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*Vertical Sundial
from the Madrasa of Al-Ashraf Inal (no. 158)
on Cairo Northern Necropolis*

It is certainly not our intention to enter here neither into lengthy speculations on the certainly most fascinating world of scientific (astronomical and algebraic) study of complex aspects of mamluk time reckoning, nor into precise theoretical questions of sundials theory and their functioning, nor into practical-technical aspects of their designing – all these matters obviously falling out of our competence. Such an approach implies good acquaintance with higher mathematics and advanced astronomical calculations, what is certainly not our case. But, what is even more – all these questions have already been very well, extensively, and not only once, studied and resumed by the true authorities in the field.¹

The scholarly fundamentals of sundials theory, i.e. conceiving, designing, drawing and the best setting of sundials, are a large branch of specific knowledge, requiring wide acquaintance with many fields of science. Therefore, our intention here is by far a modest one: we will not aim for any explanation of how these instruments were working, while trying instead to concentrate on the most accurate we can afford presentation of the one of very few preserved cairene instruments of this kind – as it was drawn and installed in its very precise material, architectural, urban, historical and social context. Furthermore we would wish also to detect the reasons and to follow the possible consequences of installing of this ingenious device in this very place, and in a very specific social milieu inhabiting the neighbourhood.

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The decision to publish our own drawing of the sundial from the Al-Ashraf Inal madrasa (we have had the pleasure to document it in 1999)² with some words of commentary was prompted by a phrase we did come across in David A. King's monumental opus *In Synchrony with the Heavens, Studies in Astronomical Timekeeping and Instrumentation in Medieval Times*.³ Namely, its author states there that our knowledge of all Middle Ages

¹ For general references cf.: <http://en.wikipedia.org/wiki/Sundial> and, in particular: K. SCHOY, Beiträge zur arabisch-islamischen Mathematik und Astronomie, Frankfurt 1988 (being a reprint of: ID., Gnomonik der Araber, [in:] E. v. Bbassernabb-Jordan (Ed.), Die Geschichte der Zeitmessung und der Uhren 1F, Berlin-Leipzig 1923, and ID., Sonnenuhren der Spätarabischen Astronomen, *Isis* VI, 1924, pp. 332–360); J.L. BERGGREN, Sundials in Medieval Islamic Science and Civilisation, *The Compendium* 8/2, 2001, pp. 8–14; D.A. KING, s.v. Miqat, EI² VII, 115f; ID., Astronomy and Islamic Society, Qibla, gnomonics and timekeeping, [in:] R. Rashed (Ed.), Encyclopedia of the History of Arabic Science I. Astronomy – Theoretical and Applied, London-New York 1996 [= HistArSc I], pp. 128–184, in particular pp. 157–184 (Polish translation by K. PACHNIAK: Astronomia w społeczeństwie muzułmańskim: Qibla, gnomonika, miqat, [in:] Historia nauki arabskiej I, Astronomia teoretyczna i stosowana, Warszawa 2002 [= HistNaukiAr I], pp. 167–208). For further works of this author see below, nn. 3–4.

² Cf. J. KANIA, Cairo. Funerary Complex of Amir Kabir Qurqumas. Restoration Project Progress Report 1999, *PAM* XI (Reports 1999), 2000, pp. 82–88.

³ Cf. D.A. KING, *In Synchrony with the Heavens, Studies in Astronomical Timekeeping and Instrumentation in Medieval*, Vol. I: The Call of the Muezzin (Studies I–IX), Vol. II: Instruments of Mass Calculation (Studies X–XVIII), Boston-Leiden 1996–2002 [= *In Synchrony* I and II]. These *in-folios* are mostly re-editions of D.A. King's works printed often in publications of difficult access. It seems therefore useful to summarize here their contents:

– the volume I of 'In Synchrony' contains: I. A survey of tables for timekeeping by the sun and stars; II. A survey of tables for regulating the times of prayer; III. A survey of arithmetical shadow-schemes for

Muslim time-keeping instruments is by now nearly satisfactory, embracing all aspects of this branch of medieval science.

Although this opinion – when speaking of manuscripts and movable instruments of time calculation – is fundamentally (and in great measure thanks to the works of D.A. King himself)⁴ true, it certainly does not reflect the particular case of poor, indeed, state of publication of cairene sundials. The truth is that the due corpus of these important (so it seems to us) instruments is always failing, and the otherwise most valuable

time-reckoning; IV. On the times of prayer in Islam; V. On the role of the muezzin and the muwaqqit in medieval Islamic societies; VIa. Universal solutions in Islamic astronomy; VIb. Universal solutions from Mamluk Syria and Egypt; VIIa. On the orientation of medieval Islamic architecture and cities; VIIb. Architecture and astronomy: The ventilators of medieval Cairo and their secrets; VIIc. Safavid world-maps centred on Mecca; VIII. Aspects of practical astronomy in mosques and monasteries; IX. When the night sky over Qandahar was lit only by stars...

– and in the volume II one finds: X. Astronomical instrumentation in the Islamic world; XI. An approximate formula for timekeeping (750–1900); XIIa. On the universal horary quadrant for timekeeping by the sun; XIIb. On universal horary dials for timekeeping by the sun and stars; XIII. Selected early Islamic astrolabes; XIIIa. The neglected astrolabe – A supplement to the standard literature on the favourite astronomical instrument of the Middle Ages; XIIIb. The oldest astrolabe in the world, from 8th-century Baghdad; XIIIc. Astrolabes from late-9th- and 10th-century Baghdad; XIId. A medieval Italian testimonial to a forgotten Islamic tradition of non-standard astrolabes; XIIE. The origin of the astrolabe according to medieval Islamic sources; XIV. Selected late Islamic astrolabes; XIVa. An astrolabe made by the Yemeni Sultan al-Ashraf; XIVb. Some astronomical instruments from medieval Syria; XIVc. A monumental astrolabe from 13th-century Damascus; XIVd. An astrolabe for the Sultan Ulugh Beg; XIVe. Two astrolabes for the Ottoman Sultan Bayazid II; XIVf. Brief remarks on astronomical instruments from Muslim India; XIVg. A universal astrolabe from 17th-century Lahore; XV. An astrolabe from medieval Spain with inscriptions in Hebrew, Arabic and Latin; XVI. The geographical data on early medieval Islamic instruments; XVII. The quatrefoil as decoration on astrolabe retes; XVIII. A checklist of Islamic astronomical instruments to c. 1500, ordered chronologically by region.

