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Geometric art in Islam: a contribution to the work of J. Bourgoin

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GEOMETRIC ART IN ISLAM:

A CONTRIBUTION TO THE WORK OF J. BOURGOIN

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The following thesis is composed of three parts:

Part A - The Text

Part B - The Drawings

Part C - The Photographs

These three parts form one unit in that both Parts B and C are illustrations of Chapter III of the text.

PART A - THE TEXT

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Abstract

The attempt herein is to begin to give some historical relationship to, some beginning outline of, the development of geometric decorative art in Islam, especially in Egypt. Admittedly this is an enormous task, which is only possible when there is a large amount of data available, on the basis of which to begin to draw some conclusions. Thus, the major part of the thesis consists in just this documentation.

Initially, two facts made possible the collection of precise data on the histories of a large number of designs. Primary we may consider the fact that Egypt ultimately was the place of usage of a very large percentage of the types of designs (and specific exact designs) known in Islamic art (it probably has the largest variety of any Islamic country). This fact of usage, of course, would be unknown to us if there had not been preserved such a tremendous quantity of historical material, particularly architecture. The second condition which enabled an early beginning of collecting the precise kind of information needed was the discovery of Jules Bourgoin's Les Eléments de l'Art Arabe: Le Trait des Entrelacs, a work consisting of one hundred-ninety analytical drawings of Islamic geometric repeat patterns largely drawn from Egyptian monuments. No information as to historical provenance of the patterns is included in the work or elsewhere but it soon became clear that these were drawings of historical designs. They thus were used in conjunction with photographs in books, identifying, when

possible, the patterns of the designs on historical works of art with the corresponding drawings. At a later stage came the making of photographs of details of geometric decoration not shown in books. After a year or so of collection and identification began the process of learning the methods of drawing the designs, which allowed both correct analysis of designs not found in the Trait of Bourgoin, and fuller understanding of the ones he (and a few others) had already drawn.

Preceeding the list of these identifications (as well as the analytical drawings and necessary private photographs), are a critical summary of the literature on the subject under consideration and a detailed statement of what has been done in the compilation of the "List". Following the "List" is an attempt to make some summarization of the more salient historical information brought into focus by the collection.

First, it seemed that the center of creativity, for whatever reasons, shifted with time from one part of the Islamic world to another. Predictably perhaps, Syria was the first great center. It is more or less well-known that pre-Islamic Syria provides a large quantity of geometric art, and the first Islamic dynasty built buildings, particularly palaces, which show a tremendous burst of creativity in the genre and the establishment of some classic patterns. No evidence was found of any advancement (and almost no usage, save in Ibn Ṭūlūn's mosque) during the 'Abbāsid period; the earliest new (post Umayyad) patterns appear at the end of the tenth and beginning of the eleventh centuries in Central

Asia and Īrān. And it is Persia that continues in the vanguard through the twelfth century. Developments seem to have been particularly dramatic there between 1050 and 1150, with the earliest known (straight-line) twelve point star pattern in 1067-68 and the earliest known ten-point star pattern in 1088; and in the latter half of this period one finds such developments as the type of pattern with the well-known radiating rosette star complex, patterns with stars of as many as sixteen points, patterns combining stars of three different numbers of points and even patterns combining eleven-pointed stars into infinite patterns.

For the earlier thirteenth century, no country competes with Anatolia in the profusion and/or complexity of patterns encountered; it is from this country that early Mamlūk Egypt seems to have received enormous windfalls of geometric art tradition. In the Fāṭimid period, Egypt in general shows considerably less quantity and sophistication than Persia; and tracing the motifs on Fāṭimid Egypt's most remarkable monuments, (the two portable miḥrābs of Sayyida Nafīsa and Sayyida Ruqayya) shows evidence that Persian developments were making their way into Egypt.

