SURVIVING INDICATIONS OF THE COMMUNICATION DEVICES EMPLOYED IN THE 13TH C. IN SELJUK, ATABEG AND AYYUBID TERRITORY FOR SIGNALING BY MEANS OF LIGHT

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Abstract

This article from written and visual indications suggests a type of optical signalling device employed in the 13th c. to convey messages transmitted in the form of a less widely visible, more secure reflected focused beam of light, to and from the ruler. This form of long distance communications was the fastest in transporting enciphered text messages, the others being mounted couriers and messenger pigeons. These indications have been ignored over the past century, in part, due to the use of a descriptive terminology based upon formal resemblance rather than one based on context and meaning. The current terminology employed records depictions of these optical signalling devices in a communications context as being: "palmette-arabesque-foliate arabesques-hanging/fleshy/split leaf palmettes-triangular floral garlands," etc., as, on the basis of form, rather than context and meaning, the probable depiction of an elliptical bifocal rock-crystal lens is today described as "a lemon" or, "a fruit".

Keywords: *Optical Signalling, Rock-Crystal Lenses, Haft-Rang, Lustre, Divriği.*

13. YÜZYILDA SELÇUK, ATABEYLİKLER VE EYYUBİ TOPRAKLARINDA IŞIK İLE HABERLEŞMEYİ SAĞLAYAN İLETİŞİM ARAÇLARINA İLİŞKİN GÖSTERGELER

Özet

Bu makale görsel ve yazılı göstergelere dayanarak 13. yüzyılda sultana gönderilen mesajlar için kullanılan dışarıdan gözlenmesi daha zor bu nedenle de daha güvenli bir optik sinyal makinası önermektedir. Bu şekil uzun mesafe iletişim araçları, ki diğer yöntemler olarak atlı kuryeler ve posta güvercinleri verilebilir, sifreli mesajları iletmekte en hızlı yöntemi sunmuş olmalıdır. Araçla ilgili görsel ve yazılı göstergeler geçtiğimiz yüzyıl boyunca, biçimsel benzerlik üzerine kurulan ancak bağlam ve anlamı dışlayan anlatımsal bir terminoloji yüzünden göz ardı edilmiştir. Günümüz terminolojisi iletişim amaçlı bu optik sinyal aracını betimleyen motifleri, "palmet-arabesk-bitkisel arabesk, arabeskler-asılı/etli/ayrık yapraklı palmetler-üçgen bitkisel garlandlar" vb. olarak kaydetmiştir. Örneğin anlam ve bağlam yerine biçim temelli bir yaklaşımla, aracın bir çiftodaklı kristal lens olan bölümü bugün "limon" ya da "meyve" tasviri olarak tanımlanmaktadır.

Anahtar Kelimeler: *Optik Sinyalleşme, Kristal Lensler, Haft-Rang, Lüster, Divriği.*

Firstly, concerning the nature of the evidence that has been employed that has led to the suggestion this research makes concerning signaling by means of reflected light in the 13th c., a suggestion which has not been either casually or easily made, in the near absence of published written documentary evidence explicitly stating the use of such devices. This research prioritizes the surviving record of research into optics from the 9th c. onwards that indicates that the construction and employment of such optical signaling devices were both theoretically possible - the scientific research had been conducted, culminating in the work of Abu Sad Al Alla ibn Sahl c. 984, which is combined with the 12th and 13th c. visual-art historical evidence concerning communications, indicating that there were such devices and they were of two types, a simple

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mirror flash signaling device (in modern terminology a "heliograph"[1]) and a more complex optical signaling device, that they were frequently used by the *barīd-istibarat* and so were depicted on official *mina'i* and luster ceramic-ware recording their actions. This evidence, both the scientific and art historical, as against the near absence of published written evidence concerning this system, as there is only slight written contemporary reference to the use of any such mirror signaling communications.

This paper therefore employs a methodology somewhat different from the usual art historical practice, in suggesting that meaning, of some importance to historians of science and other historians, concerned with communications, can be attributed to what has previously been understood to be just meaningless, context-less space filling decoration; that is, the careful depiction of mirror communications devices, enciphered messages and signalers, as also the enciphering machines employed, rather than, as is currently understood, and termed respectively: *cosmic tree*[2]*/tree of life*, *medallions*, *palmette/ split-palmette/ triangular floral garlands/ arabesque*, etc.; *pseudo-inscriptions*, *pseudo kufi* and *kufic; seated figures- sphinx, siren and harpy; sun, sunburst* or *solar device* to suggest that such a reflected light signaling system sending enciphered text messages was employed in the 12th – 13th centuries prior to the Mongol catastrophe.

It is suggested here that the depictions of these signaling devices on 12th and 13th c. *mina'i – hanft rang* and lustre ceramics, as also carved in relief in stone, provide us with a record of two versions of this device; the relatively simple device consisting of a circular mirror set within a ring to allow it to pivot to reflect sunlight (Fig. 1) and also depicted equipped with a sighting device (Figs. 2, 3)[3], and, secondly, an advanced beam of light signaling device, employing a parabolic mirror[4] (elliptic), a light intensifier and concave and convex lenses with colored filters and shutters (Figs. 4, 5, 6, 7, 8, 9, 10, 12, 13)[5] that would have issued a beam signal in a variety of colors, rather than a flash of reflected light. Both types of devices are depicted on a Seljuk mina'i bowl c. 1175-1225, today in the British Museum, London, (No. 1930,0719.63), where the advanced winged signaling devices are above and below the enthroned ruler, the simple winged signaling devices to either side (Fig. 4). These two types of optical signaling devices are depicted, together with the beam signal receiver, examples of the encryption-decryption machine from both Atabeğ Iran (Fig. 11) and Ayyūbid Syria[6], and examples of the enciphered message-word in boxes, often in color

[1] The term "heliography" was coined by 1816 by the French inventor Joseph Nicéphore Niépce (1765-1833) but for a context of early photography, recording images-signs through sunlight, not directly associated with signalling mirrors. The word is composed of two parts from the ancient Greek, reflecting the two parts, Helios - sun, and, γράφω (gráphō), lit. embracing both colour and shape in the making of signs, that is, making signs with sunlight. A signalling device which reflects the sun's rays by means of a movable mirror, supposedly not used in the 12th-13th c. but only invented and used by Europeans from the mid-19th c. onwards. The reflected light from the heliograph mirror, the 'standing flash', being interrupted by stops for longer or shorter periods to produce the coded message (usually in morse code), signalling over considerable distances as, "A ten-inch mirror, that being the size of the ordinary field-heliograph, is capable of reflecting the sun's rays in the form of a bright spot to a distance of fifty miles (80 km), where the signal can be seen without the aid of a glass.", "Messages by Heliograph", *The Popular Science Monthly*, Vol. 17, No. 37, September, 1880, New York: Bonnier Co., 1880, 716.

[2] See for example Doğan Kuban, *Divriği Mucizesi*, İstanbul, 2010, 182.

[3] See also the six examples in relief on the 12th - 13th c. frit-ware mina'i painted and gilded bowl, Metropolitan Museum of Art, New York, Acc. No. 57-36-8.

[4] To focus the light into the parabolic mirror as the sun moves along its daily path, the orientation of the off-axis mirror must be continuously adjusted so that its axis of symmetry remains parallel to the sun's rays, that is a duplex device, with secondary adjustable mirror, and this also seems at times to be represented, as a parabolic mirror cannot be aimed by tilting it the way a flat mirror can. Once the parabolic mirror is constructed, situated in its position, oriented with its axis of symmetry pointing towards the sun, and rotated about a line parallel to that axis so that the focal point is at a certain level, then the focal point is fixed.