⁴ To the monumental opus quoted above, n. 2, two volumes of D.A. King's astronomic studies must be added here, and these are:

– D.A. KING, *Astronomy in the service of Islam*, [London] 1993, containing:

General Survey: Science in the service of religion: the case of Islam; Lunar Crescent Visibility and the Regulation of the Islamic Calendar: Some early Islamic tables for determining lunar crescent visibility; Ibn Yunus on lunar crescent visibility; Lunar crescent visibility predictions in medieval Islamic ephemerides; Astronomical Timekeeping and the Regulation of the Times of Islamic Prayer. Mikat: astronomical timekeeping; Universal solutions in Islamic astronomy; Universal solutions to problems of spherical astronomy from Mamluk Egypt and Syria; Miqias; The Sacred Direction in Islam: Kibla – sacred direction; Makka as the centre of the world; Matla': astronomical rising-points; On the orientation of the Ka'ba; Astronomical alignments in medieval Islamic religious architecture; The earliest Islamic mathematical methods and tables for finding the direction of Mecca, and:

– Id., *Islamic Astronomy and Geography, Variorum Collected Studies*, [London] 2012:

Pt I. General: Islamic astronomy. From inscriptions to context: some Islamic astronomical instruments and their secrets; Some illustrations in Islamic scientific manuscripts and their secrets. Pt II. Regional Studies: Aspects of Fatimid astronomy: from hard-core mathematical astronomy to architectural orientations in Cairo; Mamluk astronomy and the institution of the muwaqqit; On the history of astronomy in the medieval Maghrib. Pt III. Mathematical Astrology: A Hellenistic astrological table deemed worthy of being penned in gold ink: the Arabic tradition of Vettius Valens' auxiliary function for finding the length of life. Pt IV. Sacred Geography and the Sacred Direction: The sacred geography of Islam; Al-Bazdawi on the qibla in early Islamic Transoxania. Pt V. Mathematical Geography: Too many cooks...: a new account of the earliest Islamic geodetic measurements; A world map in the tradition of al-Biruni (c.1040) and al-Khazini (c.1120) presented by Siraj al-Din al-Sajawandi (1210); Mathematical geography in 15th-century Egypt: an episode in the decline of Islamic science.

remarks on them, disseminated all through the more general and obviously already elderly (although still well defending themselves and much in vigour) works on cairene mamluk inscriptions by August Ferdinand Mehren⁵ and Max van Berchem, remain far from satisfying.⁶

The best proof of this poor state of things is that myself, when ‘strolling through the Old Cairo’, and paying only a bit more than usually attention to the monuments’ facades, I did come across at least three more samples of these instruments – and these were:

- a sundial above the entrance to the mosque of the Amir Shaykhu al-Nasiri (no. 147; AH 750 / AD 1349), opposite his khanqah (no. 152; AH 759 / AD 1357) at Sharia Saliba;⁷
- a sundial to the left of the entrance to the madrasa of Al-Ashraf Barsbay (no. 175; AH 826–7 / AD 1423–4) on the southwest corner of the intercrossing of Muizz li’-d-Din and al-Muski streets – that until most recently was covered by ‘temporary’ booths of perfumes’ tradesmen,⁸ and finally:
- a modern (early eighties of the twentieth century) sundial installed at the base of Burg al-Wustani (‘Middle Tower’; sixteenth century), situated at the south-west corner of the Northern Enclosure of the Cairo Citadel.⁹

Of these, only the last one can be fully admired from the close distance. The other two – both rather small in size and installed high above the present street levels – remain too far from the observer to allow their detailed study or any decent documentation with usual photographic means. One feels excused then for not being able to attribute here any date to these instruments: although they seem ‘very mamluk’ in appearance, they must not absolutely be (and are probably not) contemporaneous to the buildings themselves – the erection date of these supplying us with *terminus post quem* only.¹⁰

⁵ A.F. MEHREN, *Cahirah Og Kerafat, Historiske Studier under et Ophold I-II. Aegypten 1867–68*, (n.p., n.d., reprinted Beyrouth[?] 2011), Notes II, pp. 7, 140, 179, Pl. V (no. 3) and no. 404.

⁶ M. v. BERCHEM, *Matériaux pour un Corpus Inscriptionum Arabicarum, Première partie: Égypte/Le Caire, MMAF XIX/3–4*, Le Caire 1900 and 1903 (reprinted Beyrouth 1979) [= MatCIAA], pp. 406–408 (no. 279).

⁷ R.B. PARKER, R. SABIN (revised and enlarged by C. WILLIAMS), *Islamic monuments in Cairo. A Practical Guide*, Cairo 1985 [= IMCGuide³], pp. 71–74 = C. WILLIAMS, *Islamic monuments in Cairo. The Practical Guide*, Cairo 2002 [= IMCGuide⁵], pp. 54–57; and recently: D. BEHRENS-ABOUSEIF, *Islamic architecture in Cairo. An Introduction*, Leiden 1989-Cairo 1990 [= IslArchCairo], pp. 116–119; EAD., *Cairo of the Mamluks. A History of the Architecture and Its Culture*, London-Cairo 2007 [= Cairo of the Mamluks], pp. 191–195. N. WARNER, *The Monuments of Historical Cairo. A Map and Descriptive Catalogue*, Cairo-New York 2005 [= MonHistCairo], pp. 115f., Pl. 23, and: AUCTORES VARI, *Principles of Architectural Design and Urban Planning During Different Islamic Eras. Analytical Study of Cairo City*, Jeddah-Cairo 1992 [= Principles], pp. 111–116.

⁸ PARKER, SABIN, WILLIAMS, IMCGuide³, pp. 191f. = WILLIAMS, IMCGuide⁵, p. 161; BEHRENS-ABOUSEIF, IslArchCairo, pp. 116–119; EAD., *Cairo of the Mamluks*, pp. 251f., esp. Fig. 147; WARNER, MonHistCairo, pp. 118, Pl. 19, and AUCTORES VARI, Principles, pp. 190–195. For our comments upon this particular sundial, see below, p. 475, n. 59.

⁹ W. LYSTER, *The Citadel of Cairo. A History and Guide*, Cairo 1998, pp. 44, 46, 74, 82, 90.

¹⁰ All features of these mizwalas (including the ‘Inal’s’ one) seemingly expose a certain (so to say) ‘severity of style’, thus visibly differing themselves from the obviously much more elaborated forms of the ottoman sundials, cf. G. FERRARI, *The Ottoman Sundials in Aiello del Friuli*, *The Compendium* 17/3, 2010, pp. 31–36.

In such conditions it remains only to hope, that the long awaited *Corpus of Cairene Inscriptions*, prepared by Bernard O’Kane’s team under auspices of the Supreme Council of Antiquities (now the Ministry of State for Antiquities) of Egypt and American University in Cairo,¹¹ will soon improve this situation.

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But before we dare into the main topic of the article, it seems to us that at least few words of indispensable introduction must still be said here – in a hope that, as general as they are, they will prove sufficient for the purpose of this paper.

It is not astonishing at all that in the Muslim society – penetrated throughout with the need of exact observance of prayers five times a day, which has taken a lawful and actual until nowadays form already in the eighth century¹² – every instrument allowing to meet this necessity was of the good welcome. And this for quite a good reason: while it is quite easy for everyone to recognize the sun-down (*maghrib* – being the beginning of Islamic day), sun-rise (*fajr* – daybreak), and noon/zenith (*duhr/zuhr* – after which the shadows starts to increase)¹³ – finding out of exact mid-points between them, i.e. *asr* (afternoon), and *isha* (nightfall) is truly much more delicate and complicated matter. It requires advanced knowledge in higher mathematics and astronomy – what has given birth to the whole branch of science, called *ilm al-miqat*.¹⁴ This explains well the popularity of prayers’ time-tables, massively (if not almost obsessively) composed for every locality of any importance, and the interest of Muslim scholars in developing all kinds of appropriate time-measuring instruments.¹⁵

The sundials were (and are) designed and installed according to the principles established on a basis of advanced astronomical observations and higher mathematics calculations, and put into special pre-prepared tables and/or diagrams – according to the same, universally recognized schemes all over the world. In the Islamic countries this practice is well attested,¹⁶ reaching the very early times, and bringing in many aspects the evidence of the direct descendency of Islamic gnomonic science from achievements of the classical

¹¹ Dr. Bernard O’Kane (AUC) personal communication.