On the other hand there seems to be little or no transmission of Anatolian Seljūq designs to early twelfth-century (Ayyūbid) Egypt. It is only with the beginning of the Baḥrī Mamlūk period that dramatic evidence of Anatolian influence appears in Egypt. This period of apparent influence seems most intense up until about 1325. It is somewhat remarkable

that after this date very few of the patterns appearing in Egypt for the first time can be shown to have foreign precedents. Particularly for the later Mamlūk period, conclusions seem at this point premature; but at least in usage, Egypt seems throughout almost the entire Mamlūk period to be the foremost center of geometric art in the world.

INTRODUCTION

BOURGOIN'S POSITION AS ISLAMIC ART HISTORIAN

Though the subject of geometric art in Islām has been largely neglected, one should perhaps in the beginning make the point that Jules Bourgoin is neither the only scholar to draw the compositions involved, nor the only one to analyze them. Why then conjunct his name with the subject so intimately, implying, as our title does, that his work is the foundation on which one builds, the body to which one adds?

In brief, the reasons are: 1) Up until his publication in 1872 of Les Arts Arabes, no one, to my knowledge, had shown any analyses of Islamic geometric designs; suddenly this wonderful book, setting down systematically the principles of two-dimensional geometric construction of the type involved in art, more specifically Islamic art--no one since has set down these principles so thoroughly and systematically; 2) No one else has provided us with such a corpus of analytical drawings of Islamic geometric compositions--particularly noteworthy in this regard is his Les Eléments de l'Art Arabe: Le Trait des Entrelacs, published in 1879 (because of the frequency with which I shall refer to it, I shall generally adopt the abbreviation, "T. des E."); and 3) Despite the absence of information concerning source for the 190 épures

in the Trait des Entrelacs, the works of Bourgoin[1] probably provide more source-identified, analytically-based drawings than are provided by all other works combined.

[1] Each of the works of Bourgoin will be dealt with more thoroughly below, Chapter II.

CHAPTER I.

A SURVEY OF SOME RELEVANT LITERATURE.

At this point it is perhaps worthwhile to go in some detail into an enumeration and evaluation of works known to me, in which one has drawn and/or analyzed Islamic geometric designs. This discussion will be simplified and clarified by distinguishing from the beginning between those who show or explain the analytical (geometrical) basis of their drawings, and those who do not. The latter can generally be assumed to have made their drawings by some mechanical, non-understanding method. Under each of these two headings (i.e., those who analyze as opposed to those who merely represent) the works will be arranged chronologically.

A. Works Showing Drawings of Designs, Without Analyses.

1. Description de l'Egypte, Etat Moderne, Paris, 1809.

Very little Islamic Architecture is pictured in the Description de l'Egypte; and when it comes to details, the amount is extremely small. All the details I have been able to find are in the Tome Premier, Etat Moderne; and in this volume are the only attempts I have found, on the part of the Expédition's draftsmen, to draw Islamic geometric-repeat designs. The quality of these attempts varies considerably, perhaps with the individual draftsman involved; it is clear, however, that all the draftsmen avoided all but the simplest designs. For example, pl. 36 shows a fairly close-up view of the front of the minbar of the Madrasa of Sultān Ḥasan; but the complex design on the door of the minbar (T. des E. 131) has been avoided by

making the door-panels entirely blank.

The most complex designs represented are eight-point patterns (pl. KK, Figs. 16 & 21); and not surprisingly, these are interior details -- seemingly the comfort of the copyist's situation encouraged closer study.

The worst examples one can point to are in pl. 58, which is an elevation of the "Maison d'Ibrahim Kikheyd el-Sennary" (including entrance). Here two different and very simple six-point patterns are almost totally misunderstood and horribly deformed.[2]

Relative to the better of the drawings in the work, one doesn't quite know whether to be amazed that the draftsmen could produce any kind of likeness, considering their unfamiliarity with this sort of thing; or to wonder why they aren't better, considering that they had some sort of means for projecting the image onto the paper, which they almost surely did.[3]

2. Pascal Coste, Architecture Arabe ou Monuments du Kaire, Paris, 1839. For our purposes the most noteworthy drawings in this work are: 1) the side of the minbar of Lāǧīn at the Mosque of ibn Ṭūlūn, which is quite accurate in its geometrical proportions (pl. V);[4] and 2) the S.W. side of the minbar of Qāytbāy

[2]One is allover hexagons and six-pointed stars, or T. des E. 1a; and the other is allover six-pointed stars and regular (double equilateral triangle) lozenges.