[5] E.g. on a Kashan mina'i bowl c. 1200, Christies, London, Sale 7871 - Lot No. 112, 5/10/2010.

[6] The same encyphering-decryption machine as illustrated in Fig. 11, is also depicted on a 13th c. Raqqa lustre painted frit-ware bowl in the Aleppo National Museum. The 44 rays-pointers reach the outer circle, as with the Kashan example,

coded sequence (Fig. 12) as also depictions of the staff of signalers-observers employed. These, in addition to other elements of the *barīd*, the *kāsıd*-mounted messengers */ulak*-intelligencer and *hamān*-messenger pigeons, which are well known from the surviving textual record, and which are often depicted together with these devices and signalers on these ceramic wares, leading to the suggestion that the depictions recorded on these ceramics concern communications and therefore that many of these ceramics were in all probability made specifically for members of the ruler's *barīd-istibarat* as the representation of these optical signaling devices, often centered on the ruler, is, although not usually identified as such, a subject that is repeatedly depicted on *mina'i – haft rang* ceramics. It is suggested this art historical evidence from Seljuk, Atabeğlik and Ayyūbid territories provides us with indications of functioning light signaling systems employed by the Caliph and the Sultan's *barīd-istibarat*, relaying by simple mirror flashes of reflected light - termed in the 19th c. after its re-invention, "*heliography*" -, as also the advance made upon this device, to one that issued a beam of reflected light, transmitting color coded enciphered messages, probably from some point in the late 9th - 10th c. onwards. These reflected light signaling systems were employed to communicate in the Islamic world from perhaps as early as the 9th into the 13th century, supplementing in speed, the well-known mounted couriers and messenger pigeons of the *barīd*[7], but which, as a functioning system is largely, if not entirely unrecorded in the written sources, but is present as a system of signaling devices, recorded repeatedly in the surviving visual sources from the period, and they are also recorded earlier, on some examples of Sammanid and Nishapur painted ware dating from the 10th and 11th c.

The apparent absence in the surviving published written record of evidence of these reflected light signaling devices and systems may have been a consequence of its use by the *istibarat*, there is little record concerning the actual details of *barīd* communication systems prior to the Mongol onslaughts of the 13th c. concerning the codes, the type of enciphering devices employed etc. compared to the surviving later Mamlūke works[8], combined perhaps with the type of pinpoint-beam signal that the advanced type of this signaling device seems to have issued, and perhaps also, to some association of these lights with the *Jinn*; or, perhaps, there has been some misreading of the particular terminology that was employed in the relevant texts which would indicate the use of such a system. There is however a passage in the *Maqalat* of Shams-i Tabrezi[9] which mentions that a sequence of mirrors will repeat a false message given by the first mirror, a passage open to interpretation, but this written record may perhaps indicate some knowledge of the use of such a light reflecting messaging system (and of its abuse, possibly by the Mongols) in the first half of the 13th c.

It seems probable that scientific work in the Islamic world concerning optical signalling, that resulted in the light signalling devices that form the subject of this paper, was, in part, instigated under the Abbasid Caliph Abū al-ʿAbbās ʿAbd Allāh al-Maʾmūn ibn al-Rashīd, al-Ma'mun (A.H.198-218/A.D. 813-33) when the caliph requested the loan of the services of Leo the Engineer, known for his work on codes and for coded signalling over long distances, such as the

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indicating the same number of possibilities of encoding provided by the settings of both of these devices and suggesting that both Islamic rulers in Iran and Ayyūbid Syria employed the same enciphering technology for mirror signalling. The inner rim likewise divided into boxes.

[7] For further on the three levels-speeds of *barīd-istibarat* communications see: Terrance M. P. Duggan "Taşdibi'ndeki Rum Selçuk Mânarı", *XVIII Uluslararası Ortaçağ Türk Dönemi Kazıları ve Sanat Tarihi Araş. Sempozyum*u, Aydın, 2014, proceedings forthcoming 2016.

[8] See for example, Adam J. Silverstein, *Postal Systems in the Pre-Modern Islamic World*, Cambridge, 2007.

[9] *"It is like holding a mirror in the wrong way. Once they hold it wrong all other mirrors go wrong in their views although they may be straight*,", Erkan Türkmen, *Teachings of Shams-i Tabrezi (Rumi's Master)*, Konya, 2009, s.135.

series of fixed signal platforms from the Cilician Gates to Constantinople[10], from the East Roman Iconoclast Emperor Theophilos (r.829-42). This request was refused by Theophilos, and it seems possible that in part it was this refusal that led to the development and subsequently the employment of an optical signalling device under the auspices of the caliph and to the contemporary construction of *manār*[11]- (the original function of the later mosque minaret) to serve as the marker of the Abbasid congregational mosque of a city by night through lamps and clearly visible by day[12], an elevated noteworthy marker by day and night, and a communications node. This Abbasid scientific research was probably in part, also stimulated through the 8th c. translation into Arabic of Anthemius of Tralles's (474-533) 6th c. treatise entitled: *On Burning-Glasses*. This work includes the first recorded suggestion of Archimedes's purported device consisting of burning mirrors said to have been employed to destroy the Roman fleet at the siege of Syracuse more than half a millennium earlier, in 214-212 B.C. There seems every probability that Anthemius, known not only for his work on the dome of Hagia Sophia as architect, engineer, and exponent of geometry, but also for simulating earthquakes in Zeno his irritating neighbour's house in Constantinople by means of steam filled leather piping inserted beneath the floor, and for employing a parabolic mirror to shine a light into his neighbour's eyes, interpolated this scientific non-sense, of a fleet consisting of moving wet wood which was destroyed by a burning glass device at night[13], attributing it to Archimedes at the siege of Syracuse, as a wonderful absurdity, a 6th c. joke. Suffice it to say, when associated with name of the scientist Archimedes, copies of Anthemius's suggestion, repeated by John Tzetes[14] and John Zonaras[15] in the 12th c., provoked the European imagination and inspired tales of death ray devices for centuries and the various attempts to replicate this fabulous 6th c. A.D. imagined device in pre-modern times have continued into the 21st century[16]. In the Islamic world it can be suggested, it was not the alleged capacity to destroy at a distance that attracted scientific attention[17], but rather, within a cultural and religious context that was deeply concerned with Light/light in its metaphysical, theological, symbolic[18] and physical aspects, the capacity of a parabolic mirror, combined with rock crystal lenses to transmit a beam, rather than a flash of light or "heliograph signal", in a straight line, with a sequence of coloured glass filters, resulting in a beam consisting of a sequence of different colours sent over considerable

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[10] Clive Foss, Survey of Medieval Castles in *Anatolia I: Kutahya*. Oxford: Oxford University Press, 1985, 86-94; Clive Foss, "Beacons". *Oxford Dictionary of Byzantium*, Ed. Aleksandr P. Kazhdan, Oxford, 1991, 273-274.

[11] The Arabic word used to describe the support for a light, be it a lamp holder, a minaret type structure or the *manār al-Iskanderiyya*, the Pharos of Alexandria.

[12] Jonathan M. Bloom, *The Minaret*, Edinburgh: Edinburgh Studies in Islamic Art, 2013, 73, 96-111; Terrance M. P. Duggan, "Review of, J. M. Bloom, The Minaret, Edinburgh Studies in Islamic Art, Edinburgh, 2013", Mediterranean Journal of Humanities mjh.akdeniz.edu.tr III/2, 2013, 357-365, 362-3.