¹² The Prophet Muhammad himself is said to have prayed even seven times a day, adding to the prayers mentioned above *salatu al-ishraq* (when the sun has well risen) and *salatu al-duha/zuha* (c. one hour before mid-day), sometimes observed also by some most pious Muslims. However, in general, most of the Islamic theological authorities agree that any attempt to keep step with the Prophet in any field (and the more so – in His piety and zeal) is a manifestation of human vanity and imperfection, despicable for every true Muslim, and worth only a disapproval, if not an open damnation, cf. T.P. HUGHES, *Dictionary of Islam*, being a Cyclopaedia of the Doctrines, Rites, Ceremonies and Customs, together with the Technical and Theological Terms of the Muhammadan Religion, London 1885 (reprinted Delhi 1998), 400–407 (s.v. Muhammadanism) and 464–471 (s.v. Prayer).

¹³ It is possibly the main reason why some people claim that only these prayers are obligatory ones.

¹⁴ Cf. *supra*, n. 1.

¹⁵ Cf. *supra*, nn. 1, 3, and 4.

¹⁶ Cf. *supra*, nn. 3–4.

antiquity.¹⁷ In classical speech the sundial bears the well historically rooted name of *mizwala*, often replaced in nowadays speech with a more descriptive designation – *saa shamsiya*.¹⁸

SUNDIAL DESCRIPTION

The *mizwala*, i.e. sundial being object of this paper comes from the funerary complex of the sultan Al-Ashraf Inal (no. 158; AH 855–860 / AD 1451–1456), situated on the western slope of the hills of Muqattam in the so-called Northern Cairo Necropolis (Qarafat al-Mawt or Qarafat al-Ghafir), immediately off the actual Salah Salem road (by Kubri al-Misrah) in the al-Darrasa quarter.¹⁹

This *mizwala* is placed almost right on the middle axis on the ‘southern’ (in fact south-eastern)²⁰ wall of the sultan’s madrasa (or, to be more exact, of the madrasa’s extensions embodied in its corpse from this side).²¹ The wall dominates the huge court situated to the south of the building and, running in parallel to the qibla axis of the madrasa, it deviates by *c.* 40° (degrees) from the true astronomic cardinal east-west direction, thus remaining well exposed to the sunlight during most of the day. The *mizwala* itself is situated at the height of *c.* 6m above the foundation bench of the madrasa walls, corresponding with the actual ground of the mentioned court, extending itself on this side of the building.²²

However high its placement remains, it is still well visible (although not well ‘readable’) from the court aground. It could also be perceived from the neighbouring complexes, but – what may seem rather astonishing – not from the main road of the necropolis, running

¹⁷ For the brief summary of ancient science of gnomonics and literature, cf. S.L. GIBBS, *Greek and Roman Sundials*, New Haven, Conn. 1976, *pass.* For its application in Islamic lands, cf. E.S. KENNEDY, *The Exhaustive Treatise on Shadows I (Transl.)–II (Comm.)*, Aleppo [1976], *passim*.

¹⁸ In medieval times horizontal sundials were usually referred to as *rukhana* (lit. ‘marble’) or *basila* (lit. ‘flat’), while vertical ones – were called *munharifa* (i.e. ‘inclined’), cf. D.A. KING, *s.v.* *Mizwala*, EI² VII, 210–211, Pls XVI–XIX.

¹⁹ PARKER, SABIN, WILLIAMS, *IMCGuide*³, pp. 71–74 = WILLIAMS, *IMCGuide*⁵, pp. 208f.; AUCTORES VARI, *PrincArchDes*, pp. 202–207, and, in particular: BEHRENS-ABOUSEIF, *IslArchCairo*, pp. 143f.; EAD., *Cairo of the Mamluks*, pp. 267–272.

²⁰ As always in Cairo this designation must be considered as a convention, adopted only for the sake of easier understanding. This is the result of religious requirements, claiming the orientation of the mihrab towards Mekka – what causes that in cairene cultic buildings their axes – and hence their orientation – deviates considerably from the true astronomic directions. For Cairo this deviation varies from some 30° (when using the oldest ‘Companions of the Messenger calculation’), through some 40–42° (according to the medieval, so-called astronomical calculation), up to 45–47° (‘present day’ calculation), cf. King, literature quoted *supra*, nn. 3 and 4.

²¹ Cf. *infra*, **Fig. 3:A** on p. 473.

²² This does not change the statement of M. v. Berchem, who situated it at a height of 3m above the level of the entrance to the mosque, the place having considerably changed since his visits in the nineteenth century. In particular, the excavations and clearing works carried on the Al-Ashraf Inal complex by the Comité de Conservation de l’Art Arabe and the Supreme Council of Antiquities of Egypt (with participation of the Polish Centre of Mediterranean Archaeology in Cairo in the years 1972/6 and 2001) made it clear that the platform with the side entrance to the Inal’s madrasa (taken by van Berchem as reference point) is in fact situated well above the original court level, being acceded from this court by a staircase of more than 2m of height, actually.

along the eastern facades of this and other neighbouring foundations.²³ And, although some parts of its shield have fallen ever since out and are missing now, the overall aspect and internal subdivisions of the mizwala can be read and restored almost entirely (**Figs 1–2**), leaving no doubt that this sundial belongs to the category of vertical ones, bearing in Arabic a specific name *munharifa* – i.e. ‘inclined one’ – considered particularly effective to find out the *duha*, *zuhr* and *asr* times, corresponding to the third, sixth and ninth seasonal hours of daylight.²⁴

And so, our mizwala once have been bordered with two vertical iron bars (Ar. *antabas*), well anchored into the wall ashlar, of which only the left one still remains *in situ*, being c. 5cm wide and c. 1.04m long. It starts some 20cm above the upper sundial frame and ends (some 12cm) above its lower frame, slightly covering the inscribed left margin of the sundial. The incurved ends of the bar are anchored deep into the wall surface, and stabilized there with two large wooden dowels, inserted into the ashlar’s bodies, more or less in their middles. At equal intervals (just above joints between the subsequent layers of ashlar) the bar is additionally clued to the wall with large nails. Both the bar and needles are of hammersmith work. The other bar, once placed on the right side of the sundial is missing now, its only trace being rectangular holes in the ashlar figuring at the same heights as the left bar ends (**Fig. 1**).

One can not find any satisfying explanation for presence of these bars in this very place, but one thing is certain – they were not an original part of our mizwala installation.²⁵ Some say that they could be intended as anchors, applied there to strengthen and stabilize the madrasa’s huge wall, and thus should be installed here during the restoration works of the Comité de Conservation de l’Art Arabe, carried on the Inal’s madrasa at the turn of the nineteenth century.²⁶

²³ Cf. *infra*, pp. 471ff. and **Fig. 3** on p. 473.