[3]See Carré, Voyageurs et Ecrivains, pl. 21, "Vivant Denon dessinant une ruine (1799)" "D'après la Description de l'Egypte," in which some sort of mirror or grid-screen is apparently mounted on the drawing board.

[4]See my "List", T. des E. 143, for this pattern.

in the Khānqā of Farag ibn Barqūq, also accurate (pl. XI).[5]

3. Girault de Prangey, Monuments Arabes d'Egypte, de Syrie et d'Asie Mineure, Paris, 1846. (He also published in 1839 a work on the monuments of Cordoba and Sevilla, which I have not seen). For a not unrepresentative example from the 1846 work, we may choose the one of the sanctuary of the Mosque of ibn Tūlūn (pl. "12"), in which the minbar is somewhat fuzzy, and what lines are present are wrong. But he does show a window from the same mosque (pl. "13") which is accurate enough to be recognized as the pattern which is numbered "175" in Bourgoin's Trait des Entrelacs.

4. F.M. Hessemer, Arabische und Alt-Italienische Bau-Verzierungen, Berlin, 1853. This work is full of very accurate drawings. Most of the drawings of Islamic designs are from Egyptian monuments, and the analyses of many are to be found in the T. des E. Perhaps the best characterization of Hessemer's work would be to say that I saw no drawings of geometric compositions which seem inaccurate.

5. Owen Jones, The Grammar of Ornament, London, 1856 ("One Hundred Folio Plates, Drawn on Stone by F. Bedford..."). Jones says (p. 4, proposition 8), "all ornament should be based upon a geometrical construction." But alas! He (or Mr. Bedford) also does not show the construction, even of his geometrical "ornaments." The work is, however, characterized by highly accurate drawings of geometric motifs, several of which also are to be found in the T. des E.

[5] See my "List", T. des E. 133, for this pattern; and photo, Fig. 138.

6. Prisse d'Avennes, L'Art arabe, d'après les monuments du Kaire, Paris, 1877. Here, the geometric details could be better. Another work of Prisse d'Avennes (Histoire de l'art Egyptien d'après les monuments, Paris, 1879) has a large number of accurate drawings of allover repeating geometric motifs from the ceilings of New Kingdom tombs at Thebes, again without visual analysis of structure.[6] He does go so far as to comment (accurately) that these latter designs are based on a square grid, and that the curvilinear motifs are derived form the straight-line ones.

7. E. Collinot et A. Baumont, Encyclopédie des arts décoratifs de l'Orient, Paris, 1883. Characterized by very bad renditions of motifs in practically every respect.

8. Friedrich Sarre, Reise in Kleinasien--Sommer 1895, Berlin, 1896. This work contains a number of quite accurate illustrations by "G. Rehlender", including one of the framing band of the portal of the Konya-Akseray Sultan Han (Fig. on p. 81). This a very complex design but was almost surely not constructed by geometric principles for this "drawing."

9. Eduard Jacobstahl, Mittelalterliche Backsteinbauten zu Nachtschewân im Araxesthale, Berlin, 1899. This work is almost entirely taken up with the tomb tower of Mu'mina Khātūn; and considering the complexity of certain designs on that monument, it is fortunate that Jacobstahl is the one who has done the study. The drawings are surely mechanically produced--even the shadows are copied--but they are of an astonishing

[6] See my drawings K-1, K-2 and K-3.

accuracy, being much better to work from than photos, which latter always distort proportions.[7]

Summary of Non-analytical Works.

It will be noticed that all the above works belong to the nineteenth century. I would suggest that the type of "drawings" discussed above, as non-analytical copies of motifs found executed on monuments by Islamic artists, has been superseded by the practicability of printing photographs in books.

