*, 1931, t. 30, pp. 49-58).

- , Jean Sauvaget et Gaston Wiet: *Répertoire chronologique d'épigraphie arabe*. Le Caire, 1931-54. [Quoted as *Rép.*]
- Corsini: see Florence.
- Coster, E. [und] E. Gerland: *Beschreibung der Sammlung astronomischer, geodätischer und physikalischer Apparate im Königl. Museum zu Cassel*. Cassel, 1878, p. 20, No. 50.
- Cowper, H. Swainson: *Through Turkish Arabia. A Journey from the Mediterranean to Bombay by the Euphrates and Tigris Valleys and the Persian Gulf*. London, 1894.
- Creswell, K. A. C.: A bibliography of Islamic astrolabes (in *Bull. of the Fac. of Arts, Fouad I Univ.*, Cairo, Dec. 1947, vol. 9, pp. 1-15).
- Davis, Charles Percy: Muhammedan metal work (in *Bulletin of the City Art Museum of St. Louis*, Oct. 1926, vol. 11, pp. 50-53, ill.)
- , Frank: Early scientific instruments (in *The Illustrated London News*, 29th May, 1954, p. 294, 4 figs.)
- Day, Florence E.: A Review of "The Ceramic Art in Islamic Times. B. Dated Faience" (in *Ars Islamica*, 1941, vol. 8, pp. 49-58, ill.)
- Delambre, Jean-Bapt.: *Histoire de l'astronomie du moyen âge*. Paris, 1819.
- Devonshire, Mrs. R. L.: Some Moslem objects in the Benachi collection (in *Burlington Magazine*, Oct. 1928, vol. 53, pp. 189-196, 3 pls.)
- Dimand, Maurice S.: Dated specimens of Mohammedan art in the Metropolitan Museum of Art—Part I (in *Metropolitan Museum Studies*, 1928-1929, I, pp. 99-113, 15 figs.)
- Donaldson, Dwight M.: The nomenclature and common uses of the astrolabe (in *Islamic Culture*, 1945, vol. 19, pp. 49-53, 5 figs.)
- Dorn, Bernhard: Description of the celestial globe belonging to Major-General Sir John Malcolm . . . deposited in the Museum of the Royal Asiatic Society of Great Britain and Ireland (in *Transactions of the Royal Asiatic Society*, 1830, vol. 2, pp. 371-392, 2 pls.)
- *Drei in der kaiserlichen öffentlichen Bibliothek zu St. Petersburg befindliche astronomische Instrumente mit arabischen Inschriften*. St. Petersburg, 1865. Mémoires de l'Académie Imp. des Sciences de St. Pétersbourg, 7^e sér., t. 9, No. 1.

- Drechsler, Adolph: Mittheilungen über die Sammlung des Königl. mathematisch-physicalischen Salons zu Dresden, nebst cultur-historischen Bemerkungen (in *Bull. de la Soc. Imp. des Naturalistes de Moscou*, 1872, t. 46, pp. 396-425). Reprinted: Dresden, 1873, pp. 25-27.
- *Der arabische Himmels-Globus angefertigt 1279 zu Maragha von Muhammed bin Muwajid Elardhi zugehörig dem Königl. mathematisch-physikalischen Salon zu Dresden*. Dresden, 1873; 2nd ed., Dresden, 1922.
- *Katalog der Sammlung des Kgl. Mathematisch-Physikalischen Salons zu Dresden*.
- Elisséeff, Nikita: La titulature de Nûr ad-dîn d'après ses inscriptions (in *Bulletin d'Etudes Orientales*, 1952-54, t. 14, pp. 155-196).
- Engelmann, Max: *Sammlung Mensing. Altwissenschaftliche Instrumente. Katalog*. Amsterdam, 1924.
- Evans, Lewis: Some European and Oriental Astrolabes (in *The Archaeological Journal*, 1911, vol. 68, pp. 221-30 and pls. I-XI).
- Fiorini, Matteo: Le sfere cosmografiche e specialmente le sfere terrestri (in *Boll. della Soc. geogr. ital.*, 1893, pp. 862-888; 1894, pp. 121-132, 271-281, 331-349, 415-435). German version:
- *Erd- und Himmelsgloben, ihre Geschichte und Konstruktion*, frei bearbeitet von Siegmund Günther. Leipzig, 1895. Pp. 13-17: Arabische Himmelsgloben. [Quoted as Fiorini-Günther.]
- *Sfere terrestri e celesti di autore italiano oppure fatte o conservate in Italia*. Roma, 1899. Cap. II, pp. 27-37: Sfere celesti arabiche.
- [Florence] 1^a *Esposizione nazionale di storia delle scienze* (Firenze, Maggio-Ottobre 1929). *Catalogo con aggiornamenti*. Firenze, Istituto e Museo di storia delle scienze, 1952. Edited by Maria Luisa Bonelli, with a preface by Andrea Corsini.
- see also Bonelli.
- Fox, Philip: The Adler Planetarium and Astronomical Museum of Chicago. [Part II.] The Astronomical Museum (in *Popular Astronomy*, 1932, vol. 40, pp. 321-351, figs. 1-28).
- *Adler Planetarium and Astronomical Museum. An account of the Optical Planetarium and a Brief Guide to the Museum*. Chicago, 1933.

- Fraehn, C. M.: Astrolabii Norimbergensis saec. XIII p. C. n. inscriptio cufica novis post Tychemium curis tractata (in *Mémoires de l'Acad. Imp. des Sciences de St. Pétersbourg*, 1822, t. 8, pp. 569-571). Reprinted in his *Antiquitatis Muhammedanae Monumenta Varia*, Particula II, 1822, pp. 73-75.
- Inscriptionis cuficae pallii imperatorum Germanicorum inauguralis interpretandae specilegium (in his *Antiquitatis Muhammedanae Monumenta Varia*, Particula II, 1822, pp. 35-48).
- Franks, Augustus Wollaston: [Note on an astrolabe with Arabic inscriptions] (in *Proceedings of the Society of Antiquaries of London*, 1864, 2nd ser., vol. 3, p. 27).
- Instruments in the British Museum. List of astrolabes, quadrants, sun dials and other scientific instruments in the Department of British and Mediaeval Antiquities, British Museum, brought together for the International Geographical Congress 1895 (in *Report of the Sixth International Geographical Congress, held in London, 1895*, London 1896, Appendix B, pp. 182-190). [Quoted as Franks, "Instruments", 1896.]
- GAL: see Brockelmann.
- García Franco, Salvador: *Catálogo crítico de astrolabios existentes en España*. Madrid, 1945.
- *Historia del arte y ciencia de navegar*. Madrid, 1947.
- Los astrolabios de la Real Academia de la Historia (in *Boletín de la Real Academia de la Historia*, Madrid, 1955, t. 136, pp. 297-311, 6 figs.)
- Gunther, Robert T.: *Catalogue of a loan exhibition of early scientific instruments in Oxford*. Oxford, 1919.
- *Early science in Oxford*. Vol. II. *Astronomy*. Oxford, 1923. Pp. 188-99: Oriental Astrolabes.
- *Historic instruments for the advancement of science. A handbook to the Oxford collections prepared for the opening of the Lewis Evans collection on May 5, 1925*. Oxford, 1925.
- *The Astrolabes of the World*. Oxford, 1932. [Quoted by name of author only.]
- *The Old Ashmolean. The oldest museum for the history of the natural sciences and medicine*. Oxford, 1933. Revised edition of *Historic Instruments*, 1925.
- *Handbook of the Museum of the History of Science in the Old Ashmolean Building Oxford*. Oxford, 1935. New edition of *The Old Ashmolean*, 1933.

- *Catalogue of a loan exhibition of historic scientific apparatus in Cambridge. Arranged under the auspices of the Cambridge Philosophical Society in the East Room of the Old Schools*. 8-23 June 1936. Cambridge, 1936.
- *Early science in Cambridge*. Oxford, 1937.
- Günther, Siegmund: see Fiorini.
- Haack, H.: *Studien am Globus*. Gotha, 1915.
- Hājī Khalifa: *Lexicon bibliographicum et encyclopaedicum*, ed. G. Flügel. Leipzig, 1835-1858.
- Harari, Ralph: Metalwork after the early Islamic period (in A. U. Pope's *Survey of Persian Art*, 1939, vol. 3, pp. 2466-2529, figs. 806-843; vol. 6, pls. 1276-1396).
- Hartmann, Anton Theodor: *Oluf Gerhard Tychem oder Wanderungen durch die mannigfaltigsten Gebiete der biblisch-asiatischen Literatur*. Bremen, 1818-1820.
- Hartner, Willy: The Principle and use of the astrolabe (in A. U. Pope's *Survey of Persian Art*, 1939, vol. 3, pp. 2530-2554, figs. 844-852, vol. 6, pls. 1397-1404).
- The astronomical instruments of Cha-ma-lu-ting, their identification, and their relations to the instruments of the Observatory of Marāgha (in *Isis*, 1950, vol. 41, pp. 184-194).
- Hauteceur, Louis et Gaston Wiet: *Les Mosquées du Caire*. Paris, 1932.
- Herz Bey, Max: *Catalogue raisonné des monuments exposés dans le Musée National de l'art arabe*. Deuxième édition. Le Caire, 1906.
- Hindenburg, Karl Friedrich: Aus einem Schreiben . . . an Hrn Bernoulli (in *Astron. Jahrbuch f. d. Jahr 1785*, publ. 1782, pp. 235 f.)
- Hitti, Philip K., Nabih Amin Faris, Buṭrus 'Abd al-Malik: *Descriptive catalog of the Garrett collection of Arabic manuscripts in the Princeton University Library*. Princeton, 1938.
- Holloway, H. Maxson: Checklist of the Samuel Verplanck Hoffman collection of astrolabes and sundials (in *Annual Report of the New-York Historical Society for the year 1945*, New York 1946, pp. 62-71, ill.)
- Hourticq, Louis: *Encyclopédie des beaux-arts*. Paris, 1925.
- Houzeau, J. C., et A. Lancaster: *Bibliographie générale de l'astronomie*. Bruxelles, 1882-1889.

- Huggins, Margaret Lindsay: The Astrolabe. A summary (in *Astronomy and Astrophysics*, 1894, vol. 13, pp. 793-802).
- Ibn al-Abbâr: *At-takmila li-kitâb aš-šila*, ed. F. Codera y Zaidin. Madrid, 1887-89. Bibliotheca Arabico-Hispana, tt. 5, 6.
- Ibn Abî Uṣaibi'a: 'Uyûn al-inbâ', ed. A. Müller. Cairo-Königsberg i. Pr., 1882-84.
- Ibn Ḥajar al-'Asqalânî: *Ad-durar al-kâmina*. Hyderabad, 1348-1350.
- Ibn Iyâs: *Badâ'i' az-zuhûr*, Bûlâq, 1312 (1894); ed. M. Sobernheim, P. Kahle and M. Mostafa, Leipzig, 1931-45; ed. M. Mostafa, Cairo, 1951.
- Ibn Jubair: *Travels*, ed. M. J. de Goeje. Leyden, 1907. E. J. W. Gibb Memorial Series, vol. 5.
- Ibn al-Khaṭīb: *Al-iḥâṭa fî akhbâr Gharnâṭa*. Cairo 1319 (1901).
- Ibn an-Nadīm: *Kitâb al-fihrist*, ed. G. Flügel. Leipzig 1871-72.
- Ibn al-Qiftî: *Ta'rîkh al-ḥukamâ'*, ed. J. Lippert. Leipzig, 1903.
- Ibn Taghrîbirdî: *An-Nujûm az-zâhira*, ed. W. Popper. Berkeley, 1909-1936.
- *Al-Manhal aš-Ṣafî*, abbr. transl. by G. Wiet. Cairo, 1932. Mémoires présentés à l'Institut d'Égypte. T. 19.
- Ibn al-Wardî: *Ta'rîkh*. Cairo. 1285 (1868).
- Ideler, Ludwig: *Untersuchungen über den Ursprung und die Bedeutung der Sternnamen*. Berlin, 1809.
- Al-Jabartî, 'Abd ar-Raḥmân: 'Ajâ'ib al-âthâr fî tarâjim al-akhbâr. Bûlâq, 1880.
- Janér, Florencio: El astrolabio de Felipe II conservado en el Museo Arqueológico Nacional (in *Museo Español de Antigüedades*, 1874, t. 3, pp. 557-564, 1 pl.).
- Jaznâ'î: see 'Alî.
- Jomard, Edmé François: *Les Monuments de la Géographie, ou Recueil d'anciennes cartes européennes et orientales, accompagnées de sphères terrestres et célestes, de mappemondes et tables cosmographiques, d'astrolabes et autres instruments d'observation, depuis les temps les plus reculés jusqu'à l'époque d'Ortélius et de Gérard Mercator, publiés en fac-similé de la grandeur des originaux*. Paris, 1854.
- Josten, C. H.: *Scientific instruments (13th-19th century). The collection of J. A. Billmeir Esq.* London, 1954, 2nd ed., 1955.