²⁴ For explanation of function of these instruments, instead of our uncertain and lengthy divulgations see this masterly summary on relation of times of prayers and vertical gnomons’ running order by D.A. King, perfectly well fitting our purpose here: ... *the permitted time for the zuhr usually begins when the sun has crossed the meridian, i.e. when the shadow of any object has been observed to increase. In medieval Andalusian and Maghribi practice, it began when the shadow of any vertical gnomon has increased over its midday minimum by one-quarter of the length of the object. The interval for the ‘asr begins when the shadow equals the length of the gnomon and ends either when the shadow increase is twice the length of the gnomon or at sunset. In some circles, an additional prayer, the duha was performed at the same time before midday as the ‘asr was performed before midday...* (KING, [in:] *EncHisArSc*, pp. 170–173 = ID., [in:] *HistNaukiAr*, pp. 198–200).

For the theoretical scheme of vertical sundials’ installations cf. KING, [in:] *EncHisArSc*, Fig. 4.13 and pp. 167f. = ID., [in:] *HistNaukiAr*, Rys.13 and pp. 196f., and also: <http://en.wikipedia.org/wiki/Sundial>, s.v. vertical sundials.

²⁵ The proof is brought here by the fact that the preserved *antaba* slightly covers the left frame of the sundial drawing. It was suggested, however, that the bars might have served as rails for a movable gnomon. But this theory has neither any funding at all, since 1° – such a device is – on technical grounds – not necessary in the vertical sundials of the kind represented here, and 2° – we do not know any preserved example of such a solution so far.

²⁶ But: 1° – we could not spot any trace of such an intervention in the CCAA reports on these works, however, cf. *Bulletin du Comité de Conservation des Monuments de l’Art Arabe*, Le Caire: 171° Rapport 1894, pp. 105, 112; 179° Rapport 1895, pp. 20f.; 182° Rapport 1895, pp. 32f.; 191° Rapport 1895, pp. 94f.; 245° Rapport 1898,



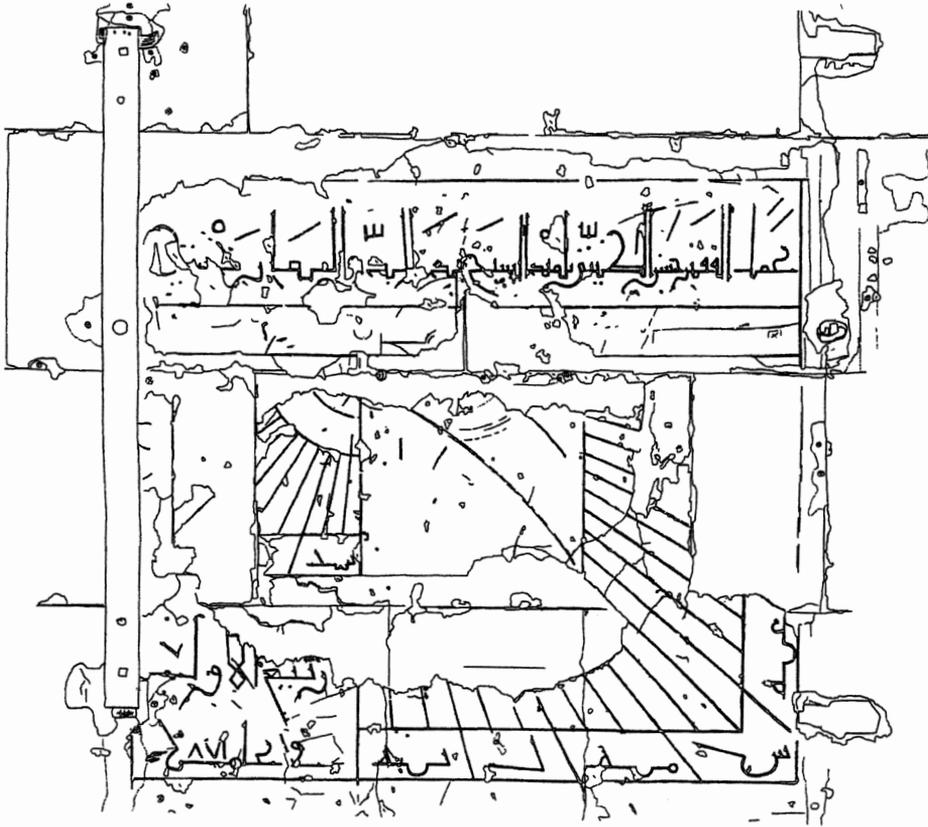
1. Mizwala on the sultan Al-Ashraf Inal madrasa (no. 163) on the 'North' Cairo necropolis (Phot. W. Jerke, 1999).

The shield of the mizwala itself was carefully designed on a surface of hard, but rather large grain mortar, smeared around in a thin layer (*c.* 3mm) on a surface of *c.* 1m², upon three layers of ashlar (each being *c.* 35cm high) of the madrasa wall. The slightly ragged edges of all the design lines suggest that they were drawn when the plaster was only half dried up. Although some parts of mortar around edges of the central ashlar have come off and are missing now, the overall aspect and internal subdivisions of the sundial can be read and restored almost *in toto*. The shield has an overall form of a rectangle, measuring 1.05m in width by 0.97m in height.²⁷

p. 134; 282^e Rapport 1901, p. 46, and 2^o – positioning of these bars in this very place has no static meaning, neither was followed by any other reinforcing installation on the other side of the wall, in the building interior.

Is it possible then, that these bars were supports of some glass frame, intended to protect the sundial(?). But even if such a project has once been devised (and then abandoned), it left no trace in the above quoted CCAA reports, either. And finally: it seems rather doubtful whether the CCAA would agree to apply any technical prop intruding the field of this unusual inscribed object.

²⁷ It seems not entirely void of interest to notice in this place that the dimensions of the other sundials we could identify in the beginnings of this article are noticeably (*c.* 1/3) smaller in size. See above, p. 462, and below, p. 475, n. 60.



2. Mizwala's drawing (Drawing: M.G. Witkowski, 1999).

In the upper rectangular field of the mizwala, extending on the whole width of the frame, the following inscription in elegant 'astronomic kufi' script²⁸ reads:

عمل الفقير حسن الطيبي (?) تلمذ الشيخ بدر الدين المارديني

Work of 'poor' Hassan al-Tayybi, pupil of the sheikh Badr al-Din al-Mar[i]dini.

This inscription is followed by another low rectangular empty field with a little hole reaching deep into the ashlar. Most probably it was originally housing an appropriately formed and inclined bronze or copper gnomon (*shak[i]s* or *mikyās*), now missing.²⁹ This gnomon must have had a simple form of an appropriately bent and/or inclined bar – since not a single trace of any other element – sometimes supporting gnomons – was found.³⁰

²⁸ v. BERCHEM, *MatCIA*, pp. 406f. (no. 279); also J. SOURDEL-THOMINE, A. ALPARSLAN, s.v. *Khatt*, *EI² IV*, 1113–1128, and S. BLAIR, *Islamic inscriptions*, Edinburgh 1998 [= *IslInscr.*], *passim*.

²⁹ This element made of highly valued material obviously did not survive the period of the complex spoiling of the site. It has most probably disappeared during the long period of abandon of the complex in the nineteenth century, exposing it to the more or less systematic robbery, cf. H. DE VAUJANY, *Le Caire et ses environs. Caractères, moeurs, coutumes des Égyptiens modernes*, Paris 1883, pp. 261–263 and above, n. 25.