[13] Polybius (*Universal History*, Book VIII.5) *"In the end Marcellus was reduced in despair to bringing up his ships secretly under cover of darkness.* " ἕως ὁ Μάρκος δυσθετούμενος ἠναγκάσθη λάθρᾳ νυκτὸς ἔτι ποιήσασθαι τὴν παραγωγήν. Likewise Plutarch (*Parallel Lives:Marcellus*) "*They then took a resolution of coming up under the walls, if it were possible, in the night*." Βουλενομένοις δὲ ἔδοξεν αὐτοῖς ἔτι νυκτός, ἂν δύνωνται, προσμῖξαι τοῖς τείχεσι.

[14] John Tzetes, *Book of Histories (Chiliades)*, Book II, l. 118-128, Trans. Ivor Thomas, Cambridge, 1941, Vol. II, 19.

[15] John Zonaras, *Epitome ton Istorion*, 9, 4, in, Dio's Roman History (Volume II: Fragments of Books XII - XXV) Trans. Earnest Cary, Cambridge: Loeb Classical Series, Harvard University Press, 1914, Vol. II, 171.

[16] https://www.youtube.com/watch?v=a9qk1l0LjEs
http://web.mit.edu/2.009/www/experiments/deathray/10_ArchimedesResult.html

[17] Literary attention was focussed on such devices, as is recorded in the Thousand Nights and One Night, The Tale of The Ebony Horse, "*and (the Indian sage) laid before him a present befitting his dignity; that is to say, a man of gold, set with precious gems and jewels of price and hending in hand a golden trumpet. When (King) Sabur saw this he asked, "O sage, what is the virtue of this figure?", and the Indian answered,"O my Lord, if the figure be set at the gate of thy city, it will be a guardian over it; for, if an enemy enter the place, it will blow this clarion against him and he will be siezed with palsy and drop down dead.*" Richard Burton, *Arabian Nights: The Book of a Thousand Nights and a Night*, London: Bracken Books, 1994, 415-416.

[18] Dating to the first *shamsa*-sunburst devices marking the end of an *ayet* of the Holy Qu'ran, the combination of The Word and The Light, long before Suhrawardi al-ishraq/al-Maqtūl and the start of the School of Illumination in the 12th c., see for examples, Terrance M. P. Duggan, "Veil of Light" *Mediterranean Journal of Humanities*, mjh.akdeniz.edu.tr, IV/1, 2014, 129-157.

distances, thereby serving as a means of rapid, secure, enciphered communications, which seems to have been an outcome of this scientific attention, and which it is suggested, resulted in the production and use of this advanced optical signalling instrument.

The science of optics had developed from that presented by Euclid in his Catoptrics and by Theon of Alexandria c. 300 B.C., and the Greek works on this subject by Diocles of Carystus d. c.180 B.C., the first to prove the focal property of a parabolic mirror[19], possibly translated by Qusṭā ibn Lūqā (820–912)[20], and by Anthemius of Tralles[21], which were available in Arabic translation[22], there are two extant copies of a translation made from Greek into Arabic dating from 902 A.D. concerning research on burning mirrors[23]. In particular, advances concerning the optical characteristics of reflected light from parabolic mirrors, through convex rock crystal lenses, (employing rock crystal, as stated by ibn Sahl[24], not glass, as a greater quantity of light passes through a crystal lens.[25] By 1284 the Venetian Guild of Rock Crystal workers imposed regulations prohibiting the substitution of glass lenses in place of the more expensive rock crystal ones.)[26], and of the intensification of reflected light, with these scientific advances in optics largely made by scientists at the Abbasid court between the 9th and the end of the 10th c., including: by Yaqub Ibn

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[19] MS. 392, the Shrine Library, Meshhed, Iran.

[20] Suggested by Gerald Toomer in, *Diocles: On burning mirrors. The Arabic translation of the lost Greek original*. ed., with English translation and commentary by Gerald J. Toomer. Berlin, Heidelberg, New York, Springer, 1976, 21. Qusṭā ibn Lūqā also translated another Greek work entitled, "*On burning mirrors*" and another entitled "*Book of the reasons for the variations in appearance which occurs in mirrors*", Toomer, *Diocles: On burning mirrors*, 27.

[21] "*Anthemius solved the problem of how to contrive that at any hour and season a ray of the sun, passing through a small aperture, shall fall in a given spot without moving away. He describes the construction of an elliptical reflector with one focus at the aperture and the other at the point to which the ray is to be reflected. Both winter and equinoctial rays are considered. In his treatment, Anthemius incidentally mentions the construction of an ellipse by means of a loop of string drawn closely around the foci. He also uses a proposition not made explicit in the* Conics*: that the straight line joining the focus to the intersection of two tangents bisects the angle between the two straight lines joining the focus to the two points of contact. Another construction shows how parallel rays may be reflected to one point at the focus of a parabolic reflector.*" George L. Huxley, Anthemius of Tralles at: http://www.encyclopedia.com/people/literature-and-arts/architecture-biographies/anthemius-tralles

[22] Paul Lettinck, *Aristotle's Meteorology and Its Reception in the Arab World: With an Edition and Translation of Ibn Suwār's Treatise on Meteorological Phenomena and Ibn Bājja's Commentary on the Meteorology*, Leiden: Brill, 1999, 408, fn. 16; Toomer, *Diocles: On burning mirrors*, 21. Anthemius's work '*On paradoxical devices*' was a comparativly well known work in Arabic translation.

[23] In the Tareq Rajab Museum, Kuwait, and a Mamlūke copy of the same text today in India.

[24] Roshdi Rashed, "A pioneer in anaclastics: Ibn Sahl on burning mirrors and lenses", Isis, Vol. 81, 1990, 464–491, 478.

[25] "*By 1284, the workers of naturally occurring rock crystal had formed their own guild and had written a "Capitulare de Cristellariis'. Among the surviving guild rules is one which forbade its members from using "vitrum blanchum" ("white" or colorless glass) in place of rock crystal (Luigi Zecchin, Vetro e Vetrai di Murano I. Venice: Arsenale Editrice , 1987:239). Within 25 years, these rules would be amended to allow the use of glass in the place of rock crystal provided the vendor was honest about identifying it.*" William P. McCray, "*The culture and technology of glass in Renaissance Venice*" University of Arizona, Unpublished Doctoral thesis, 1996, 173…"*The guild of rock crystal workers in Venice expressed concern for glass imitating their own works as early as the 13th century. More commonly discussed in the literature is the use of glass to replace items such as lenses, beads, and so forth (cf. L. Zecchin, Vetro e Vetrai di Murano II. Venice: Arsenale Editrice, 1989; 239, 244, 250). The reasons for using glass were simple. It had a similar visual appearance and it was cheaper. Zecchin notes that even after glass had been introduced and approved for use in eyeglasses, the wealthy of Venice and elsewhere continued to buy the more expensive ones of rock crystal (1989:250).*" McCray, *The culture and technology of glass in Renaissance Venice*, 231.