- A notable private collection. XVI: the collection of J. A. Billmeir, Esquire. Scientific instruments from the thirteenth to the nineteenth century (in *Connoisseur*, Oct. 1954, pp. 85-91, ill.)
- Karabacek, Joseph v.: Ein römischer Cameo aus dem Schatze der Aijûbiden-Sultane in Hamâh (in *Sitzungsberichte d. Akademie d. Wiss.*, Wien, Phil. hist. Classe, 1893, Bd. 129, V. Abh.)
- Die Involutio im arabischen Schriftwesen (*ibid.*, 1896, Bd. 135, V. Abh.)
- Karî-Niyazov, T. N.: *Astronomitcheskaya shkola Ulugbeka*. Moscow-Leningrad, 1950.
- Kaye, G. R.: *The Astronomical Observatories of Jai Singh*. Calcutta, 1918. Archaeological Survey of India, New Imperial Series, vol. 40.
- *A Guide to the Old Observatories at Delhi; Jaipur; Ujjain; Benares*. Calcutta, 1920.
- Khanykov, Nicolas de: Lettre . . . à M. Dorn (in *Bulletin de la Classe historico-philologique de l'Acad. Imp. des Sciences de St. Pétersbourg*, 1855, t. 12, cols. 161-176). Reprinted in *Mélanges Asiatiques*, 1856, t. 2, pp. 437-456.
- Extrait d'une lettre à M. Dorn (*ibid.*, 1856, t. 13, cols. 177-179).
- Kharegat, Muncherji Pestonji: *Astrolabes*, edited by Dinshaw D. Kapadia. Bombay, 1950. M. P. Kharegat Memorial Volume II.
- Klüber, Harald v.: Über einen arabischen Himmelsglobus aus Indien (in *Baessler Archiv*, 1935, Bd. 18, pp. 1-21, 14 figs.)
- Kratchkovskaya, Vera A.: Epigrafika na arabskom yazike v Rossii do 1850-kh gg. (in *Sov. Vostokovyedeniye*, 1949, t. 6, pp. 271-301).
- Kržiž, August: Beschreibung, wissenschaftliche Zergliederung und Gebrauchsweise des persisch-arabischen Astrolabium's (in *Archiv d. Mathematik und Physik*, 1866, Theil 45, pp. 289-315, pls. II-V).
- Das persisch-arabische Astrolabium des Abdul Aimeh (in *Das Weltall*, 1905, Bd. 5, pp. 121 f., 144 f.)
- Kühnel, Ernst: Ausstellung von Meisterwerken mohammedanischer Kunst in München (Mai bis Oktober 1910) (in *Der Islam*, 1910, pp. 183-194, 369-384).
- Der arabische Globus im Mathematisch-Physikalischen Salon zu Dresden (in *Mitt. aus d. Sächs. Kunstsammlungen*, 1911, Jgg. 2, pp. 16-23, 3 figs.)
- Zwei Mosulbronzen und ihr Meister (in *Jahrbuch d. Preuss. Kunstsammlungen*, 1939, Bd. 60, pp. 1-20, 15 figs., 2 pls.)

- Neuerwerbungen an islamischem Gerät (in *Berliner Museen*, 1943, Jgg. 64, pp. 27-34, 16 figs.)
- Lambert, Elie: *Tolède*. Paris, 1925.
- Lane-Poole, Stanley: *The Art of the Saracens in Egypt*. London, 1886.
- *Saladin and the Fall of the Kingdom of Jerusalem*. London, 1898; 2nd ed., 1926.
- Lasinio, Fausto: Globo celeste arabico in Firenze (in *Boll. Ital. degli studii orient.*, 1877, t. I, pp. 307-309).
- Lavoix, Henri: La Galerie orientale du Trocadéro (in *Gazette des Beaux-Arts*, 1878, 2^e pér., t. 18, pp. 769-791, ill.)
- La Collection Albert Goupil, II. L'art oriental (*ibid.*, 1885, 2^e pér., t. 32, pp. 287-307, ill.)
- Le Bon, Gustave: *La civilisation des Arabes*. Paris, 1884.
- Lee, Samuel: Notice of the astronomical tables of Mohamed Abibeker Al Farsi (in *Transactions of the Cambridge Philosophical Society*, 1822, vol. I, pp. 249-265).
- Lévi-Provençal, Evariste: *Inscriptions arabes d'Espagne*. Paris, 1931.
- Liège: see Michel.
- [London:] *Catalogue of the Exhibition of Persian Art*. London 1931.
- Löytved, J. H.: *Konia. Inschriften der seldschukischen Bauten*. Berlin, 1907.
- Maggs Bros.: *Bibliotheca Nautica*. London, 1938.
- Maitrot de la Motte, A.: Un astrolabe Shakaziyi (in *Bull. de la Société de Géographie d'Alger et de l'Afrique du Nord*, 1940, XLV, pp. 108-132, 14 figs.)
- Al-Maqqarî: *Analectes sur l'histoire et la littérature des Arabes d'Espagne*, ed. R. Dozy, G. Dugat, L. Krehl, W. Wright. Leiden, 1855-1861.
- Al-Maqrîzî: *As-Sulûk li-ma'rifat duwal al-mulûk*, ed. M. Mustafa Ziada. Cairo 1934-1942.
- Marçais, Georges: *L'Exposition d'art musulman d'Alger, avril 1905*. Paris, 1906.
- , William: Six inscriptions arabes du Musée de Tlemcen (in *Bulletin archéologique*, 1902, pp. 538-551).
- , William et Georges: *Les Monuments arabes de Tlemcen*. Paris, 1903.

- Meisterwerke*: see Sarre und Martin.
- Mensing collection: see Engelmann.
- [Mercator:] *Catalogue de la collection Mercator. Instruments de mathématiques anciennes*. Paris 1928.
- Meucci, Ferdinando: Extract from a letter received by Mr. Ranyard (in *Monthly Notices of the R. Astron. Soc.*, London, 1877, vol. 37, p. 426).
- *Il globo celeste arabico del secolo XI esistente nel Gabinetto degli strumenti antichi di astronomia, di fisica e di matematica del R. Istituto di Studi Superiori*. Firenze, 1878.
- Meyerhof, Max: Eine islamische Kunstaussstellung in Alexandrien (in *Der Islam*, 1927, Bd. 16, pp. 151-153).
- Science and medicine (in Sir Thomas Arnold and Alfred Guillaume, *The Legacy of Islam*, 1931, pp. 311-355, ill.)
- Michel, Henri: Description d'un astrolabe persan construit par Muhammad-Mehdi (in *Ciel et Terre*, 1936, 52^e année, pp. 163-172, 205-209, figs. 1-4 and 1 unnumbered).
- *Exposition internationale de la technique de l'eau — Liège, 1939. Historique de la construction navale et de la navigation* (Premières sections des classes 18 et 19). Liège 1939. Quatrième partie. Les instruments anciens de mathématiques, astronomie et navigation, pp. 51-72.
- *Introduction à l'étude d'une collection d'instruments anciens de mathématiques*. Anvers, 1939.
- Méthodes de tracé et d'exécution des astrolabes persans (in *Ciel et Terre*, 1941, 57^e année, pp. 481-496).
- *Traité de l'astrolabe*. Préface de Ernest Esclangon. Paris, 1947.
- Un service de l'heure millénaire (in *Ciel et Terre*, 1952, 68^e an., pp. 175-179, ill.)
- *Catalogue des cadrans solaires du Musée de la Vie Wallonne*. 2^e partie. *Cadrans de jardin*. Liège 1953.
- see also Brussels.
- Mieli, Aldo: *La science arabe et son rôle dans l'évolution scientifique mondiale*. Leiden 1938.

- *Panorama general de historia de la ciencia*. Vol. II. *La época medieval. El mundo islámico y occidente cristiano*. Seg. ed., Buenos Aires, 1952.
- Migeon, Gaston: *L'Orient musulman*. Paris 1922.
- *Manuel d'art musulman*. 2^e éd. Paris, 1927.
- Millás Vallicrosa, José Maria: *Assaig d'història de les idees físiques i matemàtiques a la Catalunya medieval*. I. Barcelona, 1931. Estudis Universitaris Catalans. Sèrie Monogràfica. I.
- La introducción del cuadrante con cursor en Europa (in *Isis*, 1932, vol. 17, pp. 218-258, pls. 11-16).
- Estudios sobre Azarquiel, el Tratado de la Azafea (in *Archeion*, 1932, t. 14, pp. 392-419 (= *Anales de la Universidad de Madrid*, 1932, t. I, pp. 23-55)).
- *Don Profeit Tibbon. Tractat de l'assafea d'Azarquiel*. Barcelona, 1933.
- *Estudios sobre Azarquiel*. Madrid-Granada, 1943-1950.
- Un ejemplar de azafea árabe de Azarquiel (in *Al-Andalus*, 1944, vol. 9, pp. 111-119, pls. 3-4, and *ib.*, 1945, vol. 10, p. 253).
- Tres instrumentos astronómicos árabes de los museos de Tetuán y Madrid (in *Al-Andalus*, 1947, vol. 12, pp. 49-64, pls. 1-4, ill.).
- *Estudios sobre historia de la ciencia española*. Barcelona, 1949.
- Montet, Edouard: *Maison aux treize coupes à Fez* (in *Bull. de la Soc. de géogr. d'Alger et de l'Afrique du Nord*, 1923, pp. 182-185, ill.).
- Morancé Album*: see Alexandria.
- Morley, William H.: *Description of a planispheric astrolabe, constructed for Sháh Sultán Husain Safawí, King of Persia, and now preserved in the British Museum; comprising an account of the astrolabe generally, with notes illustrative and explanatory: to which are added, concise notices of twelve other astrolabes, Eastern and European, hitherto undescribed*. London, 1856.
- Description of an Arabic quadrant (in *JRAS*, 1860, vol. 17, pp. 322-330, 2 plates).
- Mortillaro, Vincenzo: *Illustrazione di un astrolabio arabo-siculo*. Palermo, 1848.
- Illustrazione di un astrolabio arabo del nono secolo (in *Opere*, vol. 4, 1848, pp. 110-135, 2 pls.).

- Murr, Christian Gottlieb v.: *Memorabilia bibliothecarum publicarum Norimbergensium et Universitatis Altdorfinae*. Norimbergae, 1786-1788.
- Forsetzung der ausführlichen Beschreibung der Reichsinsignien (in *Journal für Kunstgeschichte und Litteratur*, 1787, Th. 15, pp. 129-384).
- *Inscriptio arabica litteris cuficis auro textili picta in infima fimbria pallii imperialis, Panormi A.C. 1133 confecti, inter S.R. Imp. Germ. klinodia Norimbergae adservati delineata et explicata*. Norimbergae, 1790.
- *Astrolabium cufico-arabicum quod observatur in Bibliotheca publica Norimbergensi, cum bibliotheca scriptorum de astrolabiis*. Lipsiae, 1806.
- Musée Rétrospectif*: see Paris.
- Nallino, Carlo Alfonso: *Aşturlâb, EI*, Engl. ed. I, pp. 501-502.
- Astrolabio (in *Enciclopedia Italiana*, 1930, t. 5, pp. 96 f., pls. XIX f., 1 fig.).
- Needham, Joseph: *Science and civilisation in China...* with the assistance of Wang Ling. Vol. I. Cambridge, 1954.
- Osipov, M.: *Astrolabiya planisfera ili persidsko-arabskaya astrolabiya* (in *Protokoli zasyedaniy i soobshcheniya chlenov Turkestanskavo kruzhka lyubiteley arkheologii*, Tashkent, 1910, 14th year, pp. 114-132, 1 pl., 16 figs.).
- [Oxford]: *Brief guide to the Museum of the History of Science*. Oxford, 1949.
- Padmakara Dube: *Astrolabes in the State Library, Rampur* (in *Journal of the United Provinces Hist. Soc.*, 1928, vol. 4, pp. 1-11, pls. I-VII).
- [Paris:] *Bibliothèque Nationale. Notice des objets exposés dans la section de géographie*. Paris, 1889.
- [—] *Musée rétrospectif de la classe 15. Instruments de précision à l'Exposition universelle internationale de 1900 à Paris. Rapport du Comité d'installation*. Paris, 1900.
- [—] *Exposition des instruments et outils d'autrefois. Mars-avril 1936. Musée des Arts décoratifs, Palais du Louvre — Pavillon de Marsan*, Paris, 1936.
- Péretié, A.: *Les medrasas de Fès* (in *Archives Marocaines*, 1912, t. 18, pp. 257-372, ill.).
- Pope, Arthur Upham: *A Survey of Persian art from prehistoric times to the present*. Oxford, 1938-1939. [Quoted usually as *Survey* only.]

- Price, Derek J.: A collection of armillary spheres and other antique scientific instruments (in *Annals of Science*, 1954, vol. 10, pp. 172-187, pls. IV-VII).
- An international checklist of astrolabes (in *Archives internationales d'histoire des sciences*, 1955, 8^e année, pp. 243-263, 363-381).
- Al-Qalqashandî: *Ṣubḥ al-a'shâ*. Cairo, 1913-1919.
- Rehatsek, E.: The Labours of the Arab astronomers, and their instruments, with the description of an astrolabe in the Mulla Firuz Library (in *Journ. Bombay Branch, Royal Asiatic Society*, 1875, publ. 1876, vol. 11, pp. 311-330, 11 figs.)
- Reich, S., et G. Wiet: Un astrolabe syrien du XIV^e siècle (in *BIFAO*, 1939, vol. 38, pp. 195-202, ill., pl. XXIII).
- Remeis, Carl: Die älteste arabische Himmelskugel (in *Sirius*, 1879, Bd. 12, N.F., Bd. 7, pp. 62-65).
- Remondini, Pier Costantino: Intorno all' astrolabio arabico posseduto dalla Società Ligure di Storia Patria di Genova (in *Atti del IV. Congresso Internazionale degli Orientalisti*, 1878, Firenze, 1880, vol. I, pp. 403-431, 1 pl.)
- Renaud, H. P. J.: Additions et corrections à Suter (in *Isis*, 1932, vol. 18, pp. 166-183).
- Notes critiques d'histoire des sciences chez les Musulmans. I. Les Ibn Bâṣo (in *Hespéris*, 1937, t. 24, pp. 1-12); III. Astronomie et astrologie marocaines (*ibid.*, 1942, t. 29, pp. 41-63, 2 figs.)
- Sur une tablette d'astrolabe appartenant à M. H. Terrasse (in *Hespéris*, 1939, t. 26, pp. 157-169, 3 pls., 1 fig.)
- Quelques constructeurs d'astrolabes en Occident musulman (in *Isis*, 1942, vol. 34, pp. 20-23).
- Rép.: see Combe, Sauvaget et Wiet.
- Repsold, Johann A.: *Zur Geschichte der astronomischen Messwerkzeuge von Purbach bis Reichenbach 1450 bis 1830*. Leipzig, 1908. Pp. 6-12: Die Messwerkzeuge der Araber.
- Rey, Emmanuel Guillaume: *Les Colonies franques de Syrie aux XII^{me} et XIII^{me} siècles*. Paris 1883.
- Rey-Pailhade, Joseph de: Sur un astrolabe arabe de l'an 613 de l'hégire (in *Bull. de géographie historique et descriptive*, année 1890, pp. 217 f.)
- [Note sur deux anciens instruments d'astronomie] (in *Bulletin de la Société Archéol. du Midi*, 1890, pp. 52 f.)