³⁰ It is to presume that such supports were even never intended to be installed here, since their shadows could only obstruct the reading of the gnomon's position on the shield of the sundial.

Below extends the main part of the mizwala, composed of three more or less square fields. The central field of the composition has but two parallel incurved lines; while the left and the right ones are internally subdivided with lines that seem to radiate from the point of already mentioned gnomon hole.

In the left case, at the end of the first bunch of the first four radii, that are starting here from two upcurved lines, one can still see traces of the word: ٤ [?] ٤. The other cases surrounding this part of the sundial composition are missing, due to the plaster come off.

On a narrow margin framing the composition on the right side and on the dial's bottom, in small fields separated by extension of every fourth radiating line, following groups of letters can be read:³¹

- on the right margin (starting from the top): 1) [- -]; 2) [- -]; 3) عيه (or عید), followed
- on the lower margin (from the right lower corner) with: 4) س (or سی); 5) مبه (or مدد); 6) ل (or لی), and 7) نيه (or نید).

Finally, the left lower corner of the shield is occupied by still another rectangular field bearing another short inscription in two lines:

٨٧١ عام في الأول (2) ربيع الأول (1) – i.e. (1) *Rabi' I* (2) *of the year 871* [AH].

COMMENTARY

Date: it is worth to expose in this place that the year date of installation of the sundial placed on the sultan Inal madrasa is given in numbers, and not put – as it was in use in before ottoman times – in words or (sporadically) in alphanumeric ‘*abiad system*’.³² This makes our inscription exceptional, and the more so that the date given, namely Rabi I, year AH 871, i.e. 11.10.–09.11.1466 AD,³³ is well anterior to the ottoman annexation of Egypt.

One can not exclude, however, that – being given singular character of mizwalas – they were not forcibly and strictly subdued to all rules of Arabic epigraphy.³⁴ Unfortunately, until better recognition of this very specific group of epigraphic monuments, our curiosity will probably remain not satisfied for a while. On the other hand this particular feature does not seem an argument strong enough to suggest the possibility of Turkish origin of this sundial designer, neither. But instead, the necessity to install this mizwala some 5 years after the death of the funerary complex owner proves that his temenos was at this time still ‘well alive’ and functioning normally.

³¹ These words are, most probably, the usual astronomical designations of subsequent hours of the day, inscribed however in abbreviated forms and without any diacritical signs over the letters – what makes their lecture equivocal, unabling us (due to lack of analogies) to propose any consistent translation. Both words in the cases 1 and 2 are missing now, due to the plaster come-off.

³² I.e. composition of letters of numeric value, cf. BLAIR, *IslInscr.*, pp. 25, 41, 49, 154f., 203, and, in particular, pp. 217–222.

³³ Year AH 871 = 13.08.1466–01.08.1467 AD, cf. G.S.P. FREEMANTLE-GRENVILLE, *The Islamic and Christian Calendars AD 622–2222 (AH 1–1650)*, Reading 1977, p. 47.

³⁴ Cf., in particular, v. BERCHEM, *MatCIA*, pp. 406f. (no. 279) and BLAIR, *IslInscr.*, *passim*.

Sibt al-Mār[i]dīnī is a *nisba* of Badr al-Dīn Muhammad ibn Muhammad ibn Ahmad ibn Muhammad ibn al-Ġazal (AD 1423–1506),³⁵ famous mathematician and astronomer and a long time *muwaqqit* (‘timekeeper’, i.e. person responsible for exactness of regulation of the astronomically-defined times of Muslim prayers) at the Al-Azhar Mosque and University in Cairo.

Coming from the old family of scholars,³⁶ he acquired a wide fame already during his lifetime. According to contemporary sources, he was a recognized authority in many fields and author of an impressive number of works on arithmetic and algebra, division of inheritances, and astronomy. The list of his known works (including several commentaries on earlier works) counts today at least 31 different titles, preserved in numerous manuscripts. As *muwaqqit* at the Al-Azhar he compiled astronomical tables for the latitude of Cairo, drawing his particular attention also to the study of astronomical instruments for the time calculation.³⁷ In his *Small treatise on the calculation of tables for the construction of inclined sundials* (*Risala latifa fi hisāb al-jadawil lil-dakijat lil-ban^{ca} al-mazawil šamsija al-ma^cila*)³⁸ and *Tables for marking vertical sundials on the walls* (*Jādawil fī rasm al-munharifat ^cala l-haytan*)³⁹ he describes the mathematical calculations implied in the construction of a sundials, tackling in particular the practical problems of calculation of the correct inclination of sundials and their proper setting on the walls of the buildings.

Hassan al-Tayyibi: so far, concerning this man we know virtually nothing, except that – relying only on his own words written down in our sundial legend that – he was a ‘pupil of the great al-Maridini’. Although such ‘affiliation’ may be presumed purely fictive, and invented only to increase the authority and competence of Hassan al-Tayyibi by himself, it seems that the date of creation of the sundial contraries at its own such a presumption. Namely, the date clearly proves that the work was completed by Hassan al-Tayyibi when Sibt al-Maridini was at the peak of his professional career and certainly would not allow anyone to abuse of his name, nor would tolerate any impostor acting in his

³⁵ Cf. M. PLESSNER, J. SAMSÓ, s.v. Mardini, *IE* VI, 542f.

³⁶ His grandfather was also a mathematician and astronomer, known also as Badr (or Shams) al-Din al-Dimashqī, cf. H. SUTER, *Die Mathematiker u. Astronomen der Araber u. Ihre Welt*, *Abh. z. Gesch. d. Mathematischen Wiss.* 10, Leipzig 1900 [= *Die Mathematiker*], no. 421; BROCKELMANN, *GAL* II/3 (*Der Niedergang der islamischen Literatur*, 1. Abschnitt: von der Mongolenherrschaft bis zur Eroberung Ägyptens durch Sultan Selim, 1. Kapitel: Ägypten und Syrien: 11. Die Astronomie), pp. 216–218 and Suppl. II, p. 218; and more recently: D.A. KING, *A Survey of the Scientific Manuscripts in the Egyptian National Library*, *ARCE Pbls* 5, Winona Lake, Ind. 1986 [= *A Survey*], C47 on pp. 66f.

³⁷ For the corpus of al-Maridini’s works see: SUTER, *Die Mathematiker*, no. 445 on pp. 182–184, and pp. 222 (n. 90a), 445; and ID. *Nachträge und Berichtigungen zu ‘Die Mathematiker u. Astronomen der Araber u. Ihre Welt’*, *Abh. z. Gesch. d. Mathematischen Wiss.* 14, Leipzig 1902 [= *Nachträge*], pp. 157–185 (repr. Amsterdam 1982), completed later on by H.J.P. RENAUD, *Additions et corrections à Suter, ‘Die Mathematiker u. Astronomen der Araber u. Ihre Welt’*, *Isis* 18, 1932, pp. 166–183) and KING, *A Survey*, C 97 on pp. 80–82. See also: BROCKELMAN, *GAL* II/3, pp. 216, 468 and Suppl. II, pp. 215–217, 484, and PLESSNER, SAMSÓ, s.v. Mardini, *IE* VI, 542f.