A species of illustration even less worthy of the name "drawing" has come to be occasionally practised in more recent times, largely made possible by photography. I speak of the practice of tracing over a design (usually in a photograph) and publishing it as the structure of the design in question (with no verbal explanation)! At this rate anyone is a draftsman and no one learns anything. I am loath to belittle the efforts of anyone who exhibits the slightest interest in geometric art, but perhaps criticism can bring about higher standards. Particularly noteworthy examples of the practice are in Ernst Kühnel's "Der Mamlukische Kassettenstil" (Kunst des Orients I, 1950) and in Semra Ögel's Anadolu Selçuklulari'

[7] To Jacobstahl goes at least part of the credit for my success in analyzing and drawing the design from Mu'mina Khātūn which contains thirteen- and eleven-pointed stars (see drawings K-21 and K-22). Other designs represented by Jacobstahl include T. des E. 48 and 51, as well as K-8. For all these, see the "List" included here.

nin Taş Tezyinati.[8] It is clear that Kühnel's illustrations are tracings by the sheer irregularity of line and sloppiness of execution. As for Ögel, certain of her "drawings" (e.g., "Şek. 1") exhibit the characteristic irregularities and displacement of line of the coursed stone original, leading inevitably to the conclusion that they were traced from photographs.

B. Works Providing Analyses of Designs.

1. Jules Bourgoin, Les Arts Arabes, Paris, 1872; Les Eléments de L'Art Arabe: Le Trait des Entrelacs, Paris, 1879; Précis de l'Art Arabe, Paris, 1892; and three smaller works in the form of articles. I merely list Bourgoin here to reiterate his primacy. I shall take up each of his works in some detail in Chapter II.

2. Al Gayet, L'Art Arabe, Paris, 1893. This somewhat general work of Gayet includes a section, beginning on page 93, called "Le Tracé Géométrique des Polygones," which deals with the basic elements of geometrical construction. Though he gives no credit, this "work" of his consists of intermittent paraphrase and outright quote from J. Bourgoin's "Le trait de l'art Arabe: La géométrie des polygones" (which forms the first part of Les Arts Arabes). There is absolutely no question of the thievery when one systematically compares the phraseology, the order of presentation and/or the examples offered. Gayet's malicious

[8]This book also has what seem to be tracings from older drawings, apparently without credit: notably, the drawing from Sarre's Reise in Kleinasien mentioned in No. 8 above; and Jacobstahl's Fig. 13. But perhaps these are true "originals," i.e., traced directly from photographs.

intent to claim all this as his own is proven by his statement (at the end of his section on the polygons one can assemble around a point on a plane surface, copied example for example from Bourgoin's text and figures): "j'arrête là ces citations par trop algébriques pour n'en retenir que la philosophie des formes assemblés".[9] This is a phony fast-talking excuse; the relevant fact is that this is precisely where Bourgoin stops his enumeration of possible assemblages!

Whereas Bourgoin's work goes on to a systematic and thorough analysis of methods of drawing the more complex geometric designs (which he and others call "entrelacs", and which include both star-patterns and various "meanders", etc.), Gayet contents himself with showing one example, which is a star-pattern with seven- and fourteen-pointed stars.[10] He admits, for once, that it is not his own analysis; "je le transcris d'après un traité de géométrie décorative sans y rien ajouter".[11] Following this remarkable admission is a quotation-marked passage giving instructions for drawing the design (though again he does not give the source); perhaps predictably, we find that it has been taken from Bourgoin's Les Arts Arabes.[12]

[9] p. 96.

[10] The design corresponds to T. des E. 167.

[11] p. 98.

[12] Part II, p. 27, example No. VII. It is interesting to note that Gayet's "drawing" includes strapwork which is not present in Bourgoin's diagram. Has Gayet adapted Bourgoin's drawing to some historical occurrence he has found?