[26] For rock crystal lenses in antiquity see: George Sines - Yannis A. Sakellarakis, Lenses in Antiquity, *American Journal of Archaeology*, Vol. 91, No. 2, 1987, 191-196. It is noteworthy that the polishing and cutting of rock-crystal are clearly explained by Theophilus in, Caput XCIV, De Poliendis Gemmis, but the carving of it is said to entail the soaking of the stone in warm goat's blood to make the stone warm as it is carved, which perhaps indicates that the method of carving of rock-crystal was not known to Theophilus c. 1120 and perhaps not actually practiced in the Latin West in the early 12th c. Theophilus, *An Essay Upon Various Arts*, trans., with notes, Robert Hendrie, London: John Murray, 1847, 386-391.
The change from using natron (sodium carbonate) from Wadi El Natrun as flux, to potash (soda rich plant ash alkali source) in glass production in the 9th c. required an increase in melting temperature of about 200 °C to around 1350 °C, while to melt quartz without a flux requires a heat of about 1700 degrees Celsius (Sagui 2007, 220). Crystal quartz (SiO2) remains a very useful material today in the fabrication of finished optics: laser beamsplitters, AO elements, polarizing optics, prisms, windows, lenses in the ultraviolet due to its high UV, VIS and NIR transmittance, birefringence, the ability to rotate plane polarized light, high damage threshold and resistance to scratching.

Ishaq, by Ahmad ibn ‘Isa (c.864) in his *Kitab al manazir*-the Book on Optics and Burning Mirrors, Ibn Sabah Al-Kindi (c. 801-873), “*Thus, in his second optical treatise on burning mirrors Kitab al-Shu’a’at (Book of the Rays), Al-Kindi first recalls Anthemius’ report on how ships were set aflame*”[27], Hunayn Ibn Ishaq concerning the lens of the eyes, by Abu Sad Al Alla ibn Sahl in 984, on optics and the theory of refraction combined with the theory of conics, on how curved mirrors and lenses bend and focus light[28]. Ibn Sahl experimented “*to determine by which combination of refractive surfaces he could transform a beam of light rays from a given source into a pencil of rays under certain conditions, for example if the rays be parallel or converge toward a point.”*[29], and, by Abu Sahl Waijan Ibn Rustam Al-Quhi also in the 10th c. who studied optics, constructed optical observation instruments and investigated the optical properties of mirrors made from conic sections. Further work on the science of optics was conducted by Abu Ali Hasan Ibn Al-Haytham (Alhazen) c.965-1039. In consequence of this scientific research in the field of optics, in particular on reflected light from parabolic mirrors passing through concave and convex lenses, by the 10th century the stage had been reached where such an advanced signaling device was theoretically possible, while an intact concave lens of rock crystal is reported to have been excavated from a 9th c. context[30] in the Kuban district of Georgia, a lens that may even have been employed in a device of this type.

However, there are no surviving intact examples of this signaling instrument known. Nor have excavated fragments of this device, nor have other rock crystal lenses nor colored glass filters been found, or perhaps no fragments of these have been recognized and published as such, from other 9th to 13th c. sites excavated or under excavation.

That said, both the simple mirror signaling device with and without the sighting arm (Figs. 1, 2,3) and also the advanced device that is also depicted on these 12th and 13th c. ceramics, as also carved in stone on either side of the north portal to the mosque at Divriği (Figs. 13, 14), in terms of the optics employed, works. The latter, a scientific instrument sending a focused beam of light, a pre-lazer lazer type device, a prototype is currently under construction, hopefully to be tested in the field in 2017-2018 to determine under various light conditions its range; together with the construction of a prototype of the 12th-13th c. 3 disk cypher engine; while surface survey research has also been undertaken in 2016 under the auspices of the T.C. Tourism and Culture Ministry, to determine possible 13th century signaling routes and stations between Alâ’iyye (Alanya), Antalya and Konya[31].

Terminology

Secondly, there is the matter of the particular art historical terminology that has to date been employed and of the problems brought about by the cultural and religious associations implicit in the use of the particular terminology established in the late 19th and 20th c. by Europeans trained in the Greco-Latin-Christian tradition in describing the designs employed on works of Islamic art. More particularly in this context, the use of the pagan-*jahiliyya* terms, *sphinx*, *siren* and *harpy* to describe the winged crowned human headed creatures often shown on either side of the

[27] Jean Jolivet - Roshdi Rashed, “Al-Kindi”, *Dictionary of Scientific Biography*, New York: Charles Scribner's Sons, 1973-, vol. 15, Supplement I, 261-66, 264.
[28] Roshdi Rashed, “A pioneer in anaclastics: Ibn Sahl on burning mirrors and lenses”, 464–491.
[29] Tareq Rajab Museum, Kuwait, citing Roshdi Rashed http://www.trmkt.com/902manu.html
[30] *Mathematical Review*, American Mathematical Society, 1986, p.1816.
[31] On part of the area of this survey this see, Terrance M. P. Duggan-Mehmet E. Şen, “On the Exercise of Coastal Control through Observation and Long Distance Communication Systems in Seljuk Territory in the XIIIth Century”. *Phaselis* II, 2016, p. 1-17.

depiction of this device[32], when the human figures - the suggested signalers[33] are not depicted in these positions[34], is a terminology which is certainly unhelpful[35], as well as being meaningless and largely unrecorded in contemporary Islamic texts[36]. Further and unfortunately no reason has been provided for the depiction of the so-called *palmette/ split-palmette/ triangular floral garlands/ arabesque/ medallions*, on these ceramics. The suggestion made here is that these are rather to be understood as being depictions of this optical signaling device, with the seated figures often depicted to either side, the signalers-observers. This twice or thrice fired *mina'i-haft rang* ceramic ware was the most expensive ceramic to be produced and, one would think, would not be repeatedly decorated with apparently meaningless seated figures and decorative devices, today termed *palmette/ split-palmette/ triangular floral garlands/ arabesque/ medallions*, as this type of *mina'i* decoration has been repeatedly associated with the type of decoration employed in contemporary illuminated texts that were the work of *nakkaş* and were made for the elite. Consequently one faces the choice, accept that only parts of the decoration, for example the depiction of the enthroned ruler, carry some meaning, while other and equally well decorated parts carry decoration of no significant meaning, which does seem to be rather odd in the context of these ceramics, or, one looks for some degree of coherence in the context and meanings given to what is represented in this manner on these ceramic.

Concerning the terms: terms, *sphinx* (as is recorded today for the *Jinn* figures depicted on Figs. 4, 10), *siren* and *harpy*, the term *jinn* (those of the Land today termed *sphinx* and those of the Air today termed *siren* or *harpy*) is perhaps the more appropriate, culturally, scientifically and religiously relevant term for what is represented by the depiction of these winged and crowned human headed creatures with the body of either a feline or a bird, *jinn* being repeatedly mentioned in the Holy Qu'ran, where they are recorded as being made of scorching/smokeless fire:

> Qu'ran, *Al-Hijr*, 15. 27:
> وَٱلْجَآنَّ خَلَقْنَٰهُ مِن قَبْلُ مِن نَّارِ ٱلسَّمُومِ
> "*And the jinn We created before (man) from scorching fire.*"),
> السَّمُومِ =scorching-blazing-smokeless-searing/*alssamoomi*[37],

[32] E.g. c. 1180-1219, Iran, Kashan, mina'i dish, Fitzwilliam Museum, Cambridge, No. C.144-1935; Seljuk mina'i bowl of underglaze and enamelled pottery. 1175-1225 (circa). British Museum, London, 1930,0719.63; 12th-13th c. mina'i painted bowl, areas restored, V&A Museum, London, No. EA1055.