³⁸ MSS preserved now in the Mansuri Collection of the Library of Congress (USA).

³⁹ MSS preserved now in the Egyptian National Library, cf. KING, *A Survey*, pp. 80ff.

‘whereabouts’ – and in fact, the Al-Azhar lies at a distance of less than 2km from the Inal’s funerary complex.⁴⁰

In the light of the above one is allowed then to assume rather safely that the ‘affiliation’ alluded to by our Hassan al-Tayyibi is true and that he was, indeed, entitled to quote his master’s name in context of his own, most probably with personal approval of al-Maridini himself. If so, Hassan al-Tayyibi must have known the works and professional secrets of al-Maridini (or at least some of them)⁴¹ and was in fact bringing his master’s theories into life, applying them in everyday practice. Otherwise speaking: we are most probably allowed to recognize in his mizwala a good example of direct translation of high scholarly theories into the sphere of practical life and physical reality

The patronymous *laqab* al-Tayyibi, meaning: ‘[coming or the one] from Tayyibah’ does not help us neither in narrowing the possible origin of our Hassan, since – as van Berchem has already stated in his time – *there were several villages of this name, dispersed all over through the mamluk empire, both in Egypt and in Syria.*⁴² At the best it allows us then to recognize a rather modest status of our mizwala-designer and his ‘provincial’ – if not directly ‘rural’ – descent, without however allowing to narrow it further. The fact that, so far we could confirm van Berchem’s statement only for Syria does not mean automatically that our Hassan al-Tayyibi was forcibly a Syrian. It seems also too premature to scent in the use of numbers in date of the mizwala an indication suggesting his possible ‘turkish’ or ‘ottoman’ origin.⁴³

In this aspect, more informative proves the otherwise imprecise term *faqir^{am}*, our sundial designer used when introducing himself. As already stressed by van Berchem the term is to be understood here not in its first sense of ‘a poor one’, but in its symbolic and meta-physical meaning, that at the same time underlies the craftsman’s pride but also exposes his humility and nothingness of his own achievement – when confronted with the perfection of all God’s creations. Thus understood, the word *faqir^{am}* leads us the direct path to the sufi milieu, well anchored and flourishing on the ‘Northern Cairo Necropolis’ at least since the beginnings of the fifteenth century, in consequence of the decisions of the first Burgi Mamluk Sultans (Al-Zahir Barquq and his direct descendants).⁴⁴

It is naturally impossible to find out whether this word echoes the true feelings of the craftsman or is this only a mere ‘politically correct’ expression and otherwise void of any semantic meaning term, used here only to evoke the desired reaction of the public and to acquire its approval. But, whatsoever its true meaning or value was, it should be remembered that in the Islamic world the word *faqir^{am}* became a standard epitheton of even the most distinguished and prized artists and craftsmen.⁴⁵

⁴⁰ Cf. WARNER, *MonHisCairo*, plan on p. XVI, 58 and 251.

⁴¹ Cf. *supra*, nn. 35–39.

⁴² Cf. v. BERCHEM, *MatCIA*, pp. 404–407 (no. 279). For different localities of this name in Syria, cf. R. RUS-SAUD, *Topographie historique de la Syrie antique et médiévale*, Paris 1927, pp. 90ff., 178, 182ff., 251ff., 258ff., 266, 275, 370, 514. For Egypt so far we could not spot any locality bearing this name.

⁴³ Cf. *supra*, p. 468.

⁴⁴ Cf. H. HAMZA, *The Northern Cemetery of Cairo*, Cairo 2001, *pass.*, but especially pp. 46–53.

⁴⁵ E.g. it was used even by the great ottoman architect Sinan Pasha, truly a genius in the field of architecture, cf. G. NECİPOĞLU, *The Age of Sinan. Architectural Culture in the Ottoman Empire*, London 2005, pp. 127–152;

CONCLUSIONS: SUNDIAL IN SOCIAL CONTEXT

So, although the sundial of ‘the poor’ Hassan al-Tayyibi, pupil of the great Sibṭ al-Maridīnī, was installed in the funerary complex of Al-Ashraf Inal some five-six years after the death of the sultan, its appearance on the madrasa’s walls proves that by that time the whole funerary complex of this sultan was ‘still doing well’.⁴⁶ One is tempted to admit also (and there are no proofs of the contrary) that this installation may have remained in relation and could have something to do with the obviously literate sufis living in the Inal’s khanqahs,⁴⁷ forming an integral part of his mortuary precinct, as well as with the *maktaba* (‘library’),⁴⁸ installed in his funerary madrasa (NB. accessed through the nearby entrance, giving to the ‘South Court’ extending under the sundial). It seems to us rather an unexpected way – for somebody presumed illiterate⁴⁹ – to commemorate his person with installation of the primarily intellectual institutions as khanqahs and maktabas and forwarding the obviously intellectual milieu, indeed.⁵⁰

In the light of the above observations, taken together with the location of the sundial, one can hardly resist to the temptation to tie the person of its designer – ‘the poor’ Hassan al-Tayyibi – to the milieu of sufis living in the third quarter of the fifteenth century in the khanqahs of the Inal’s funerary precinct. As numerous graffiti left on the walls of these cells prove, at least some of them obviously were quite well educated men.⁵¹ Can we therefore admit that our ‘poor’ Hassan al-Tayyibi was one of them? And are we at all allowed to look for his roots in this milieu?

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It seems obvious that the sundial of Hassan al-Tayyibi installed on a wall of the sultan Al-Ashraf Inal madrasa was in first place intended for the use of the ‘personnel’ of this funerary complex. The high position on a wall and the large size make however this sundial well visible from quite a long distance around, well above the otherwise rather low roofs of surrounding buildings, although – what may seem rather astonishing at a first glance

also: S. FAROQHI, *Artisans of Empire: Crafts and Craftspeople Under the Ottomans*, London 2011, pp. 23–44, 65–86, and A. RAYMOND, *Artisans et commerçants du Caire au XVIII^e siècle*, Damas 1974¹ et Le Caire 1999², pp. 213–242, 373–416, 433–450, and, in particular 544–559.

⁴⁶ Cf. *supra*, p. 468.

⁴⁷ Until now one can see numerous ink graffiti written down – by obviously well trained hand(s) – on the walls of Inal khanqah’s cells. And these are not only the frequent and usual *basmalas*, but also quite numerous and lengthy texts of pious contents and ethic value (personal observation).

⁴⁸ This library is identified by an inscriptional tablet, hewn directly in stone framing of the door giving to the staircase, leading to the upper floor rooms, once situated on this side of the madrasa.

⁴⁹ The illiteracy of Al-Ashraf Inal has often been exposed, becoming even object of mockery, e.g. IBN IYAS, *Histoire des Sultans Mamlouks (872–906)*, traduction par G. Wiet, *TTAO* 6, Le Caire 1945, *pass.* – what does not change that in reality he was probably one of the most competent rulers of late mamluk period, cf. M.C. SEHABEDDIN, s.v. Al-Ashraf Inal, *EP* III, 1198f. See also the following note 50.

⁵⁰ L. REINFANDT, *Mamlukische Sultansstiftungen des 9./15. Jahrhunderts: Nach den Urkunden der Stifter al-Ashraf Inal und al-Mu’ayyad Ahmad Ibn Inal*, *IU* 257, Berlin 2003, *pass.* (n.v.).