- [Recherches sur les inscriptions gravées sur l'astrolabe arabe de la Société Archéologique] (*ibid.*, 1891, pp. 27).
- [Note sur la comparaison de l'astrolabe du XVI^e siècle, qui appartient à la Société, avec un autre astrolabe fait à la même époque à Séville] (*ibid.*, 1891, pp. 60 f.)
- see also Sauvaire.
- Ricard, Prosper: L'horloge de la Médersa Bou-Anania de Fès (in *Bull. de la Soc. de Géogr. d'Alger et de l'Afrique du Nord*, 1924, pp. 248-254, 2 figs.)
- *Maroc*. 7^e éd. Paris 1950. Les Guides Bleus.
- Rice, D. S.: Studies in Islamic metal work—III (in *Bull. of the School of Oriental and African Studies, University of London*, 1953, vol. 15, pp. 229-238, figs. 1-4, pls. I-VIII).
- Roberts-Austen, W. Chandler: Alloys. Cantor Lectures. IV (in *Journal of the Society of Arts*, 1893, vol. 41, pp. 1006-1019 and 1022-1030).
- see also Wingham.
- Rhode, Alfred: *Die Geschichte der wissenschaftlichen Instrumente*. Leipzig, 1923.
- Roncière, Charles de la: *La découverte de l'Afrique au moyen âge*. Tome I. *L'Intérieur du Continent*. Le Caire, 1924 (on the cover 1925).
- [Roussel:] *Catalogue des objets d'art... composant la collection de feu M. Roussel*. [Paris] Hôtel Drouot, 13-15 mars 1911.
- Ruiz Orsatti, Ricardo: La astronomia entre los árabes (in *Mauritania*, 1940, año 13, pp. 27-30, ill.)
- Ryckmans, G., et Fernand Moreau: Un gnomon arabe du XIV^e siècle (in *Muséon*, 1926, t. 39, pp. 33-40, 1 pl.)
- Saavedra, Eduardo: Astrolabios árabes que se conservan en el Museo Arqueológico Nacional, en la Biblioteca de Palacio y en collecciones particulares (in *Museo Español de Antigüedades*, 1875, t. 6, pp. 395-414, 1 pl.)
- Ṣabṛī, Aḥmad Mukhtâr: Al-aṣṭurlâb 'inda-l-'Arab (in *Muḥâḍarât Ibn al-Haitham*, Cairo, Univ. Fu'ad I, Fac. Polytechnique, 1947).
- Sacy, Silvestre de: *Relation de l'Égypte* par Abd-allatif. Paris, 1810.
- aṣ-Ṣafadî: *Nakṭ al-himyân*, ed. Ahmed Zeki. Cairo, 1911.

- Salīm, Maḥmūd Rizq: *ʿAṣr salaṭīn al-Mamālīk*. Cairo, 1952.
- Salinas, Antonino: *Breve guida del Museo Nazionale di Palermo*. 3a ed., Palermo, 1901.
- Sánchez-Pérez, José: *Biografías de matemáticos árabes que florecieron en España*. Madrid, 1921.
- Sarre, Friedrich: *Sammlung F. Sarre. Erzeugnisse islamischer Kunst*. Teil I. *Metall*. Berlin, 1906.
- und F. R. Martin: *Die Ausstellung von Meisterwerken muhammedanischer Kunst in München 1910*. München, 1912.
- Sarrus, Frédéric: Description d'un astrolabe construit à Maroc en l'an 1208 (in *Mémoires de la Société du Muséum d'histoire nat. de Strasbourg*, 1853, t. 4, pp. 1-32, pls. 1-6).
- Sarton, George: *Introduction to the history of science*. Washington, 1927-1948.
- Sauvaget: see Combe.
- Sauvaire, Henri et Joseph de Rey-Pailhade: Sur une mère d'astrolabe arabe du XIII^e siècle (609 de l'hégire) portant un calendrier perpétuel avec correspondance musulmane et chrétienne. Traduction et interprétation (in *JA*, 1893, 9^e sér., t. 1, pp. 5-76, 185-231, 2 pls.).
- Schier, Karl H.: Bericht über den arabischen Himmelsglobus im Kgl. Sächs. mathematischen Salon zu Dresden (in *Koner's Zeitschrift f. allgemeine Erdkunde*, 1864, N.F., Bd. 16, pp. 494-500). Reprinted in his *Globus*, pp. 65-71.
- *Globus coelestis arabicus qui Dresdae in Regio Museo Mathematico asservatur*. Lipsiae, 1865. Reprinted in:
- *Ciel et Enfer ou Description du globe céleste arabe qui est conservé au Musée mathématique royal de Dresde*. Dresden-Leipzig, 1866.
- Schio, Almerico da: Intorno a due strumenti astronomici antichi trovati in Valdagno (in *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti*, 1874-1875, serie 5, t. 1, pp. 1399-1402).
- Die due astrolabj in caratteri cufici occidentali trovati in Valdagno. Comunicazione seconda (in *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti*, 1879-1880, serie 5, t. 6, pp. 259-268).
- *Di due astrolabi in caratteri cufici occidentali trovati in Valdagno (Veneto)*. Venezia, 1880.

- Sur deux astrolabes arabes (in *Atti del IV Congresso Internazionale degli Orientalisti 1878*, Firenze, 1880, vol. I, pp. 367-369).
- Schmalzl, Peter: *Zur Geschichte des Quadranten bei den Arabern*. München, 1929.
- Schmoranz, Gustav: *Old Oriental gilt and enamelled glass vessels*. Vienna and London, 1899.
- Sédillot, L. Am.: *Mémoire sur les instruments astronomiques des Arabes*. Paris, 1841. Mémoires présentés par divers savants à l'Académie royale des Inscriptions et Belles-Lettres, 1844, série I, tome I.
- *Supplément au Traité des instruments astronomiques des Arabes*. Paris, 1844, pp. 149-194.
- *Matériaux pour servir à l'histoire comparée des sciences mathématiques chez les Grecs et les Orientaux*. Paris, 1845-1849.
- Description d'un astrolabe construit par Abd-ul-Aïma, ingénieur et astronome persan (in *Annales de l'Observatoire Impérial de Paris, Mémoires*, 1868, t. 9, pp. 164-171).
- Seemann, Hugo J.: Die Instrumente der Sternwarte zu Marāgha nach den Mitteilungen von al 'Urdī (in *Sitzungsberichte der Physik. mediz. Soz. Erlangen*, 1928, Bd. 60, pp. 15-126, 44 figs.)
- Shadharāt: see 'Abd al-Ḥayy.
- Siddiqi, Abd us-Sattar: Construction of clocks and Islamic civilization (in *Islamic Culture*, 1927, vol. I, pp. 245-251).
- Smith, Rob. Murdoch: *Persian art*, 2nd ed., London, 1878.
- South Kensington: cf. Atchinson.
- Stevenson, Edward Luther: *Terrestrial and celestial globes, their history and construction*. New Haven, 1921.
- Survey: see Pope.
- Suter, Heinrich: Das Mathematiker-Verzeichnis im Fihrist (in *Zeitschrift f. Mathematik u. Physik*, 1892, Jgg. 37, Hist.-lit. Abt., Suppl. I, pp. 1-87).
- *Die Mathematiker und Astronomen der Araber und ihre Werke*. Leipzig, 1900.
- Nachträge und Berichtigungen zu "Die Mathematiker und Astronomen der Araber und ihre Werke" (in *Abhandlungen zur Geschichte der mathemat. Wiss.*, 1902, pp. 155-185).

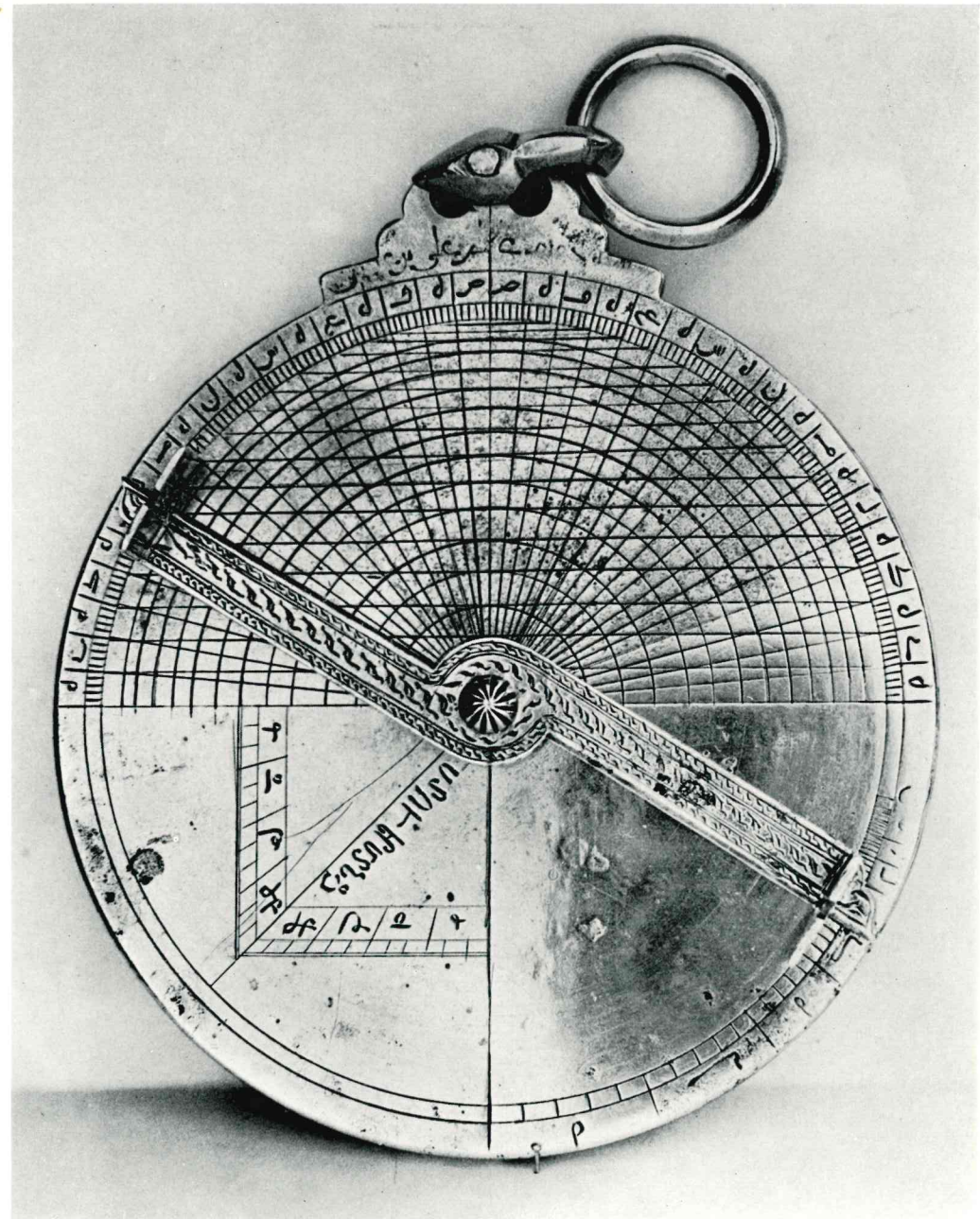
- as-Suyûtî: *Husn al-muhâdara*. Cairo, 1299.
- Taylor, F. Sherwood: The Diffusion of Greek culture. IV. The Moslem carriers (in *The Geographical Magazine*, London, June 1946, vol. 19, pp. 64-72, ill.). Reprinted in *The Root of Europe*, ed. by Michael Huxley, London, 1952, pp. 44-52, ill.
- Tiesenhausen, V. G.: *Materiali dlya bibliografii musul'manskoy arkheologii*, ed. by K. A. Inostrantsev and Ya. I. Smirnov. St. Petersburg, 1906, pp. 0263-0268.
- Ungerer, Alfred: *Les Horloges astronomiques et monumentales les plus remarquables de l'antiquité jusqu'à nos jours*. Strasbourg, 1931.
- Ünver, Süheyl A.: *Fatih külliyesi ve zamanî ilim hayatı*. Istanbul, 1946.
- *Türk pozitif ilimler tarihinden bir bahis Ali Kuşci. Hayatı ve eserleri*. Istanbul, 1948. Istanbul Üniversitesi, Fen Fakültesi Monografileri. Ilim tarihi kısmı Sayı 1.
- Sur les cadrans solaires horizontaux et verticaux en Turquie (in *Archives internat. d'histoire des sciences*, 1954, pp. 254-266, 15 figs.)
- Upton, Joseph M.: A manuscript of "The Book of the fixed stars" by 'Abd ar-Rahmân aş-Şûfî (in *Metropolitan Museum Studies*, 1932-33, vol. 4, pp. 179-197, 51 figs.).
- Usher, Abbott Payson: *A History of mechanical inventions*. Revised ed. Cambridge, Mass., 1954.
- Vallee, Léon: *Bibliothèque Nationale. Notice des documents exposés à la section des cartes*. Paris, 1912.
- Weibel, Adele Coulin: A Persian Astrolabe (in *Bulletin of the Detroit Institute of Arts*, 1946, vol. 25, pp. 59-61, ill.)
- Wiedemann, Eilhard [and] Fritz Hauser: *Über die Uhren im Bereich der islamischen Kultur*. Halle, 1915. Nova Acta. Abhandl. d. Kais. Leopold-Carolin. Deutschen Akademie der Naturforscher. Bd. 100, Nr. 5.
- Beiträge zur Geschichte der Naturwissenschaften. III (in *Sitzungsberichte der Physikal.-medizin. Sozietät*, Erlangen, 1905, t. 37, pp. 218-263).
- Beiträge zur Geschichte der Naturwissenschaften. LXXIX. Ibn al-Schâṭir, ein arabischer Astronom aus dem 14. Jahrhundert (*ibid.*, 1928, Bd. 60, pp. 317-326).
- Wiet, Gaston: *Lampes et bouteilles en verre émaillé*. Le Caire, 1929. Catalogue général du Musée Arabe.