[33] E.g. Bowl Depicting a Falconer and Four Pairs of Seated Figures (signallers), 12th -13th c.. Frit-ware, covered with a turquoise glaze with in-glaze and over-glaze painting in red, green, blue, yellow, black, and gold, Brooklyn Museum, No. 86.227.65; c. 1180-1219, Iran, Kashan, mina'i dish, Fitzwilliam Museum, Cambridge, No. C.135-1935; Kashan mina'i bowl c. 1200, Christies, London, Sale 7871 - Lot No. 112, 5/10/2010; 12th-13th c. mina'i painted bowl, areas restored and repainted, Metropolitan Museum, New York, Acc. No. 20.120.98; 1175-1220, Ray, Iran, Seljuk mina'i ware, Philadelphia Museum of Art, No.1943-41-4, where in the centre, between the surrounding signallers and their devices, is depicted a Jinn of the Land; c. 1200 Central Iran, mina'i painted frit-ware bowl, Christies, Lot 0089, Sale 7428, 23rd Oct. 2007; Iran, Kashan, Seljuk Minai Beaker with Seated Princes (sic.), 1180-1220, fritware with overglaze-painted design (minai ware) Cleveland Art Museum No. 1917.977; also, www.harvardartmuseums.org.art216883.

[34] E.g. Iran c. 1175-1225, frit-ware mina'i painted bowl, excavated from Rayy, restored. British Museum, London, Museum No. 1930,0719.64, where human figures-signaller are on either side of one device, facing, on either side of the other device are *Jinn of the Land*, human headed lion-bodied winged figures; likewise, Iran, Kashan, c. 1170 - c.1220, frit-ware mina'i painted bowl, Fitzwilliam Museum, Cambridge, No. C.146-1935.

[35] For further on this matter see: Terrance M. P. Duggan, "The O'Grady factor and false resemblance – blinding Orientalisms and misapprehensions of the 13th century in the absence of due contextualisation and a little common sense", *Talât Sait Halman'a Armağan Kitabı*, Ed. Arda Arıkan, Antalya, 2015, 178-198.

[36] For example the wingless sphinx at Gizeh was in the 13th c. called *'the father of fear'- Abu'l-Hawl*, being buried up to its neck in sand, see, 'Abd al-Latīf al-Baghdādi, *Kitāb al-ifādah wa'l-l'tibār. The Eastern Key*. Trans.: K. H. Zand – J. A. & I. E. Videan. London: George Allen & Unwin, 1965, p.123.

[37] Also interpreted into English as, Jinn created from: "*from smokeless fire*", "*the fire of scorching winds*", "*intensely hot fire.*", "*the fire of a burning wind*", "*from a scorching firestorm*", "*from the flames of fire*", "*from intense radiated heat.*", "*from smokeless, scorching fire penetrating through the skin.*", "*of radiating fire.*", "*the scorching (and smokeless) fire*", "*out of blazing fire.*", "*the flaming, smokeless fire.*", "*a smokeless blazing fire.*", "*of smokeless fire.*", "*the fire of the*

And so the term *jinn* seems to be the appropriate term within this religious-cultural context, in part also, in reference to the consequence of the concentration of the rays of sunlight via a mirror or lens to produce an area of intense heat-of scorching/burning; and because, "*the study of burning mirrors were an essential preoccupation*"[38] of 9th and 10th c. scientific work concerning research into optics, works which are themselves frequently entitled, "*On burning glasses*" *Kitāb fī'il-marāyā'l-muhriqa*, meaning, On burning mirrors-lenses, as a treatise by Qusṭā ibn Lūqā (820–912) is entitled[39], as are three works on burning mirrors by Ibū Ishāq Al-Kindī (c. 801-873), with the second section of one entitled *Kitāb al-Shu'ā'āt* (Book of the Rays[40]), and the mid-9th c. work by Ahmad ibn 'Isa entitled, *Kitāb al-Manāzir wa al-marāyā almuhriqa* (The Book on Optics and Burning Mirrors) *almuhriqa* meaning scorching/burning[41]. Thereby this signaling device which was developed through this scientific work concerning burning mirrors/lenses, can reasonably be associated with the *Jinn* that are recorded as being made by the Almighty from scorching/ blazing/searing/smokeless fire[42]. This, in addition to the *jinn* travelling at the speed of light/conveying messages at the speed of light, as the jinn are recorded as travelling at this speed[43]. Further, *Jinn* also seems to be the appropriate term, rather than *sphinx*, *siren* and *harpy*, not least, when looked at within the context of rulers who were themselves described by their contemporaries as being "*The Second Suleyman*", with the believing *jinn*, that is *nakkaş*-engineers[44], the ingenious, quick and clever, (hence genius from the Arabic word *jinn* in English from the 16th c. onwards, displacing the ancient Greek derivation in usage[45]) doing the work of the *jinn* under the Second Sulayman's command, as the Prophet Suleyman had the believing jinn under his own command, working for him and making devices (Qu'ran, *Saba'*, 34. 12 - 34. 13; *Al-'Anbyā'*, 21. 82; *Şād*, 38. 37-38).

The art historical terms *palmette/ split-palmette/ triangular floral garlands/ arabesque/ medallion* seem to be unrecorded in contemporary 12th and 13th c. sources, but which have been repeatedly employed from the 19th c. onwards to describe, what can rather be understood within the context of the depiction of *barid-istibarat* communications, to be designs recording and representing both these optical communications devices, mirror, light shutters, light intensifier, lenses, with a number of colored filters, pivot rings and support (Figs. 1-10, 12, 13, 14)[46].

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scorching wind.", "*a piercing fire*.", "*the fire of a searing wind*.", "*from the smokeless flames (of fire)*.", "*the fire* (The Arabic word *samum* is sometimes understood to be a pestilential wind) *of a pestilential (fire)*."

[38] Roshdi Rashed, *Encyclopedia of the History of Arabic Science*, London: Routlege, 2002, p.631.Paul Lettinck writes: "*Burning mirrors were a well known subject of discussion in the Arab world. The Greek works on this subject such as Diocles and Anthemius were available in Arabic. The work of Anthemius was used on the writings on burning mirrors by al-Kindı, 'Utarid ibn Muhammad al-Hasib, Abu Sa'd al-Ala' ibn Sahl and Ahmad ibn 'Isa. Ibn al-Haytam wrote two treaties on burning mirrors, the one on spherical, the other on parabolic mirrors*." Lettinck, *Aristotle's Meteorology and Its Reception in the Arab World: With an Edition and Translation of Ibn Suwār's Treatise on Meteorological Phenomena and Ibn Bājja's Commentary on the Meteorology*, 408, fn. 16.

[39] He also wrote a work entitled, "*Book of the reasons for the variations in appearance which occurs in mirrors*" *Kitāb fī'ilal mā yaridu min iktilāfi 'l-manāzir.*

[40] *al-shu'ā'āt* as in the Arabic 1227/h. 625 copy of Euclid's Optics, entitled: *Kitāb Uqlidis fī liktilāf al-manāzir wa al-shu'ā'āt,* today in the Topkapi Palace, Ahmet III, 3464, 4.

[41] The problem of how to construct a parabolic mirror with a given focal distance was solved by the Bagdad based Muḥammad ibn Muḥammad ibn Yaḥyā ibn Ismāʿīl ibn al-ʿAbbās Abūʾl-Wafāʾ al-Būzjānī (940-998), Toomer, *Diocles: On burning mirrors*, 23.

[42] Qu'ran, Al-Hijr, 15. 27.

[43]Jinn travelling at the speed of light, as in the blink of an eye, Surat An-Naml 27:38-9, like, or in, the flash of a reflected message.

[44] Jinn-*cin* as in, *cin fikirli*, clever, ingenious, shrewd or *cin gibi* agile, clever, quick, or, *cin göz*, shrewd, clever.

[45] *Shorter Oxford Dictionary*[3] 1969 s.v. *Genius* 2.