⁵¹ Cf. *supra*, n. 47.

– not from the main necropolis road longing the ‘eastern’ facades of this and adjacent funerary structures.

Thus, it must have been also very well visible from the roof of the rab^c of the somewhat later Qurqumas’ funerary complex (no. 162; AH 911–913 / AD 1506–1507),⁵² almost contiguous from the south to that of Al-Ashraf Inal. And this very roof was used, according to the preserved *waqfiyya/hugga* of Qurqumas’ foundation,⁵³ for *the purpose of astronomic observations* (miqat).⁵⁴ It could be reached only by one, staircase, situated in the ‘northernmost’ unit of this building and especially adapted to suit well this purpose, to allow access both from the rab^c exterior, from the ground level, as well as from the building interior, from the ‘antechambers’ of the qa^a (i.e. living room), situated on the first floor of this unit (**Fig. 3:B**).

But there is even more: in this very unit, in the same ‘living room’ one finds still another feature that seems to confirm interest of the man inhabiting it in constant observation of the sundial installed on the madrasa of Al-Ashraf Inal. Namely, at a height of c. 1.5m in the qa^a itself, in its ‘northern’ wall, a narrow window was arranged – giving quite a good view on the ‘Inal’s mizwala’, just above roofs of the later architectural structures now separating both precincts. This window forms explicitly part of the original wall construction. It had the shape similar to the medieval shooting loop-holes: high (c. 80cm) and narrow (c. 12cm) at the building outside, it was widening within the wall thickness (up to c. 30cm) inside, once much destructed (**Fig. 3:C**), but restored now. It seems that the laying of

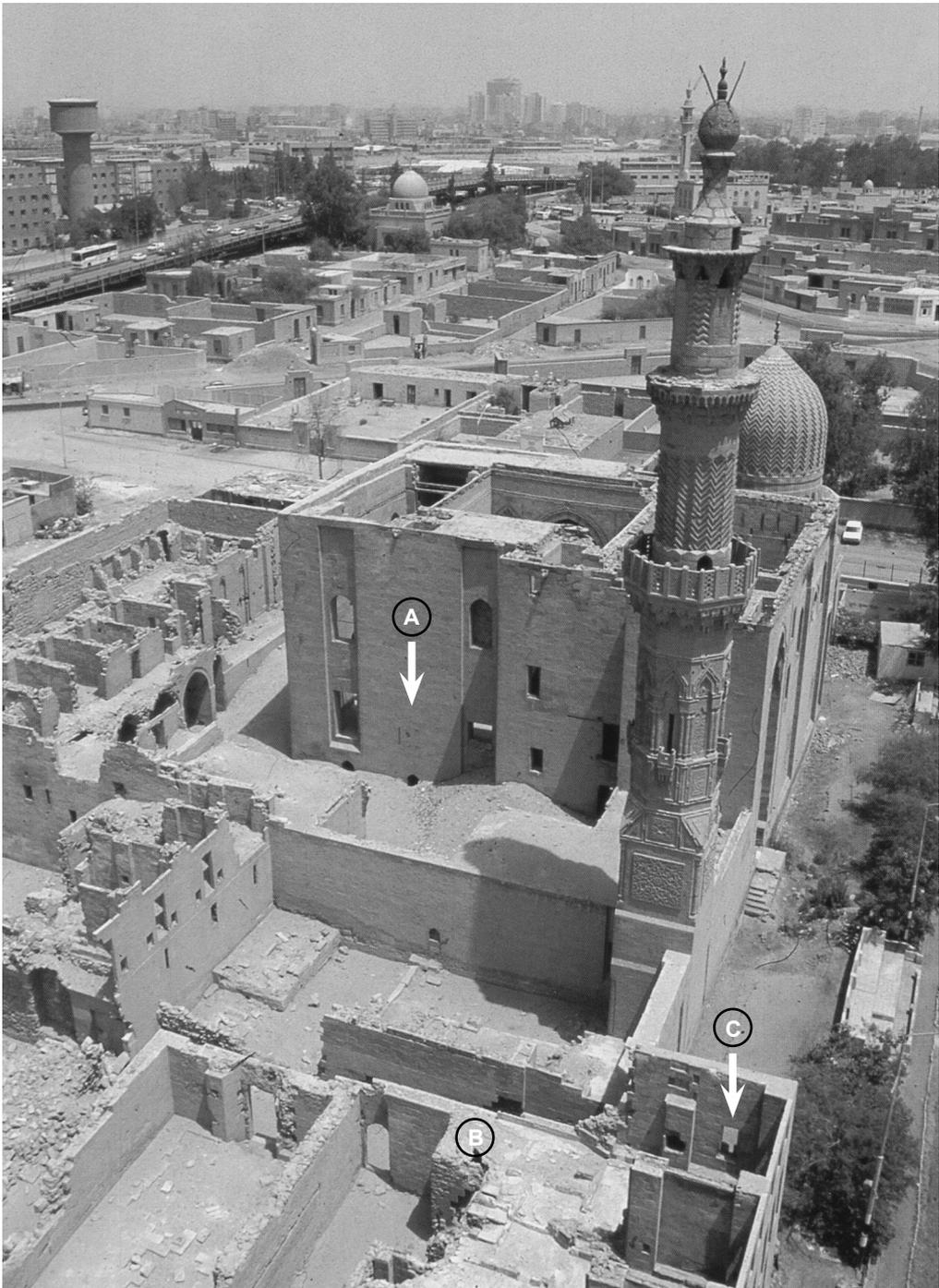
⁵² For general information on Amir Qurqumas complex cf. PARKER, SABIN, WILLIAMS, IMCGuide³, pp. 71–74 = WILLIAMS, IMCGuide⁵, pp. 209–211 and, most recently: BEHRENS-ABOUSEIF, IslArchCairo, pp. 154–157; EAD., Cairo of the Mamluks, pp. 306–312. Cf. also: AUCTORES VARI, PrincArchDes, pp. 230–235.

For detailed studies of this complex see: A. MISIOROWSKI, Mausoleum of Qurqumas in Cairo. An example of the architecture and building art of the Mamluk Period, Warsaw 1979, *pass.*; AUCTORES VARI, Mausoleum of Qurqumas in Cairo. Results of the investigations and conservation works, 2 and 3 (being a continuation of the precedent works), Warsaw 1985–1991, *pass.*; M. NAGIB, *Kitab al-Waqf* and monuments of Qurqumas, unpublished PhD thesis, in Arabic, Cairo University c. 1978, *pass.*; I. NIEDUZIAK, Polish-Egyptian restoration work at the burial complex of Amir Qurqumas, [*in.*] M. Meinecke (Ed.), *Islamic Cairo: Architectural Conservation and Urban Development of the Historic Centre: Proceedings of a Seminar Organised by the Goethe Institute* (October 1–5, 1978), *Art and Archaeology Research Papers* 6, June 1980, pp. 42–51; ID., La fondation “waqf” de l’émir Qurqumas au Caire, *EtudTrav* XIV, 1990, pp. 239–281; J. DOBROWOLSKI, The funerary complex of Amir Kabir Qurqumas in Cairo, [*in.*] U. Vermeulen, D. De Smet (Eds), *Egypt and Syria in the Fatimid, Ayyubid and Mamluk Eras II*, Proceedings of the 4th and 5th International Colloquium organized at the Katholieke Universiteit Leuven in May 1995 and 1996, *OLA* 83, Leuven 1998, pp. 265–282.