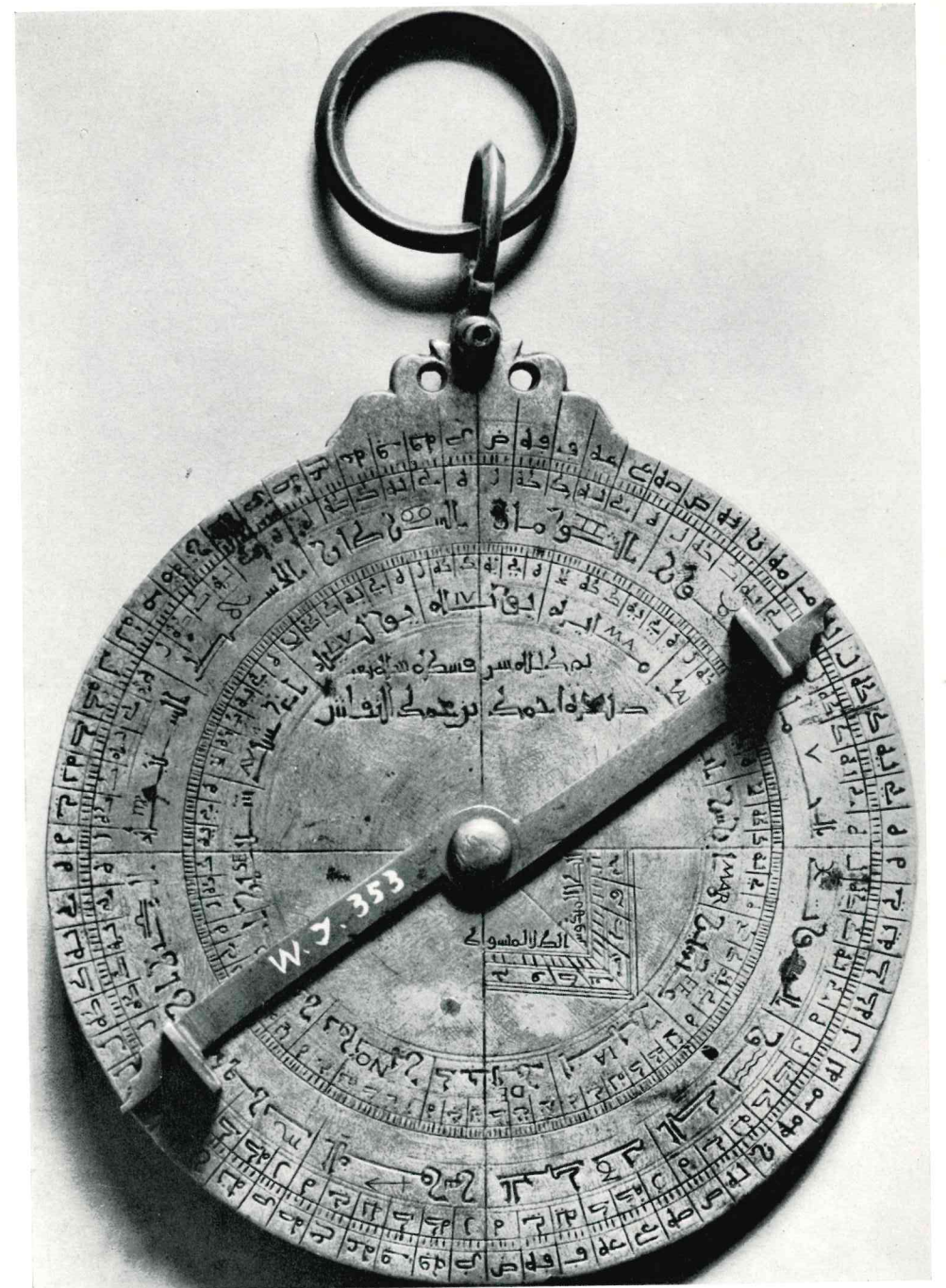
- *Matériaux pour un Corpus Inscriptionum Arabicarum*. Première partie. *Egypte*. Le Caire, 1930. Mémoires de l'Institut Français d'Archéologie Orientale, t. 25.
- *Les objets mobiliers en cuivre et en bronze à inscriptions historiques*. Le Caire, 1932. Catalogue général du Musée Arabe. [Quoted as *Cuivres*.]
- L'exposition d'art persan à Londres (in *Syria*, 1932, pp. 65-93, 196-212, pls. XIX-XXIV, XLIV f.)
- *L'Exposition persane de 1931*. Le Caire, 1933.
- *L'Épigraphie arabe de l'Exposition d'art persan du Caire*. Le Caire, 1935. Mémoires présentés à l'Institut d'Égypte, t. 26.
- *L'exposition d'art persan*. Le Caire, 1935.
- see also Combe, Hauteccœur, Reich.
- Wilber, Donald A.: *The Architecture of Islamic Iran. The Il Khanid Period*. Princeton, 1955.
- Williamson, G. C.: Early scientific instruments (in *Connoisseur*, 1920, vol. 56, pp. 227-230, ill.)
- Wingham, Arthur: *Report on the analysis of various examples of Oriental metal-work, &c., in the South Kensington Museum and other collections, made under the direction of . . . W. C. Roberts-Austen . . .* London, 1892.
- Wittstein, Armin: Historisch-astronomische Fragmente aus der orientalischen Literatur (in *Zeitschrift f. Mathematik u. Physik*, 1892, Jgg. 37, Hist.-lit. Abt., Suppl. II, pp. 89-118).
- Über die Wasseruhr und das Astrolabium des Arzachel (in *Zeitschr. f. Mathematik u. Physik*, 1894, 39. Jgg., Hist.-lit. Abt., pp. 41-55, 81-94, ill.)
- Woepcke, François: Über ein in der Königlichen Bibliothek zu Berlin befindliches arabisches Astrolabium (in *Mathematische Abhandlungen der Kgl. Akad. der Wissenschaften, Berlin*, 1858, publ. 1859, pp. 1-31, 3 pl.)
- Über ein in der Kaiserlichen Bibliothek zu Paris befindliches arabisches Astrolabium (in *Bulletin de l'Acad. Imp. des Sciences de St. Pétersbourg*, 1864, t. 7, cols. 220-227, 1 pl. = *Mélanges Asiatiques*, 1868, t. 5, pp. 98-108, 1 pl.)
- Zinner, Ernst: *Die Geschichte der Sternkunde von den ersten Anfängen bis zur Gegenwart*. Berlin, 1931. Pp. 302-313: Geräte und Sternwarten.
- Über die früheste Form des Astrolabs (in *XXX. Bericht der Naturforschenden Gesellschaft Bamberg*, 1947, pp. 9-21, 2 figs.)

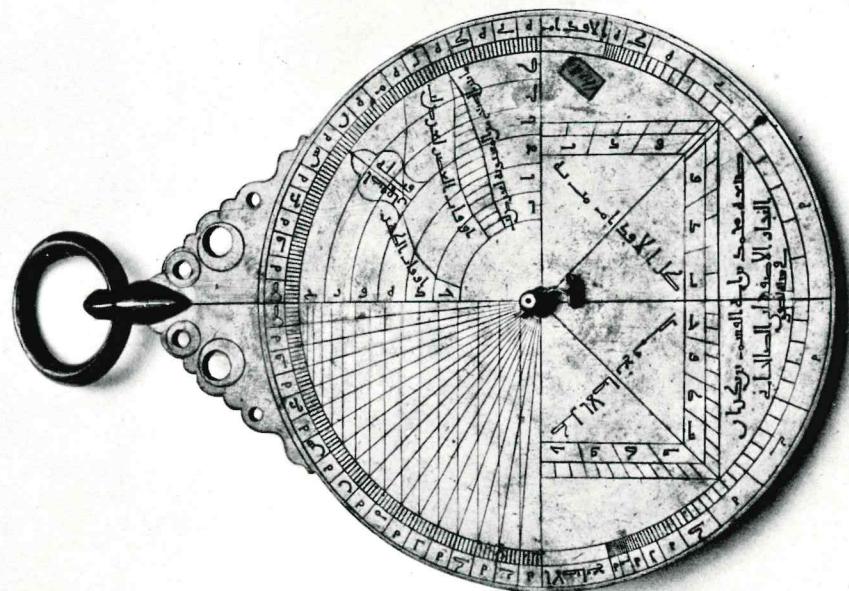
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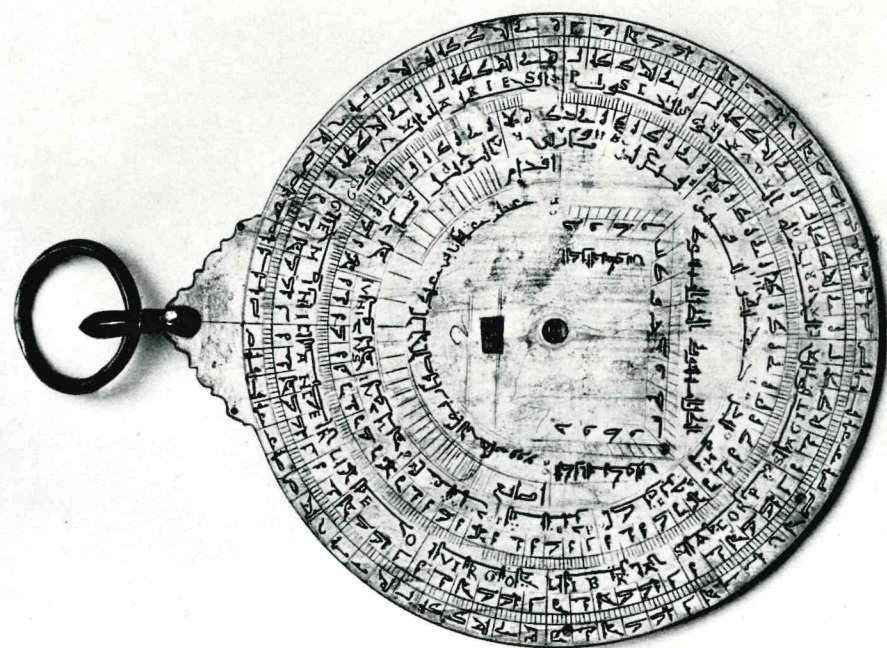
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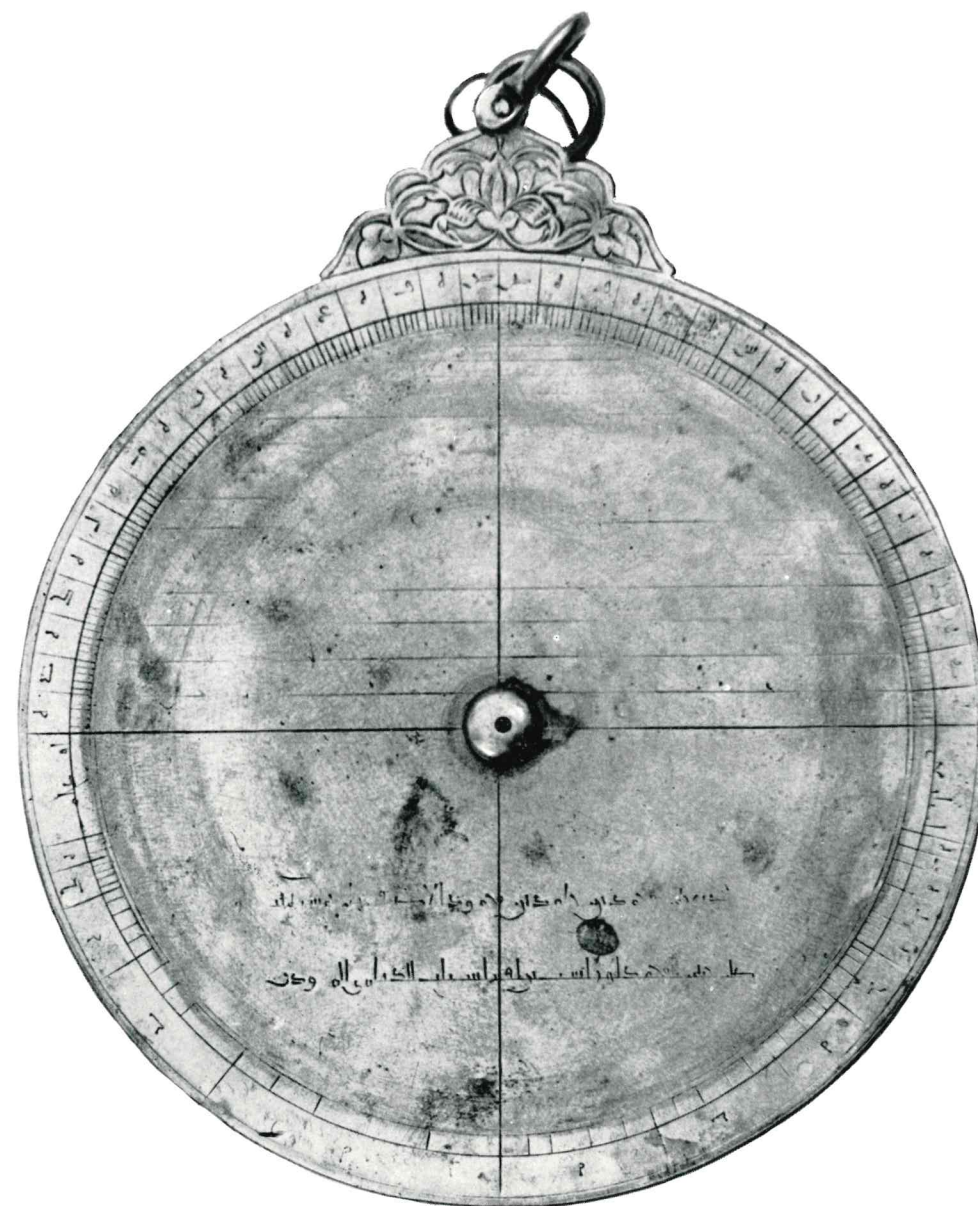