[46] E.g. on a Kashan mina'i bowl c. 1200. Christies, London, Sale 7871 - Lot No. 112, 5/10/2010; as on a c. 1175-1225, frit-ware mina'i painted bowl, excavated from Rayy, restored, British Museum, London, Museum No. 1930,0719.64; as on Brooklyn Museum, No. 86.227.65; as on a c. 1180-1219, Iran, Kashan, mina'i dish, Fitzwilliam Museum, Cambridge, No. C.135-1935; as on a c. 1180-1219, Iran, Kashan, mina'i dish, Fitzwilliam Museum, Cambridge, No. C.144-1935;

Likewise currently the terms, *pseudo-inscriptions*, *pseudo kufi* and *kufic* are today employed to describe what can rather be understood to be examples of the representation of a band of enciphered texts contained in message boxes (e.g. Figs. 4, 5, 6, 8, 10, 13), recorded on luster and often in colored boxes when painted on *mina'i* ceramics (Fig.11), recording actual communications or indicating them. An enciphered text recorded in legible alphanumeric Arabic letters is neither a *pseudo-inscription*, nor is it written in *pseudo kufi* nor in *Kufic*. It remains an un-deciphered text recorded in alphanumeric Arabic. Those bands that do contain legible Arabic words in boxes may also, and at the same time, represent encoded messages, while the colored boxes in which these Arabic letters/words are situated (e.g. Fig.12) appear also to be related to the code employed, as it appears from the depiction of the cypher machines on *mina'i* and lustre painted vessels (e.g. Fig. 11), that both a specific number of letters/numbers and a specific number and sequence of colors together formed the code, and so it seems that to decipher the code, both the particular code book, presumably with colored pages/sections, and the particular settings at a given date of the given cypher machine with a specific number of settings would be required, e.g. 20 rays-pointers (number of colors unknown as the example is in luster technique)[47], 44 pointers-rays with three colors (red, blue, green) (Fig.11)[48], and 50 pointers-rays, with probably three colors (red, blue, yellow?)[49], 55 rays-pointers (number of colors unknown as the example is in luster)[50] etc. Otherwise the possibilities of decipherment of these depictions of code, if they are accurate rather than being representative, seems to be quite remote. The unfortunate use of the modern terminology in this respect, the depiction of 12th -13th c. cypher machines which have been described as a, *sun, sunburst* or a *solar device,* on the basis of a formal resemblance, rather than one of meaning, context and function, also tends towards the on-going and repeated evasion of any attempt to address matters of meaning in the employment of these designs within a cultural-scientific-religious context rather different from that of 20th c. Europe or that of pagan antiquity. Similarly, what can be understood as being the representation on a Kashan lustre plate c. 1200 of a signaler holding up an elliptical convex lens, has instead been described as, "*a seated lady proffering a lemon*",[51] while the associated cartouches are stated to contain "*abstract designs*" rather than the design of the signaling device[52], the context of the work, that of communications, not being recognized resulting in these terminological misinterpretations.

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likewise, c. 1175-1220; Ray, Iran, Seljuk mina'i ware, Philadelphia Museum of Art, No.1943-41-4, and on a Seljuk mina'i bowl c. 1175-1225, British Museum, London, 1930,0719.63; as on a Seljuk mina'i bowl of underglaze and enamelled pottery, c. 1175-1225 British Museum, London, 1930,0719.63; likewise, a Seljuk mina'i bowl of underglaze and enamelled pottery, c. 1175-1225, British Museum, London, No: 1914,0318.1, etc.

[47] Iran, Kashan, lustre bowl, c. 1170 - 1199, Fitzwilliam Museum, Cambridge, No. C.4-1922.

[48] Iran, Kashan, c. 1170 - c.1220, frit-ware mina'i painted bowl, Fitzwilliam Museum, Cambridge, No. C.146-1935.

[49] Iran, Kashan, frit-ware mina'i painted bowl, Metropolitan Museum, New York, No. 57.36.4. It is noteworthy that the pointers extend only onto one of the six adjacent astrological representations, reaching the adjacent representation of a scribe, representing Mercury, the Messenger, the scene intoto presumably relates to diplomacy, to coded communications between the two enthroned rulers facing each other in the band below the boxed messages around the rim. Possibly, from the fragmentary inscription on the exterior, together with the circling mounted *kāsıd*, it was commissioned to record the passage of enciphered communications between the Caliph and the ruler who commissioned this bowl, presumably the enthroned figures above and below in the band beneath the message box band below the rim.

[50] Plat aux cavaliers, Iran, Kashan, début du XIIIème siècle, Sotheby's Paris, 18-11-2013 Lot. 33, pf1319lot74c56en

[51] It has also been described as another fruit, see, Gönül Öney, "Büyük Selçuklu Seramik Sanatında Resim Programı Ve Gelişen Figür Üslübu" *Sanat Tarihi Dergisi*, 13, 2004, 61-82, 68, "*Londra, Victoria and Albert müzesinde Rey kentinden lüster seramik tabakta elinde ebedî hayat meyvesi nar tutan, bağdaş kurarak oturan figür*." However, as pomegrante were known in antiquity and lemons were grown in Iran before the 7th c. A.D. the reason why this figure wearing tiraz painted c. 1200 is said to be proffering either fruit is, to say the least, somewhat unclear.

[52] *Large fritware dish c.1200, Iran, Kashan, lustre painted © Victoria and Albert Museum, London. Ades loan. "transitional monumental' style with a depiction of a seated lady proffering a lemon amidst dense scrollwork and cartouches with abstract designs.*" http://collections.vam.ac.uk/item/O118167/dish-unknown/

Some Art Historical Implications

It seems evident that the method of depiction in respect to pictorial distance, pictorial recession, had not in essence changed in some cases in the centuries between the depiction of the mosque on the Ṣanʿā' Qu'ran frontispiece in the early 8th c.[53], where the steps leading up to the front façade of the mosque are depicted at the bottom of the page, the facing *kibla* wall at the top of the page with both walls depicted of the same length and height, and the 12th-13th c. *mina'i* painted bowl depicting the ruler enthroned today in the British Museum, London[54] (Fig. 13), or similar *mina'i* examples today in the Cincinnati Art Museum and another in the Louvre, Paris (fragment), and the depiction of this reflected light signaling device carved on either side of the 1228-9 Divriği Ulu Camii North Portal (Figs. 13, 14). The signaling device is not, as it appears to eyes trained in western one-point perspective, to be understood as something growing out of the Sultan's head, or headdress, rather, it is behind the ruler and pointing towards him; while the signaling device carved either side of the mosque portal is not depicted in one point perspective, but rather, the front of the device, the lens and filters, are depicted at the base, with the rear of the device, the mirror[55], farthest from the viewer, at the top of the depiction, what Matrakçı Nasuh in the 16th c. would term a matter of "*true perspective*"[56], that is, true to meaning, rather than just a visually accurate likeness as is provided by one-point perspective.

It is also suggested within a context of the depiction of communications in the 12th -13th centuries that the blue and white zigzag repeat design can be understood to indicate-represent reflected light from water[57] or to indicate-represent light reflected from the surface of a mirror (Fig. 1)[58], and it also appears to be a design in these colors that was worn by some members of the ruler's *barid-istibarat*, their official dress[59]. It can perhaps be understood to represent, as a zigzag design in these two colors, both the flash of reflected light, including the message sent by means of

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[53] Illustrated for example in, Oleg Grabar, *The Mediation of Ornament*, Princeton: Princeton University Press, 1992, Plate 16.

[54] British Museum, London, 1930,0719.63

[55] The geometric pattern on these carved mirrors is found also on a 12th-13th c. bronze mirror back from Nishapur, Metropolitan Museum, N.Y. 40.170.265, and on a 13th c. cast bronze mirror back, Mosul (?), Metropolitan Museum, No. 67.146.2.