⁵³ Copy of the complete *kitab al-waqf* of Amir Qurqumas is preserved in the Ministry of Awqaf in Cairo under no. 901 [= *Waqfiyya 901*] and has been translated into Polish by J. Wronecka in 1977; cf. also M.M. AMIN, Catalogue des documents d’archives du Caire de 239/853 à 922/1516, *TAEI* 16, Le Caire 1981, p. 121.

The rab^c itself was composed of eight habitation units (erected as a suite of four adjacent ‘twin’ segments, conceived on mirror-like plans, with living spaces situated at the first floor level). According to the *waqfiyya/hugga* of Qurqumas foundation it served to locate sufis carrying for the cult service in the precinct – what means that in fact it played the role of khanqah – although in the foundation act itself it is always consequently called rab^c, cf. *Waqfiyya 901, passim*.

⁵⁴ Cf. *Waqfiyya 901*, pp. 71, 82. The ‘astronomic observations’ must naturally not be understood here for the true value of the word, being limited naturally to the basic observations of Sun, Moon and few stars/planets for practical religious purposes.



3. General view on the 'northern' part of the Qurqumas' rab^c, with the madrasa of Inal (no. 158) in the background: A – mizwala; B – 'antechambers' of the living unit on the first floor of the rab^c, with remains of a staircase leading to the roof; C – the narrow window in the 'northern' wall of the qa'a (Phot. M.G. Witkowski, 1996).

this window was not just a haphazard nor coincidence, but the result of well thought-out choice – to allow the inhabitant this unit of Qurqumas' rab^c a non-obstructed view on the 'Inal's mizwala', without need of going outdoors or climbing to the roof.

However small, these details must not be overlooked nor neglected. And indeed, the *waqfiyya/hugga* of the Qurqumas' foundation puts in explicit terms that the man occupying this unit was a kind of superior of other dwellers of the rab^c, responsible (between other charges named) for numerous tasks, including observance of the appropriate schedule of prayers in the Amir's complex, and for keeping them right on time.⁵⁵ In other terms it means that this window was obviously installed in its place deliberately, to facilitate duties of this man. Put in plain words, it was allowing him to follow, at any time, the progress of the gnomon's shadow on the shield of the facing mizwala, directly from his home interior and from the room where he mainly lived, saving him the necessity of frequent climbing to the roof to know the exact hour.

Naturally, one can object that this wall opening could also have been installed as a simple vent, allowing better air circulation in the unit only.⁵⁶ It could also, as well, have served still other purposes. In particular, it was offering also a good look not only on the 'east' entrance to the madrasa of Inal, but also on a gate of the zuqaq (i.e. kind of internal 'lane' allowing access to the buildings situated in the interior of the *insula*) extending below, between Qurqumas' and Inal's precincts, and leading to the funerary hawš of still another complex, identified as that of Amir Guirbaš Qašūq [al-Karimi], Great Admiral and father-in-law of Inal, situated 'behind' those of Qurqumas and Inal, towards the 'west' – thus allowing to keep an eye on everyone coming in or out through this passage. So, as we could see, it could well serve multiple practical purposes. And last, but probably not the least, the sun-ray penetrating through this narrow slot and wandering slowly through the room space, could also quite well inform its inhabitant (naturally only someone accustomed to the places, who knew how to 'read' its progress) of the approximate hour of the day, thus becoming itself – as primitive and virtual as it was – just another sundial.⁵⁷

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What was said above throws an interesting light also on two sundials mentioned above, at the beginning of this article,⁵⁸ namely those placed at the entrances to the funerary madrasa of Amir Shaikhu al-Nasiri (no. 147, AH 750 / AD 1349) at Sharia Saliba

⁵⁵ *Waqfiyya 901*, pp. 71, 82.

⁵⁶ This idea should probably be dismissed due to the position of this aperture next to the 'main' windows of the room. But beyond any doubt, almost identical apertures in the store-rooms on the rab^c's ground-floor were intended precisely for this purpose.

⁵⁷ The 'Inal's mizwala', important for the community of Qurqumas' funerary personnel as it was, was not the unique sundial in this(?) precinct. M. van Berchem could identify in the ruins of this(?) complex another sundial by the otherwise unknown 'Abd al-Qadir, son of Abu al-Tahir (or az-Zahir), undated (cf. v. BERCHEM, *MatCIA*, p. 593, no. 404), that has disappeared since. Our numerous and repeated trials to locate it in what is still preserved from Qurqumas' temenos and its surroundings have, however, proven ineffective so far.

⁵⁸ Cf. *supra*, p. 462.

and that of the sultan Al-Ashraf Barsbay in the al-Muski quarter (no. 175, AH 826–7 / AD 1423–4).⁵⁹ In the light of what we could observe above it seems that these sundials were placed deliberately high on the walls, and that it is not just a mere coincidence, but clearly the result of a very practical reasoning. Their high position, although making the ‘reading’ of mizwalas from the street level somehow difficult, assured instead the very best view on them from the first floor windows of the khanqahs situated across the street and inhabited by sufis.⁶⁰ Moreover, if it was so, this could also explain the relatively modest dimensions of these ‘city sundials’ when compared to the mizwala munharifa of ‘the poor’ Hassan al-Tayyibi from the Northern Necropolis of Cairo – this one being intended to be seen from much bigger distance than from the across the street only.⁶¹ But, however it was, all the same, all these mizwalas seem to us to be addressed to the narrow and well educated elites, namely – people responsible for cult maintenance in different pious foundations – i.e. mainly sufis rather than to the simple passing-by believers. And so those who knew how to make a good use of these strange and much complicated instruments were able – keeping constantly an eye on a shadow moving across the mizwalas’ shields – to observe strictly the schedule of daily prayers prescribed for the institutions they were working for, and to keep the horary of prayers right on their time, imposing it to the whole community – for the sake of all believers.

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⁵⁹ The khanqah belonging to this funerary complex is no more preserved. One knows well, however, that it has existed once, and it is very tempting to locate it across the Muizz li-d-Din Street, on a spot now occupied by a rather disordered complex of perfumes’ and fragrances shops, cf. *supra*, n. 8. This assumption, though hypothetical only, can not be excluded *a priori* in the light of recent investigations, that did allow to detect numerous ancient architectural units of different (mostly commercial and artisanal) use under these more or less modern ‘overbuildings’, all over through the Khan al-Khalili quarter, cf. S. DENOIX, J.-Ch. DEPAULE, M. TUCHSCHERER, Le Khan al-Khalili, Un centre commercial et artisanal au Caire du XIII^e au XX^e siècle I–II, *Étud urb* 4/1–2, *passim*.

⁶⁰ It seems to be contrary to the seventeenth–eighteenth ottoman usage, when the sundials were drawn *in such position to be easily viewed by those who passed the city streets*, cf. FERRARI, *The Compendium* 17/3, 2010, pp. 31–36.

⁶¹ These sundials as seen from the street level seem to be *c.* 2/3 of the ‘Inal’s mizwala’s size at the best, cf. *supra*, p. 466, n. 27.