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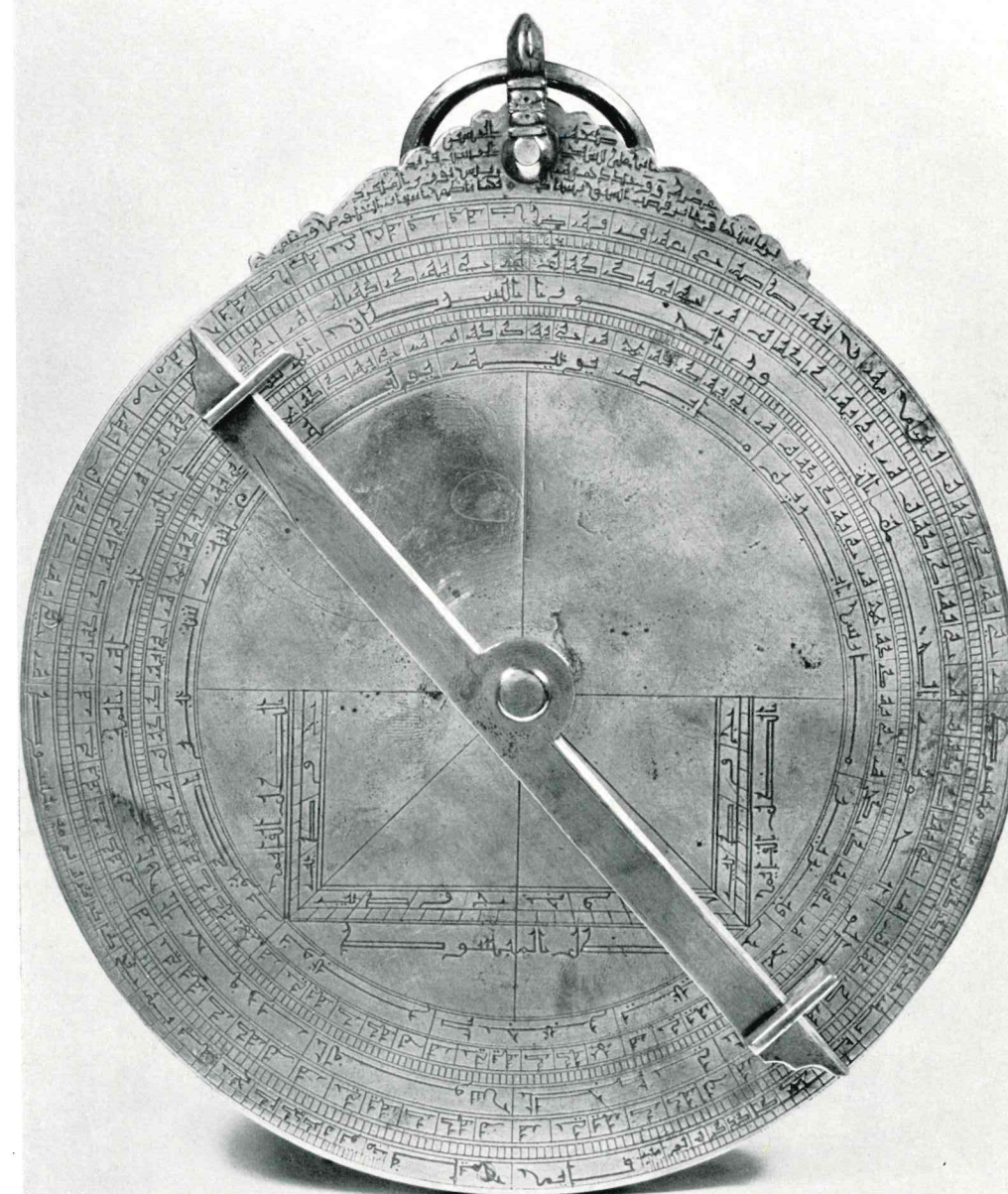
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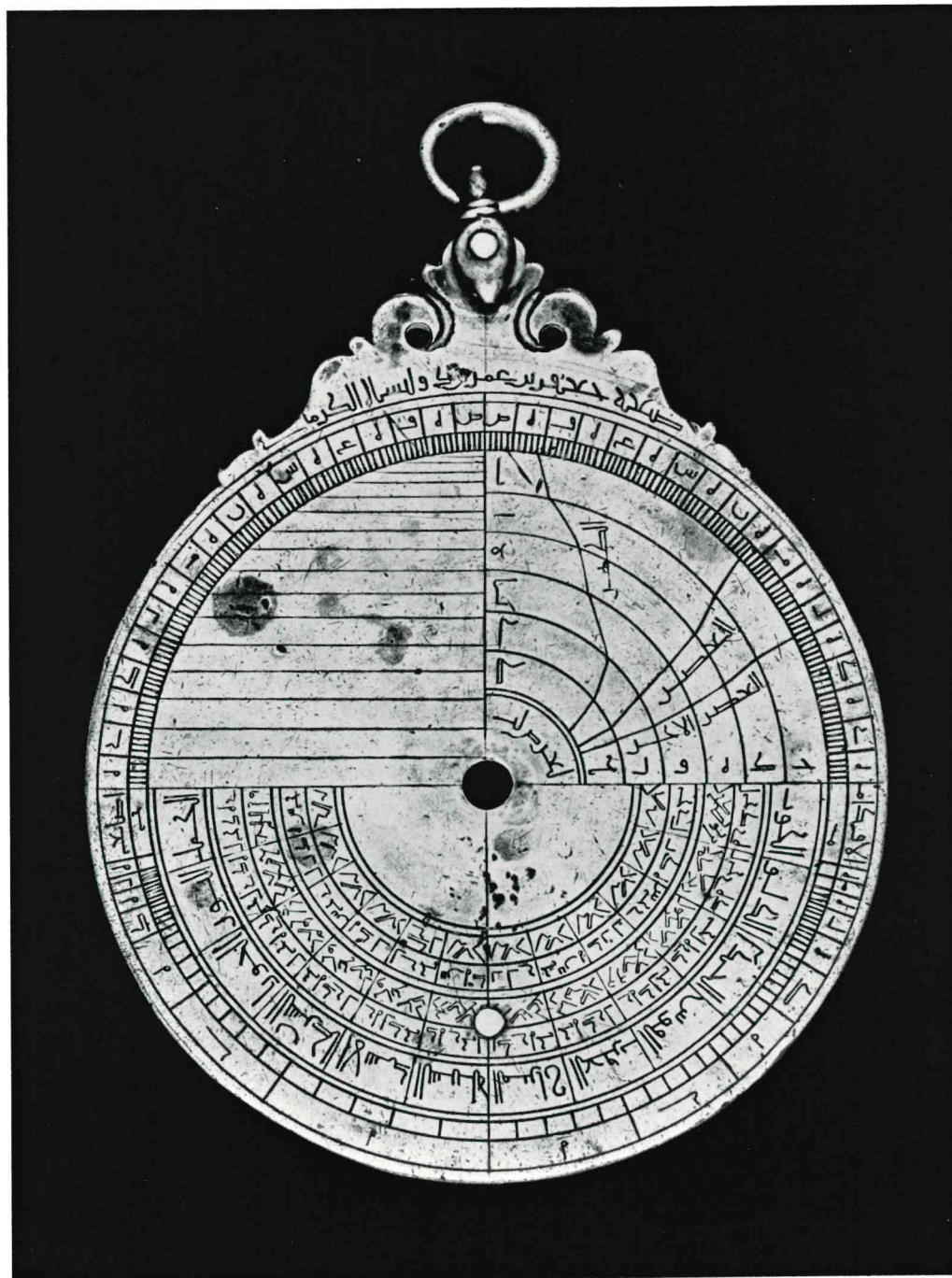
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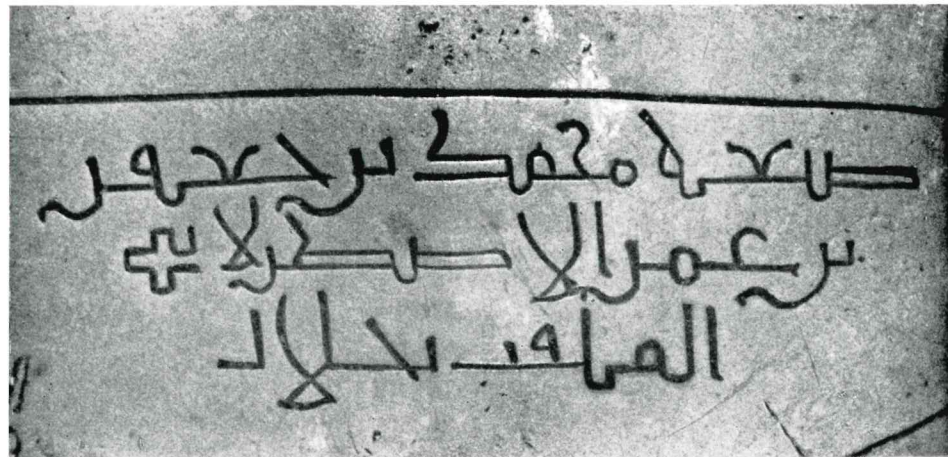
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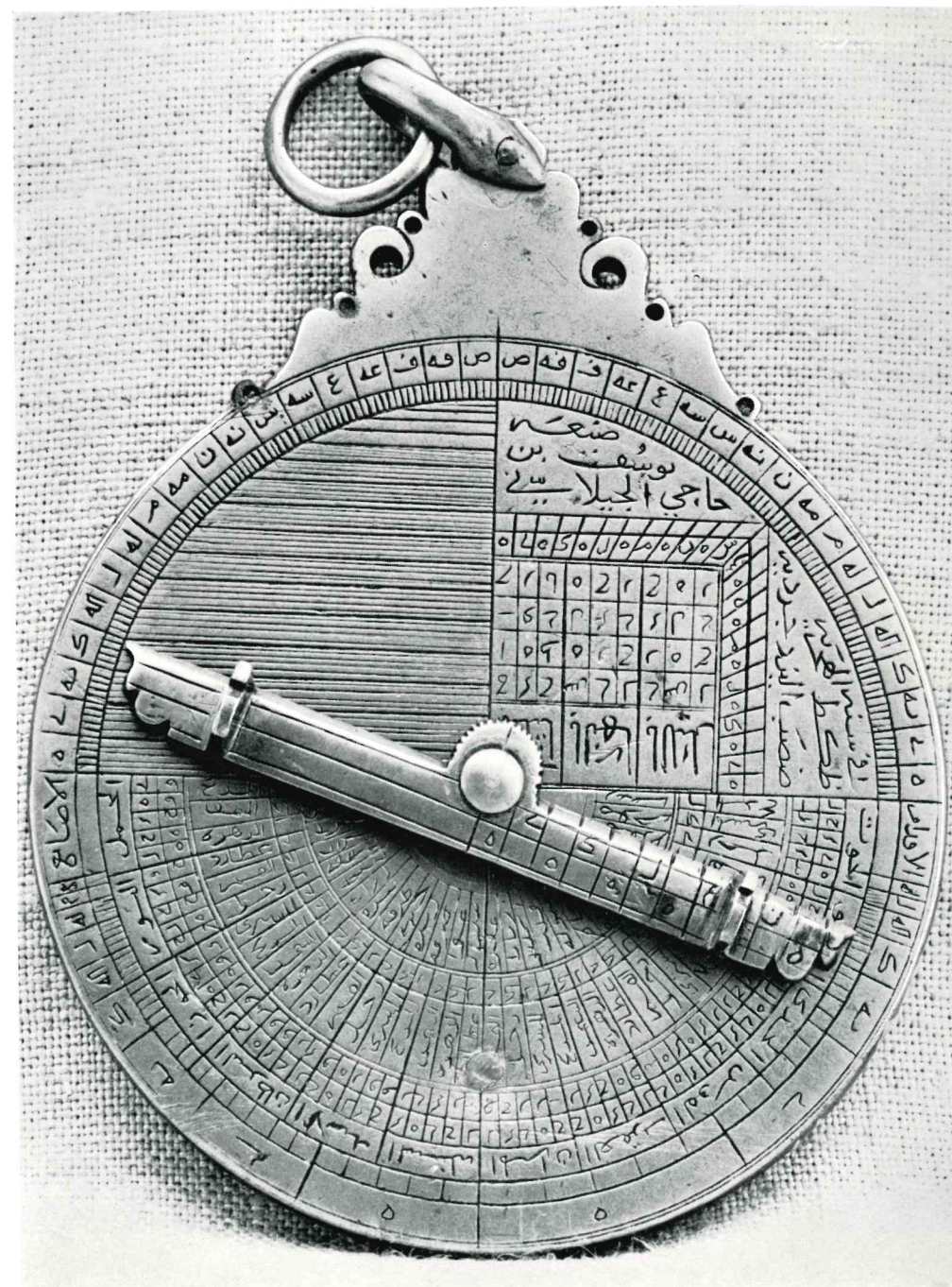
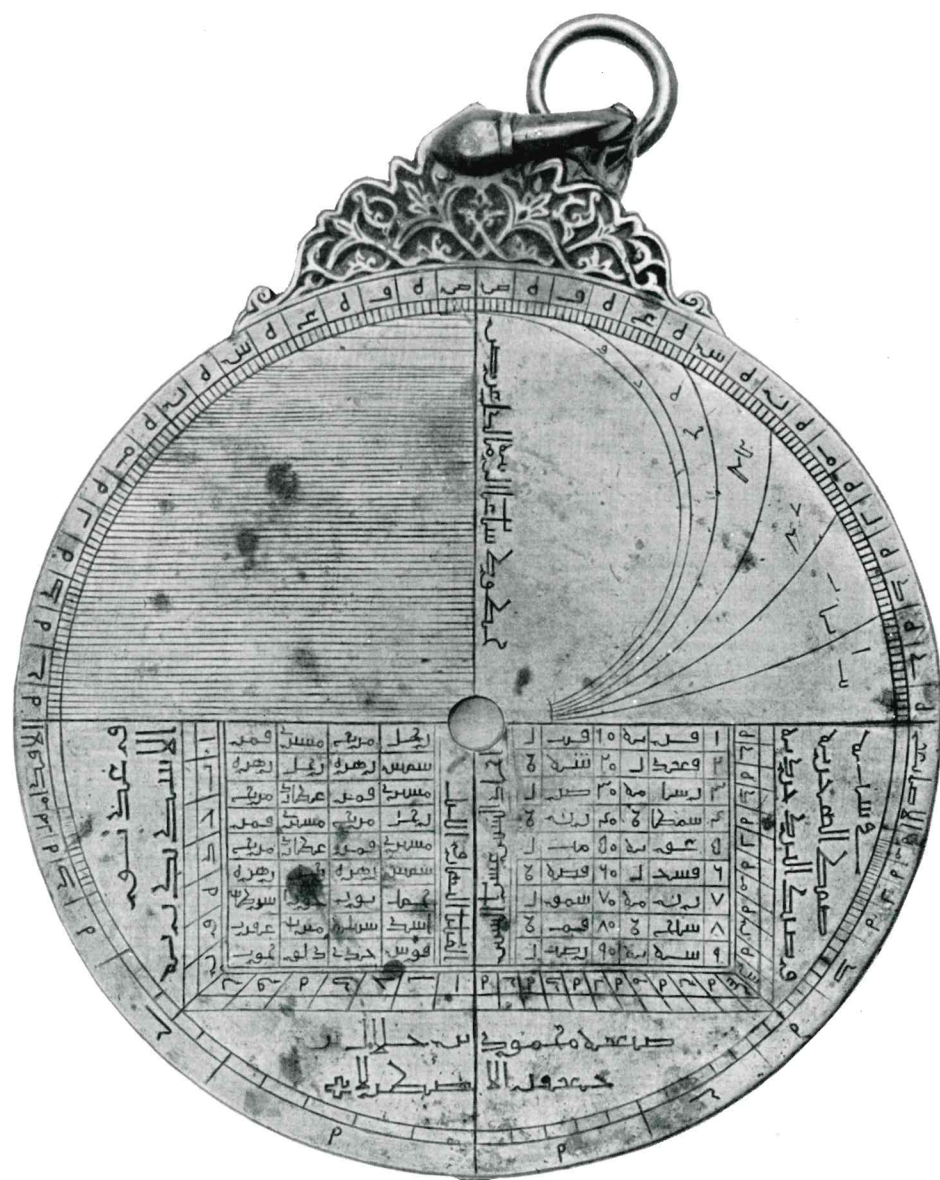