[56] Hüseyin G. Yurdaydın, *Nasūhu's Sılāhī (Matrākcī) Beyān-I Menázil-i Sefer-i 'lråkeyn-i Sulṭān Süleymān Hān*, Ankara: Türk Tarih Kurumu Basımevi, 2014, 132.

[57] Other examples of this design representing the reflection of light from water see: Persia, late 12th/early13th century mina'i bowl with a rider on horseback and attendants. Sothebys, London, 24-04-2013, Sale Lot. 173; Freer-Sackler F1909.75 Smithsonian Inst. where the horseman-*kāsıd* to the left of the tree also wears this design. This same design was later employed to mark the reflection from the channels and pools of water on some examples of the Iranian 18th c. "Garden Carpet" type, e.g. TIEM Env. Nu. 815, and, for a variant on this pattern, see, Hermann Forkl and others, *Die Garten Des Islam*, Stuttgart-London: hansjörg mayer, 1993, Abb. 71.

[58] For this blue and white zigzag design on mirrors see also: Iran, 12th -13th c. mina'i painted frit-ware bowl. Offered for sale at icollector.com, withdrawn from sale 07-2002, where the two circular mirrors are in red circular pivot rings, neither of these mirrors is winged; the same pattern on the upper winged mirror depicted on the mina'i painted bowl, Freer-Sackler FS-8346_04 Smithsonian Inst.; Kashan Iran circa 1175 - circa 1220, mina'i frit-ware under-glaze bowl with applied gold over glaze. No. OC.158-1946, The Fitzwilliam Museum, University of Cambridge, where there are six circular mirrors carrying this design in an inscription band below the rim. It also appears as the design on a mosque lamp, thereby, it is suggested, indicating reflected light, Late 12th -13th c. Iran, frit-ware tile, Metropolitan Museum, New York, Acc. No. 20.120.106.

[59] Examples of riders, signallers and officials wearing a dress with a design of blue and white zigzags include: some of the seated figures on the Kashan mina'i painted frit-ware bowl c. 1170-1220 Fitzwilliam Museum, Cambridge, no. C.129-1935; worn by a rider-*kāsıd* on a c. 1200 mina'i frit-ware bowl also in the Fitzwilliam Museum Cambridge; on a c. 1200 Central Iran, mina'i frit-ware bowl. Sold Christies King St. London, Lot 0208, Sale 6628, 15th Oct. 2002, where the officials on either side of the enthroned ruler are dressed in the vertical version of this design; the dress of the *kāsıd* depicted on a c. 1200 Central Iran, mina'i frit-ware bowl. Christies South Kensington, Lot. 0090, Saeed Motamed collection, Part I, sale 8652, 22nd April, 2013; as likewise worn by the rider- *kāsıd* attacked by a panther on a c. 1200 mina'i frit-ware bowl, restored, Christies Sale 2335, Lot.464, New York, Rockerfeller Plaza, 31st Aug 2010.

reflected light, and it identifies the members of the *al-barid wal-akhbar* intelligencers[60], in the particular service of the ruler, with the design in these two colors serving as a visual reminder of the unaltered reflection of the truth. It is noteworthy in this respect that the zigzag design can be read as formed of the Arabic numerals 7 and 8, which combined = 15 = 1+5 = 6, that is, a repeat of the number 6, with 66 being the numerical equivalent of the letters forming the word Allah and so the zigzag can be read as repeating the name Allah[61].

From these observations it can be suggested that that the group of 12th -13th c. Kashan *mina'i* or *haft-rang* frit-ware ceramics that carry a rim decorated with a blue and white zigzag, carrying depictions relating to communications (e.g. Figs.1, 4, 6, 8, 10, 12, 13), were not produced to be sold to the public. Not least because they carry depictions of the signaling devices, the encryption machine etc., but rather, that these frit-ware ceramics were painted to court produced designs, at Kashan as elsewhere, and were, it seems reasonable to suggest, gifts that were made to be presented to the members of the Sultan's *barid-istibarat* service, not least because some seem to record particular events, diplomacy[62], or, for example, depict a mounted courier being attacked by a panther etc.[63], and were therefore presumably made to honor the completion of certain specific duties performed by particular members of the ruler's *barid-istibarat*.

In consequence, from the identification of these devices, it can be suggested that the importance of communications by means of mirror signaling devices, the most rapid form of secure long distance communications available, does require some serious investigation by historians of the period, as it seems evident that "*heliograph*" type signaling, and also advanced beam mirror signaling devices were not only a product of the 19th and late 20th centuries, invented by British and Americans, but rather they seem to have been invented much earlier and seem to have been in widespread use by the *barid-istibarat* of the 12th and 13th centuries in Seljuk, Atabeylik and Ayyūbid territory prior to the Mongol intervention, an intervention which seems to have brought an end to the use of these signaling devices, although, as a meaningful motif related to The Light, rather than to a specific optical signaling instrument, it was a motif employed later in the 13th, for example on the 1265 lustre tile-work at the Imamzada Yahya in Veramin by Tehran (Figs. 15, 16), and continued to be employed in subsequent centuries, unlike the signaling instrument.

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[60] See also the example of the use of this zigzag design on an important Kashan mina'i frit-ware bowl, with a "*court scene*", but which rather carries a depiction concerning communications with the ruler, 12th-13th c. in the Xavier Guerrand-Hermès Collection of Islamic arts, Sothebys, 9-10-2013. An article by the author on the subject of the zigzag design, its use, and the meanings it reminds of, entitled "*Zigzag" – The flash of light in the polished mirror – the design and a reminder of the Light of the Almighty - nūr-i ilāhi*" is forthcoming.

[61] That this was an understood and practiced pattern of thought at this time see for example, Ibn 'Arabī, *Contemplation of the Holy Mysteries, Mashāhid al-asrār al-qudsiyya wa matāli' al-anwār al-ilāhiyya*, Trans. Cecilia Twinch – Pablo Beneito, Oxford: Anqa, 2009, in particular 16-17, for the remarks on the science of Arabic letters-numbers, Qur'an 20:1 Ta, Ha, 9+5=14 etc. As likewise, İbn Arabi, *Harflerin İlmi*, Çev. M. Kanık. Bursa: ASA, 2000, passim.

[62] Metropolitan Museum, New York, No. 57.36.4

[63] E.g. c. 1200 mina'i frit-ware bowl, restored, Christies, Sale 2335, Lot.464, New York, Rockerfeller Plaza, 31-08-2010; .

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FIGURES

Fig. 1: Mina'i painted frit-ware bowl, Iran c. 1200. Museum für Islamische Kunst, Berlin (Hermann Forkl and others, *Die Garten Des Islam*. Stuttgart – London: hansjörg mayer, 1993, abb.72) Two circular mirrors in pivoting rings, both with two pairs of wings, above and below, indicating the speed of communication by means of reflected light, on either side of the enthroned ruler. The same blue and white zigzag pattern is on both mirror faces, as also on the surface of the water below the enthroned ruler and it decorates the rim of the bowl. The scene on this bowl seems to depict the 3 types of communication employed by the Caliph-Sultan's *barīd-istibarat*: *kāsıd*-mounted messengers/*ulak*-intelligencer, *hamān*-messenger pigeons and mirror flash signal messaging ("*heliography*")

Fig. 2: 12th - 13th c. frit-ware *mina'i* painted and gilded bowl with relief decoration. Met. Museum, New York. Acc. No. 57-36-8. Enthroned ruler, official to left and right within a hexagon, surrounded by six seated signallers, between each, the relief moulded representation of a mirror in its pivoting ring

Fig. 3: Detail of Fig. 2. The relief moulded representation of a signalling mirror in its pivoting ring with the sighting mechanism, with possible biconvex lens, on its vertical support, linked to a pair of wings below the rim indicating speed.