Gayet's book has numerous illustrations taken from Bourgoin's works, even including the Précis, which was published only one year before his own; and even this copying is inaccurate. For example, his Fig. 73 is a black-and-white rendering of Précis II, pl. 16: while Bourgoin identifies it as mosaic from Italy, Gayet says it is from the Mosque of Sultān Ḥasan.[13]

Gayet does add from his own side certain general statements. For instance, he says that the drawing of these designs rests on geometry, that it has nothing in common with art and that it has been formulated as problems by Arab mathematicians.[14] This runs contrary to the position taken by Bourgoin in the "Introduction" to Les Arts Arabes, where he maintains that geometric art has little to do with theoretical geometry in the sense that the former has a life and development of its own. It is based, he says, on intuitive empirical discoveries made by the artisans themselves on the basis of the development of their art and "par une synthèse pratique des éléments adéquats préexistants", although it is implicitly bound by the theories of geometry; "c'est-à-dire que les donnés fondamentales qui constituent l'art du trait sont aussi les donnés fondamentales de la science de la géométrie".[15]

[13]The design corresponds to T. des E. 84; to remove any question from the mind of the reader, we may say that no such design exists in the mosaics of Sultān Ḥasan's mosque.

[14]p. 93. He cites, in quotation marks, certain geometric problems supposedly posed in Arab mathematical treatises, but gives no sources. He does mention one Wroicke, who is supposed to have analyzed these treatises. I have been able to find no information on any work by "Wroicke".

[15]p. 1.

The only other comments offered by Gayet in his section on geometric art which are not derived directly from Bourgoin are in the form of certain observations on the psychological effect produced by various geometric figures. These comments I would characterize as over-generalized and unfounded; any validity which any of them may have is of a simple-minded variety.[16]

3. E.H. Hankin: 1) "On some discoveries of the methods of design employed in Mohammedan Art", Journal of the Society of Arts, LIII, 1905; 2) "The Drawing of Geometric Patterns in Saracenic Art", Memoirs of the Archeological Survey of India, No. 15, Calcutta, 1925; 3) "Examples of Methods of drawing Geometrical Arabesque Patterns", Mathematical Gazette, IX, 1925; 4) "Some difficult Saracenic Designs", Mathematical Gazette, XVIII, 1934, and XX, 1936. As Creswell points out in the Bibliography (column 970), the latter two are numbered "II" and "III", and a note at the end of "II" "shows that it is a sequel to Examples of Methods, which must therefore be regarded as No. 1." This series of three articles contains what their titles imply: i.e., analyses of relatively complex star patterns (or "geometrical arabesques", to use his terminology). It is in the other two articles that Hankin most clearly and systematically lays out his method for constructing geometric designs.

[16] Examples (pp. 97-98): figures with an even number of sides produce calm, sweet, serene sentiments; figures with an odd number of sides produce a vague melancholy, incertitude, etc., by their lack of symmetry and equilibrium; and the juxtaposition of the two forms gives a mixed impression, determined by the proportions of their combination (!).

Hankin was familiar with the work of Bourgoin, though I am not clear as to just how thorough was his knowledge of Parts I and II of Les Arts Arabes. In any case, beside discovering some original construction lines of a design in a dome interior at Fathpūr Sīkrī (see fuller discussion below), he has increased the number of recorded and analyzed designs.[17]

It was Hankin's discovery of a design on the interior of a dome in the Hākim's bath at the Jodh Bai Palace, Fathpūr Sīkrī, that led him to elaborate his method, which he apparently thinks is different in a basic way from that of Bourgoin. In the design in question, an eight-pointed star occupies the center of the dome interior, and is surrounded by and tangent to alternate five- and six-pointed stars, which are in turn surrounded by more five-, six-, seven- and eight-pointed stars. Through the tips of some of these stars, at right angles to their axes, he found faint scratched lines which, when completed, would form polygons of five, six, seven and eight sides, in which the stars would be contained. He would seem entirely justified in concluding that these faint scratches were the primary construction lines of the craftsman. It should be readily apparent that on the curved but not spherical surface of a dome (where none of the known or directly calculable assemblages would be valid) there would be a great advantage in working out such a framework beforehand (the polygons are not entirely regular, to judge from his drawing, "On Some Discoveries...", Fig. 8).