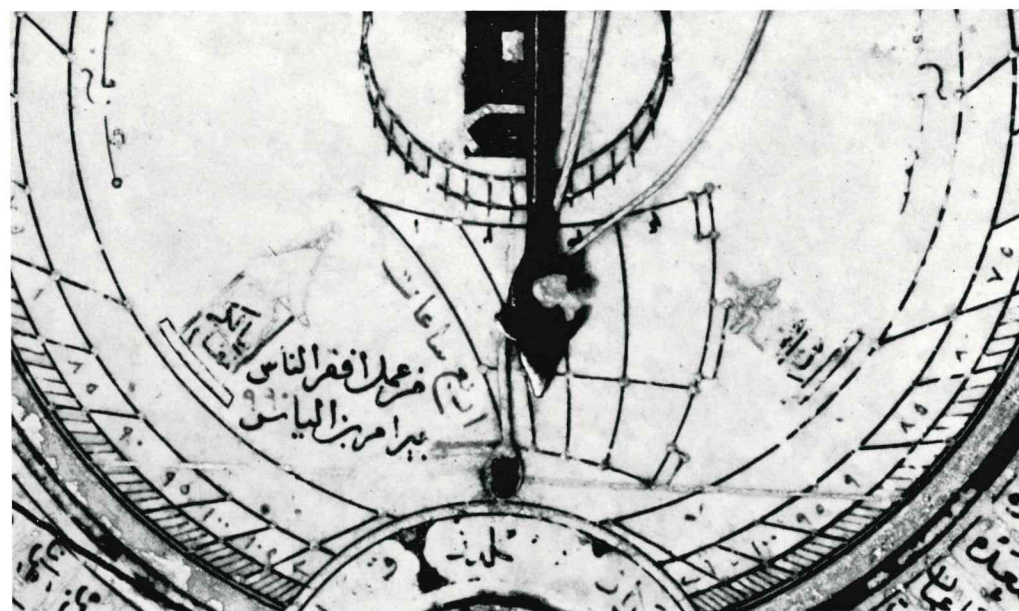
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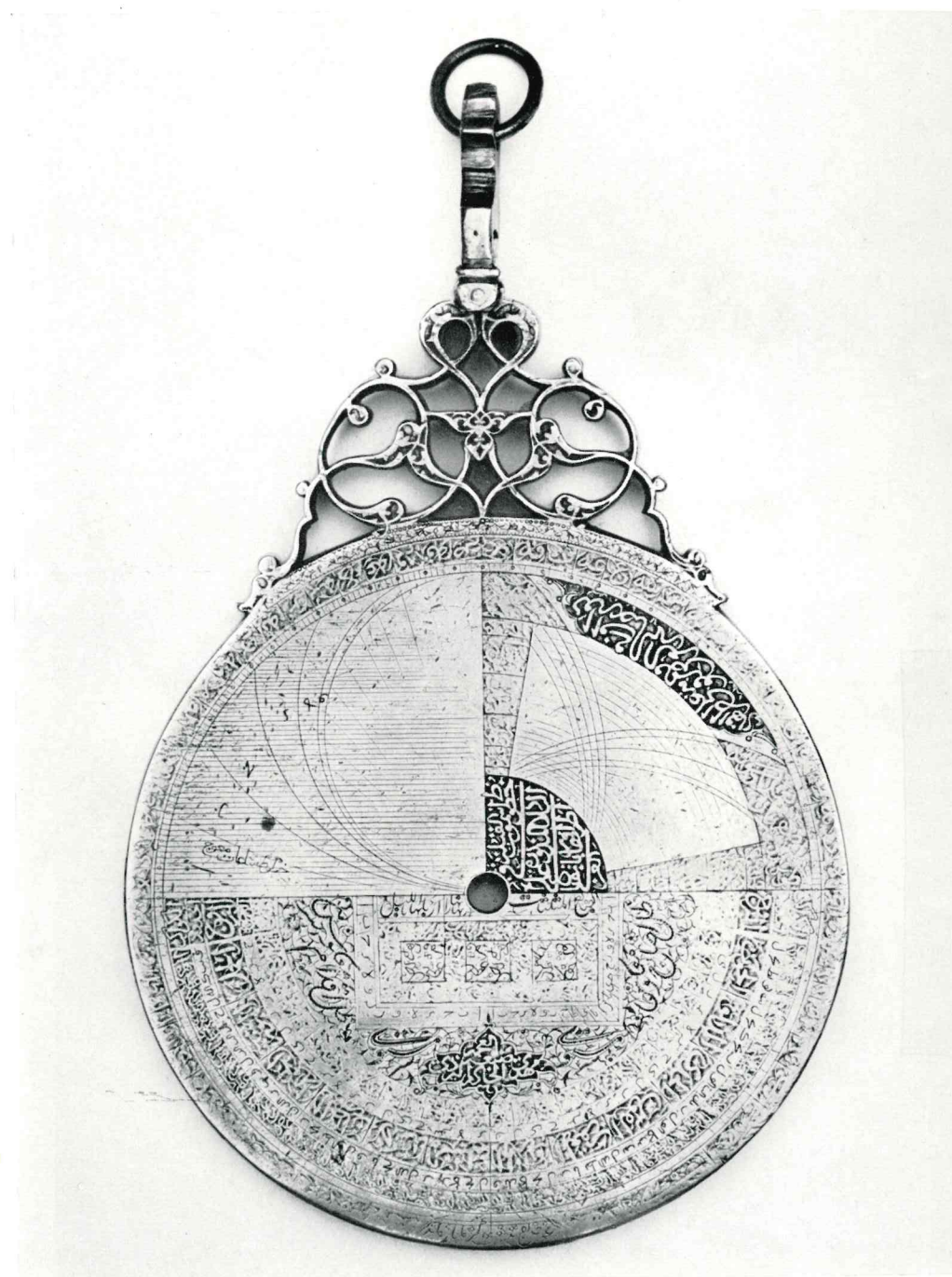