Fig. 4: Kashan, Iran, late 12th -13th century mina'i-frit-ware bowl. British Museum, London (Inv. 1930,0719.63) Enthroned ruler, official to either side. Above and below a representation of the advanced signaling device with a pair of wings and Jinn of the Land figures to either side. To left and right a pair of winged simple mirror signaling devices. Above a band of underlined encoded message boxes and the zigzag pattern on the rim

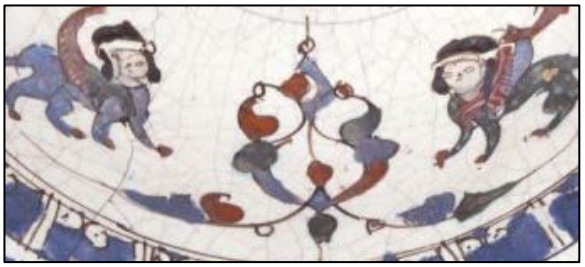

Fig. 5: Detail of fig. 4, showing the advanced winged signaling device with arm extending out to the right (to ensure the device is clearly represented), sighting ring-lens at the tip, red filter attached to the other end of the arm. The other advanced device has a blue filter depicted

Fig. 6: 12th -13th century Iran *mina'i*, frit-ware bowl, Brooklyn Museum, 86.227.65. *kāsıd* in the center with a pigeon, surrounded by a band containing four signaling devices, each with two pairs of wings, with pairs of seated signalers-observers between them, a band of text message boxes above and the zigzag design on the rim

Fig. 7: Detail of Fig. 6, of one of the four signaling devices, each with two pairs of wings, showing the sighting mechanism and possible biconvex lens, with the targeting spot represented in the lens of the targeting circle, the dot in its center, the targeting circle on a vertical support, with the mirror angled behind it, with the curved enclosing arms to either side perhaps serving as signal breakers

Fig. 8: Kashan mina'i bowl c. 1200, Christies, London, Sale 7871 - Lot No. 112, 5/10/2010. Three mounted couriers across the center, left to right, messenger pigeons and a pair of signalers either side of the pair of winged optical signaling devices above and below. A band of encoded text in message boxes below a blue and white zigzag on the rim. The scene depicts *barīd-istibarat* communications

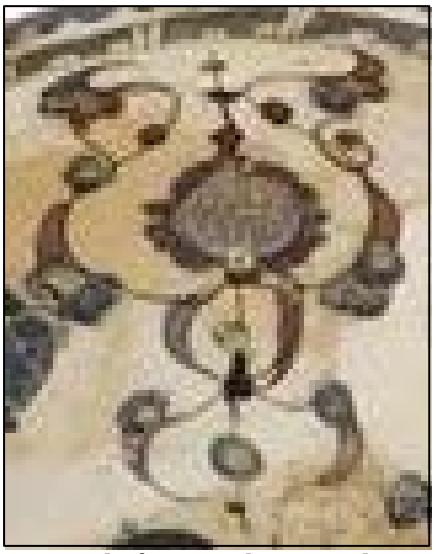

Fig. 9, Detail of Fig 8: The upper device has what can be understood as the depiction of a sequence of perhaps three lenses extending out on a rod out from the base of the pointed leaf-shaped parabolic mirror and, around the mirror, a series of colored disks, presumably the filters

Fig. 10: Iran, Kashan, c. 1170 - c.1220, frit-ware mina'i painted bowl, Fitzwilliam Museum, Cambridge, no. C.146-1935. Barīd communications: mounted couriers, messenger pigeon and winged mirror devices, one with a pair of signallers, the other with a pair of Jinn of the Land figures, depicted in the bowl. Above, a band of message boxes and a blue and white zigzag on the rim.

Fig. 11: Underside of Fig. 10 (Fitzwilliam Museum, Cambridge, no. C.146-1935), depicting the 3 disk encryption device with 44 pointers-rays in three colors, blue, green and red, presumably employed in *barīd-istibarat* communications

Fig. 12: 12th-13th century Iran, mina'i frit-ware bowl, Metropolitan Museum, NY. No. 20.120.99. The two designs of 4 segments right and left of the central seated figure may provide the colour code settings, right, B T B R and T B R B right where R=Red T=Turquoise and B=Blue. Above and below two winged complex signalling devices, on either side paired wings, perhaps resembling Fig. 4, but if simple winged mirrors, remain incomplete. The band of signaled coded text in a sequence of 34 colored message boxes, may starts from the doubled red boxes upper left, read counterclockwise around the band is: R T B R B T B R B T B R B T B R B T B T B R B T B R B T B R B T B R. What has been represented is therefore a code in three different colours, not any random or any accidental sequence of coloured boxes. Each box separated from the next by a double space split by a black vertical line, which could be read as a double white flash. On the rim the blue and white zigzag

Fig. 13: Left, detail of a Seljuk *mina'i* bowl c. 1175-1225, British Museum, London, No: 1914,0318.1, the signaling device (in fact) behind the enthroned ruler resembles that represented on the right, a relief carving depicting the advanced mirror signalling device, carved on either side of the North portal of the 1228-9 Divriği Ulu Cami

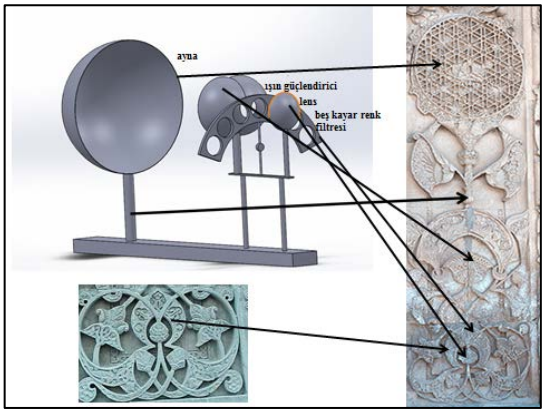

Fig. 14: Upper left, working model of the device. Right the 1228-9 Divriği Ulu Cami, North portal relief carving of the mirror signalling device. Read from the top down: mirror, wings, shutter, light intensifier, ring of five slit apertures (presumably coloured filters) and lens, which can be understood to have been placed in this position of prominence either side of the Mosque entrance to remind of the descent into this world of the Light of The Word/*nūr-i ilāhi*. Lower left, detail of the carving of the slit apertures of the colour filter and the lens

Fig.15: *Ayat al-Kursi*, The Throne Verse, the 255th verse of the second surah *Al-Baqara*, surrounding depictions of this winged optical signaling device on a lustre painted Kashan 8-pointed sun/star tile today in the Detroit Institute of Art (Acc. No. 25.57), probably from the Imamzada Yahya in Veramin near Tehran where the 1265 lustre painted tile-work, both 8-pointed and cross-tiles, repeatedly employs representations of this light signaling device to indicate the Divine Light-*nūr-i ilāhi*

Fig.16: The entire first surah of the Qur'an surrounding the depictions of this winged optical signaling device on a Kashan lustre 8-pointed sun/star tile today in the Metropolitan Museum, New York (Acc. No. 91.1.105) probably from the Imamzada Yahya in Veramin near Tehran where the 1265 lustre tile-work repeatedly employs representations of this light signaling device to indicate the Divine Light-*nūr-i ilāhi*