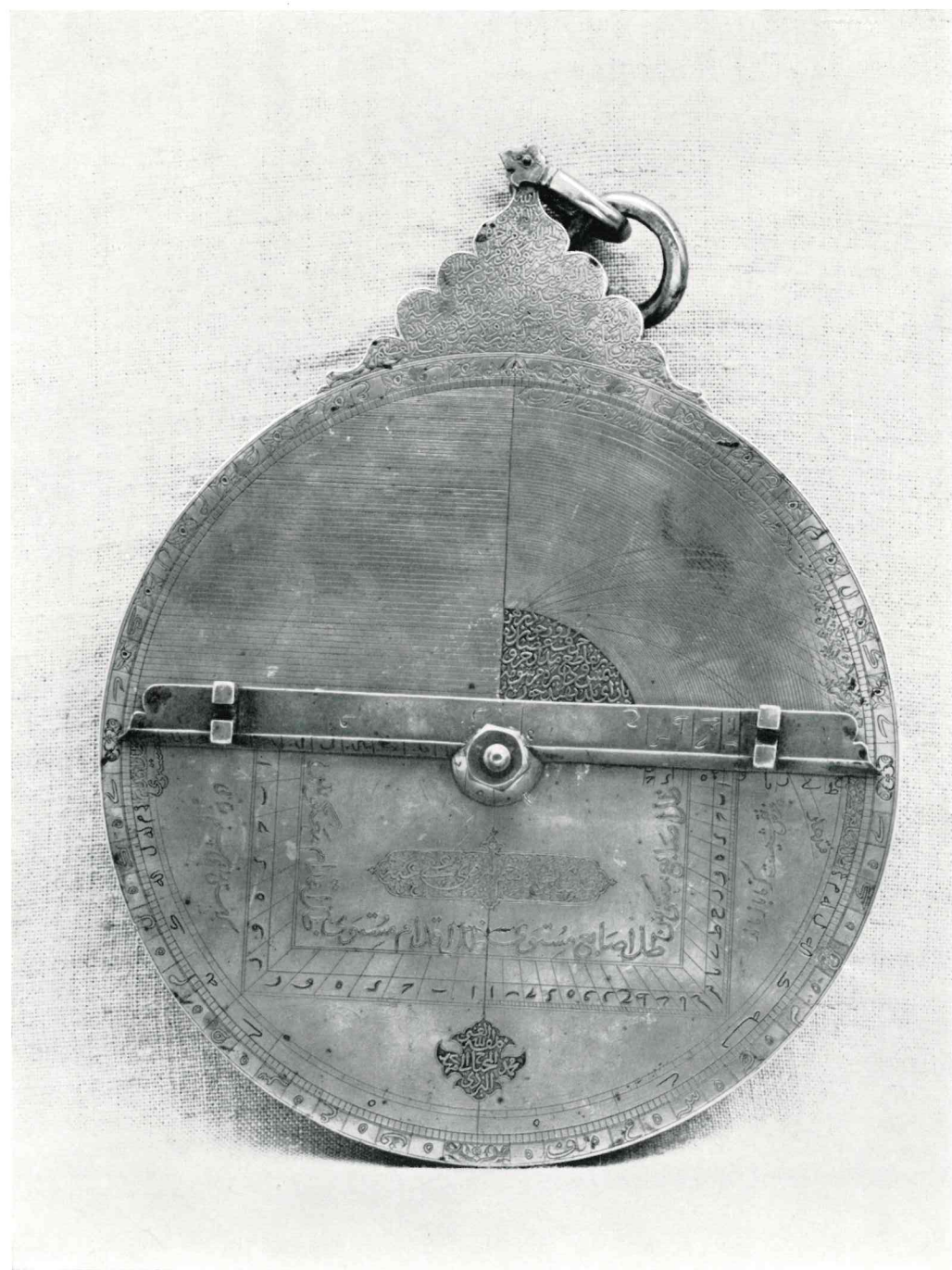


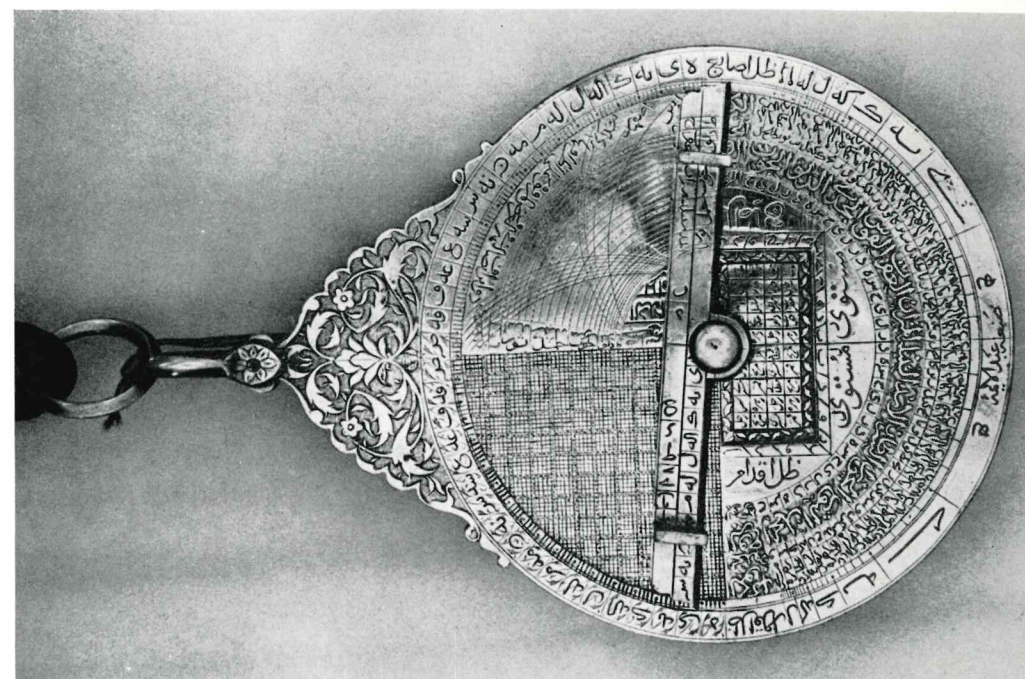
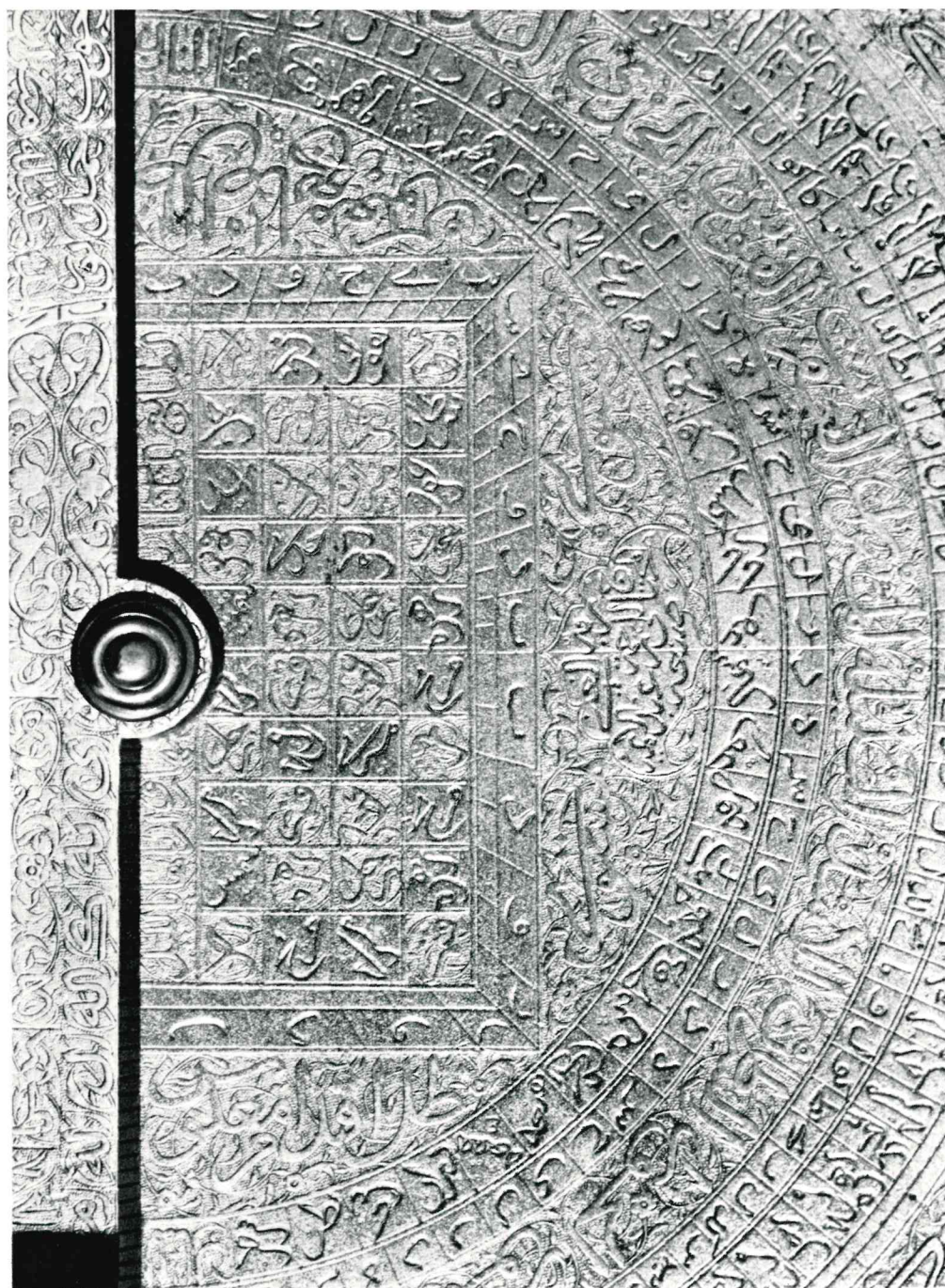
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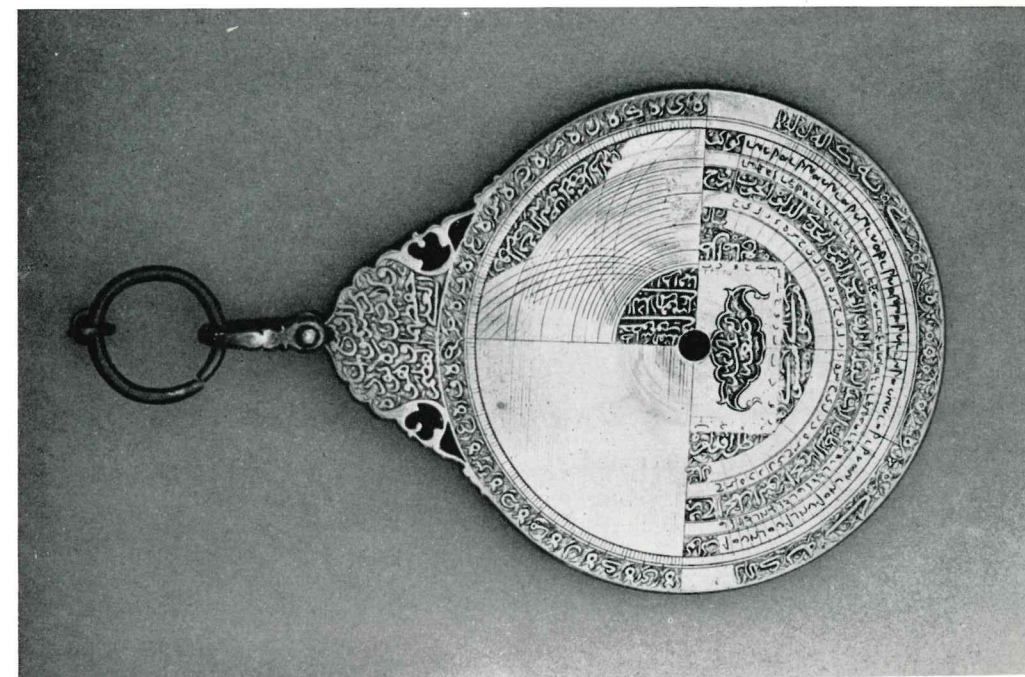
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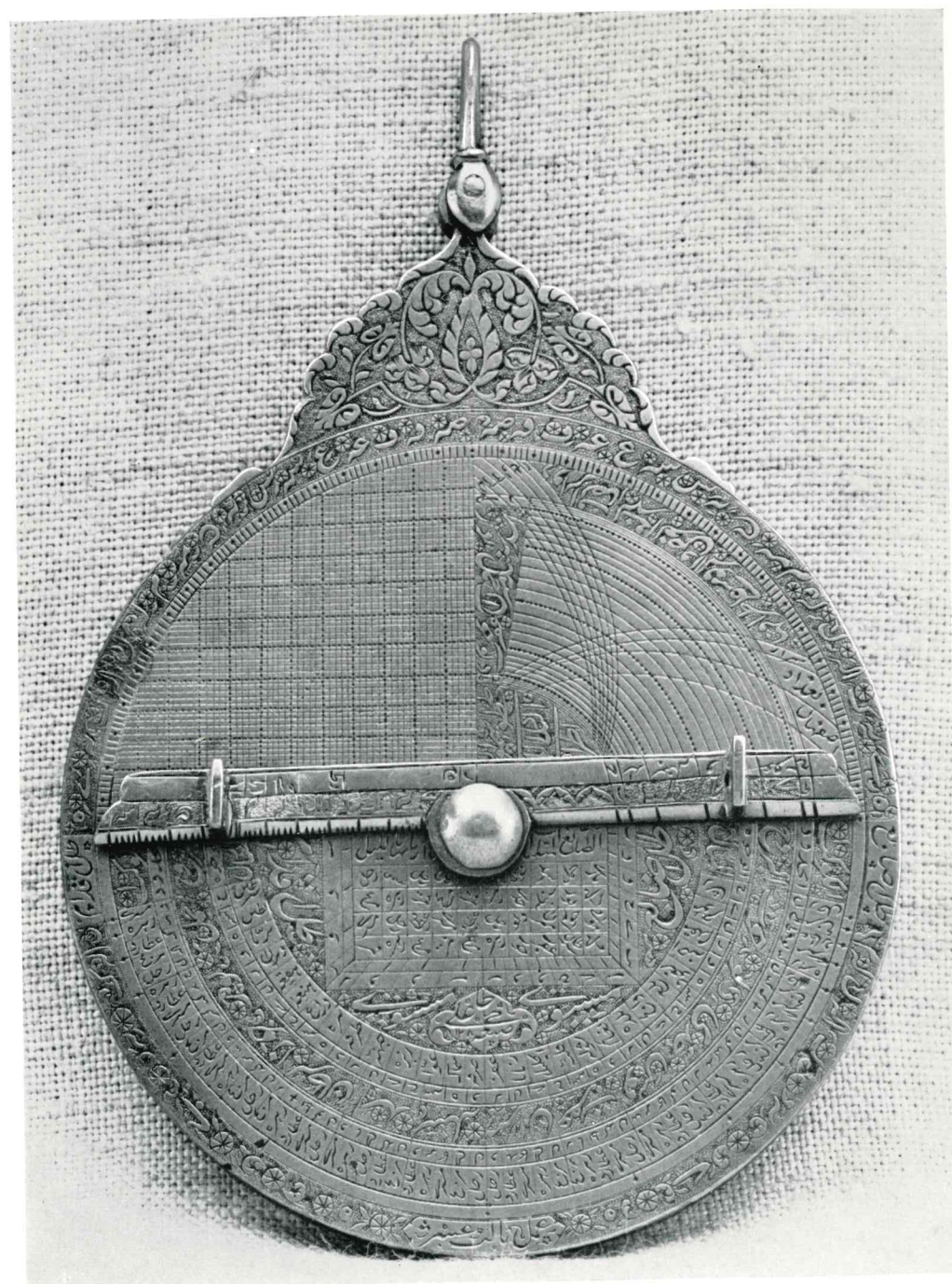
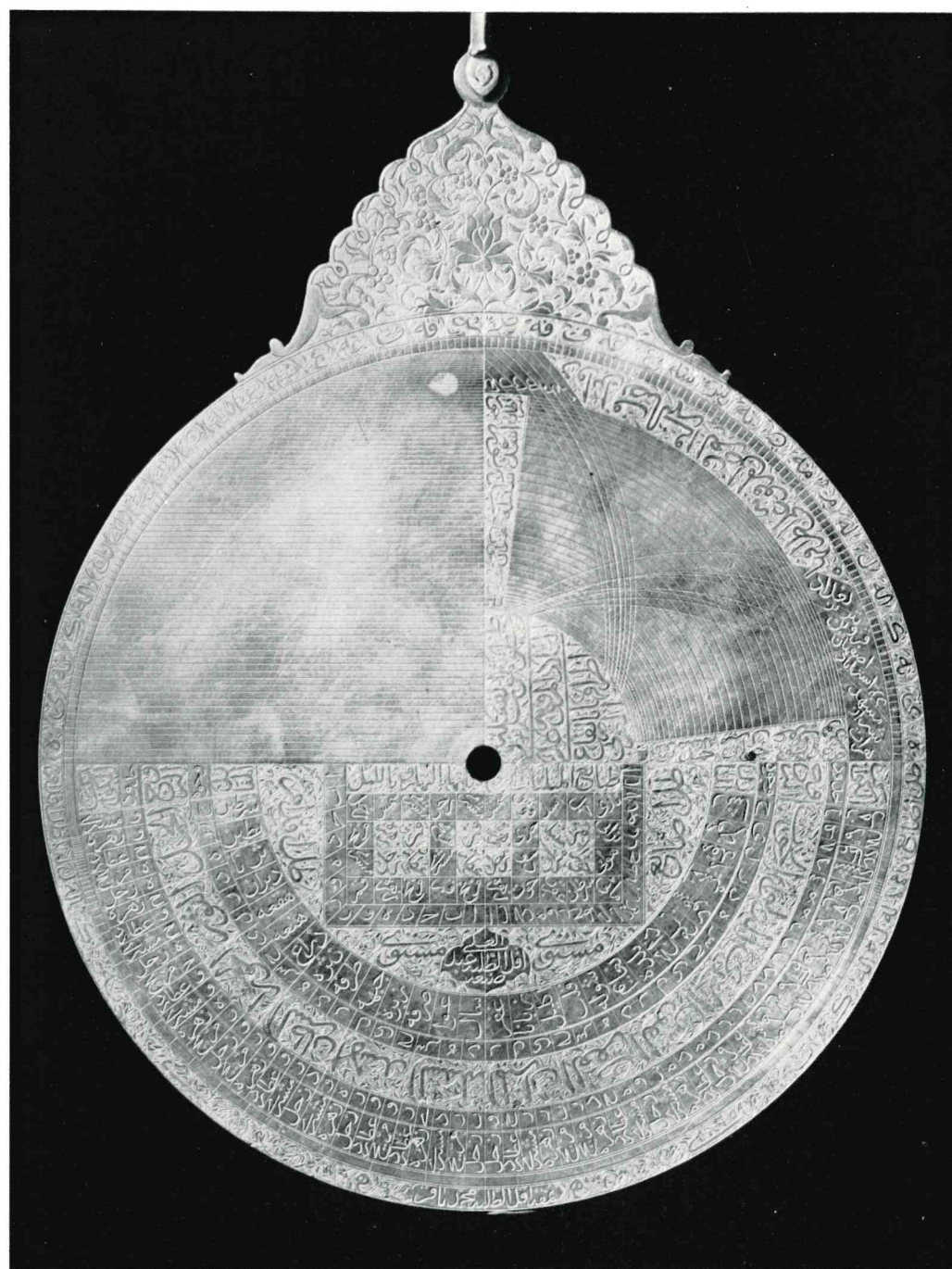


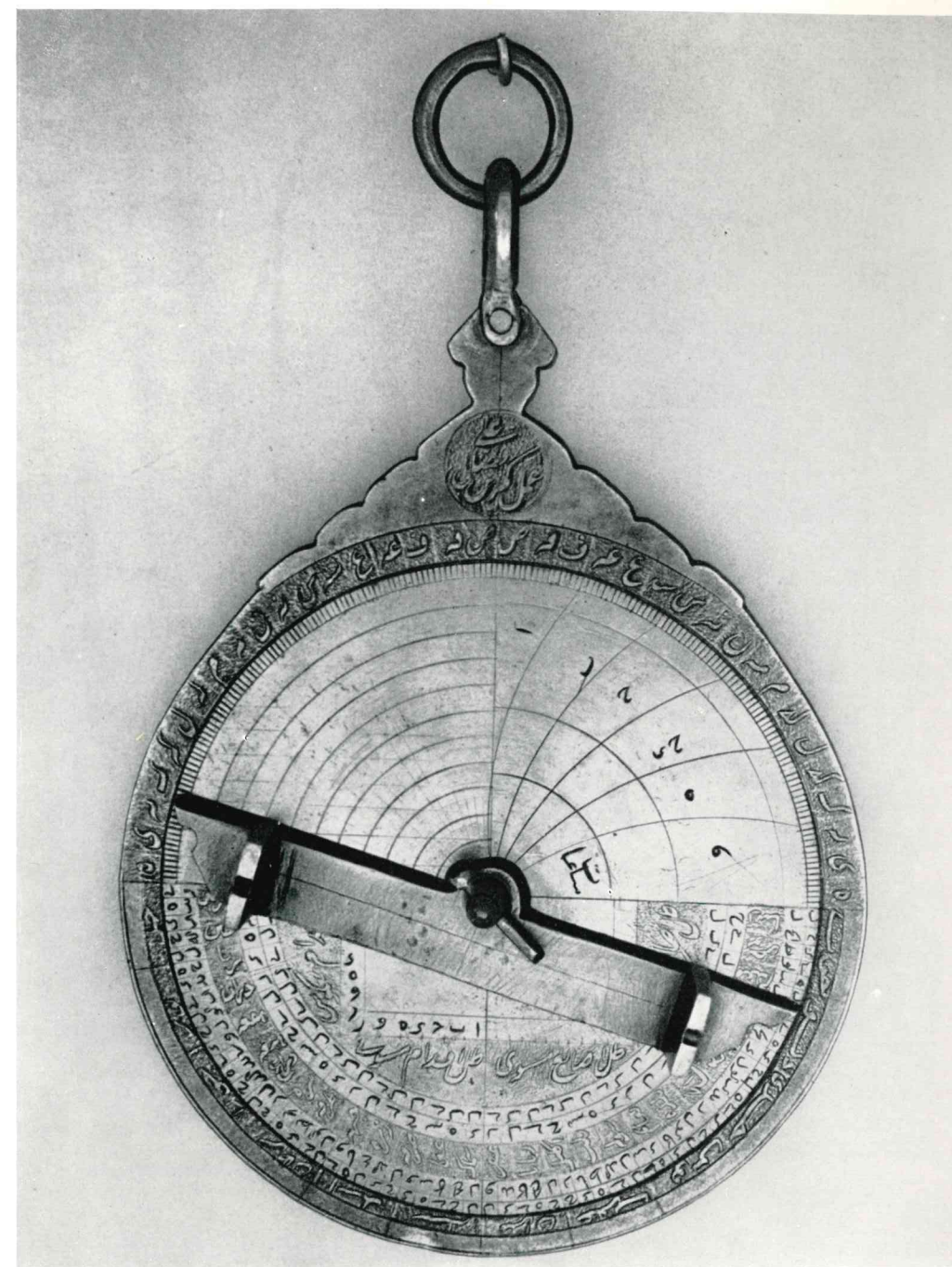
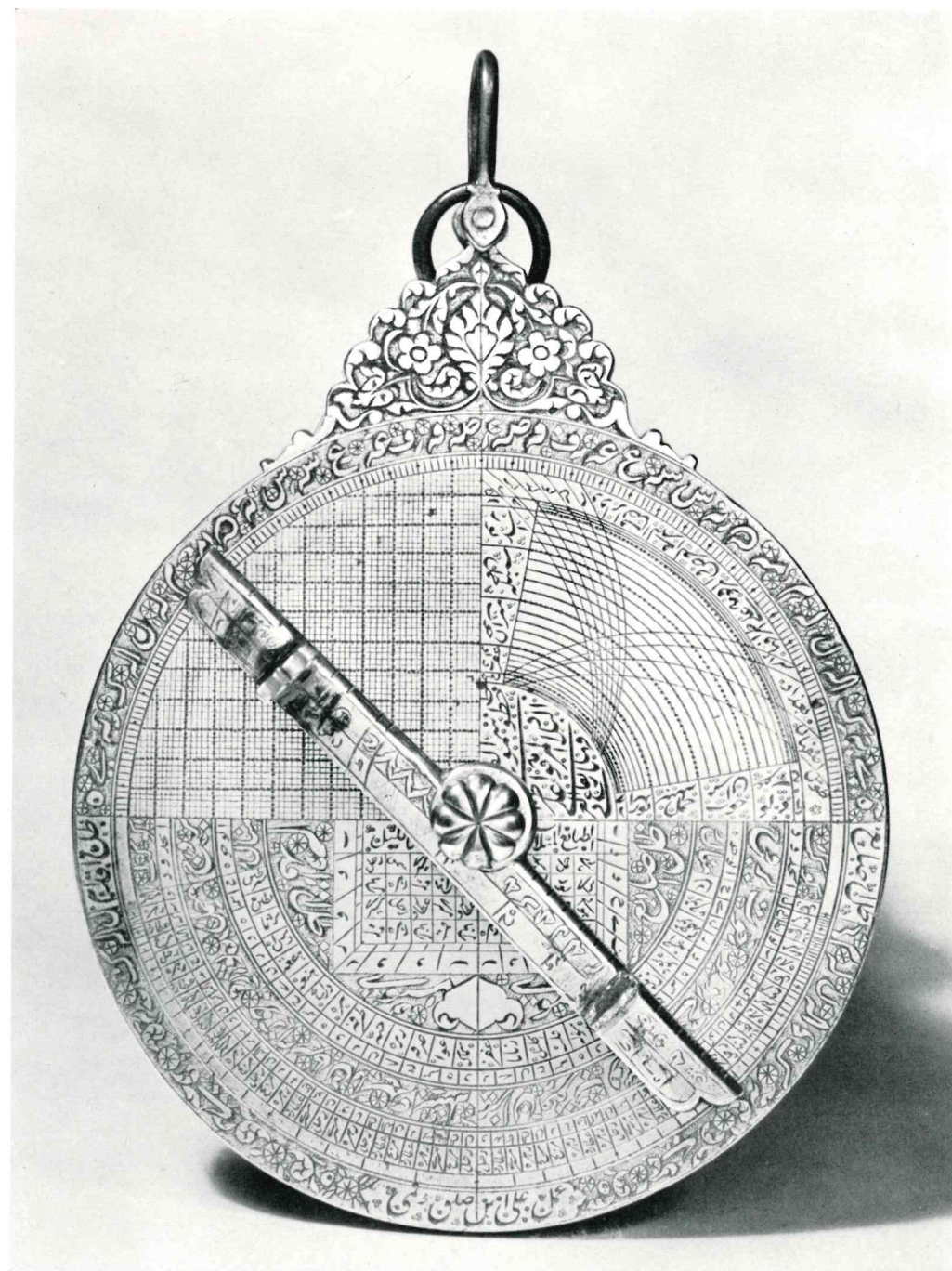


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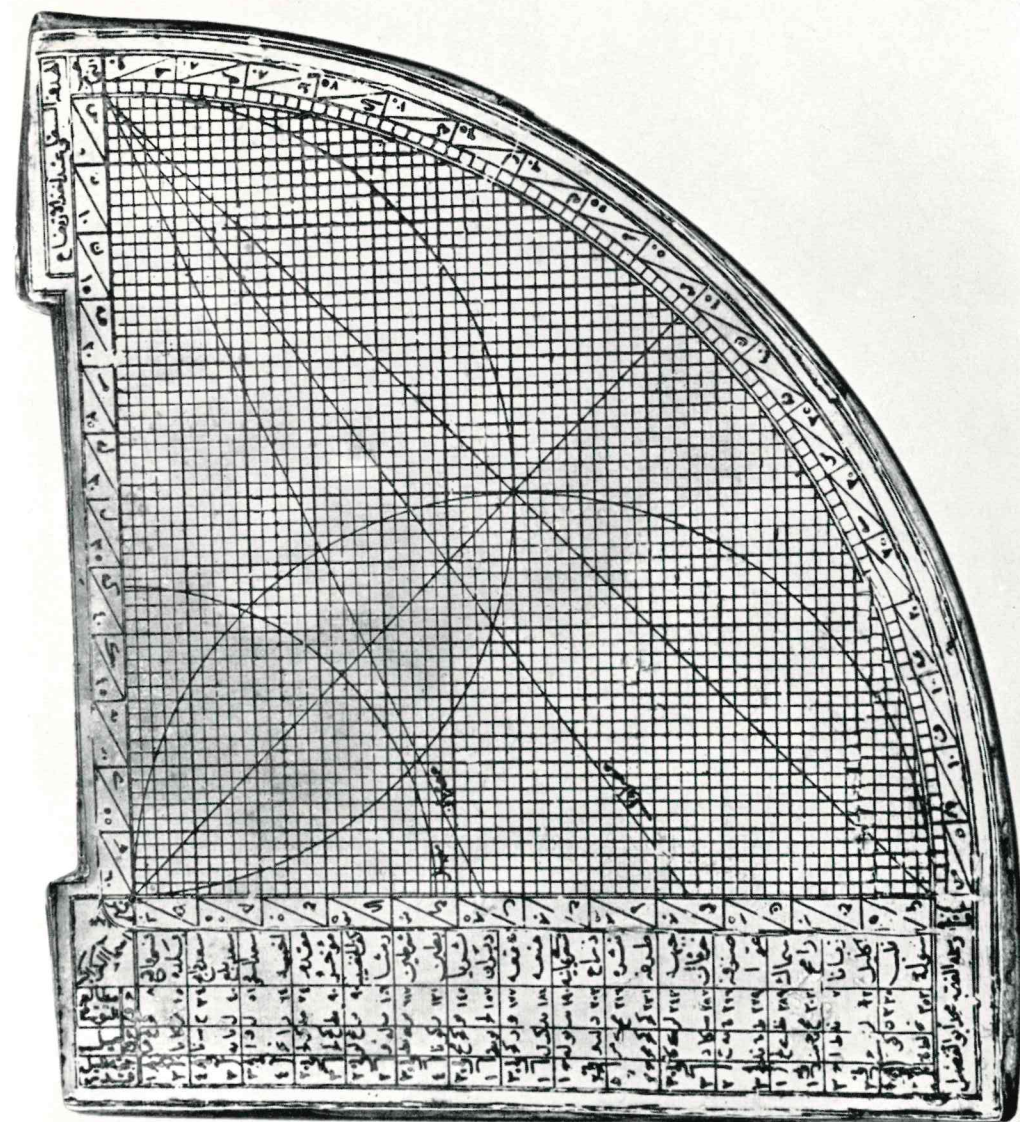


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