[17] It was in India that Hankin did his field work, and he is the only one I know to have dealt with Indian designs.

I think, however, that Hankin was too deeply impressed by his discovery (more on this a bit later).

Hankin begins his earliest essay (read before the Society of Arts) thus:

> The most striking peculiarity of Mohammedan or Saracenic art is the employment of extremely complicated geometrical patterns. The actual methods by which these patterns were drawn and designed, are, so far as I am aware, unknown to modern artists, either in Europe, in India, or in Egypt. The works of Prisse d'Avesnes [sic], of Bourgoin, or of Gayet, dealing with Arabian art, are equally destitute of any satisfactory explanation of the matter.[18]

It is very interesting to compare the above quotation with a passage from Hankin's "The Drawing of Geometric Patterns in Saracenic Art" of twenty years later:

> The method of drawing such patterns is quite unknown at the present day in India and during a visit to Cairo, some years ago, I found no evidence that it was known to the Egyptian workmen. They were making beautiful products of Saracenic art, but appeared never to attempt to reproduce the more complicated patterns used by their predecessors.[19] Lack of knowledge of the methods appears also to

[18] "On some discoveries...", p. 461. It would seem that a good study of Bourgoin's earliest work and of that of Gayet would have apprised Hankin of, among other things, the fact that the latter was copied from the former and he would therefore not have mentioned Gayet in this manner.

[19] On repeated visits to a large marble-inlaying workshop (in the courtyard behind the Mausoleum of Timurbāy al-Husaynī, opposite the north end of the Southern Cemetery) which makes qibla walls for new mosques and does restoration of old ones (they claim to have restored the qibla wall of the Mosque of an-Nāṣir Muḥammad in the Citadel), I have seen only three or four patterns; and these are among the simpler ten- and twelve-point patterns. Though the workmen insist that the Mu'allim makes the designs, including new ones, I saw no evidence for this; when I asked the Mu'allim to show me some drawings he produced only a simple type of layout drawing. On the other hand, I was on one occasion shown a set of steel templates for getting the required angles on the pieces of marble to be cut; and the explanations offered as to the difference between two ten-point designs led me to believe the understanding of them was superficial.

> handicap European artists when copying the more elaborate achievements of Saracenic art. For instance, Prisse d' Avesnes [sic] , in his magnificent work La décoration Arabe, gives a series of coloured plates. Of these, 64 contain geometric patterns of which no less than 60 belong to the classes of patterns that are easy to draw, namely the hexagonal, the octagonal and the decagonal. The only book known to me containing a large collection of the more complicated designs is Le trait des entrelacs by J. Bourgoin. This book contains 190 plates of geometric patterns shown in plain line engravings without colour. But elsewhere one looks in vain for illustrations of the more complicated of these patterns in decorative work, the fact being that in selecting these designs for illustration, the European authors have almost invariably chosen those patterns which are relatively easy to draw. Bourgoin's drawings are made with wonderful skill and industry, but the description he gives of the geometrical construction of the patterns is of little practical use and serves merely to show how his remarkable skill as a draftsman has enabled him to surmount the difficulties of his task.[20]

The only work of Bourgoin's which Hankin actually mentions in "On some discoveries..." is the Trait des Entrelacs. It is true that the drawing instructions in that book are somewhat opaque if one has not studied closely the "Trait de l'Art Arabe" in Les Arts Arabes. But Hankin had at least seen this latter work by the time he wrote "The Drawing of Geometric Patterns...", as he cites (p. 23) pl. 44 from it. One almost wonders whether his discovery of the polygons as primary construction lines and subsequent elaboration of the method did not put him in a position he felt obligated later to defend for all types of designs, even in his last essay.

What does Hankin pose as an alternative, what is the difference between his method and that of Bourgoin? In the simplest terms, the difference is only one of working proceedure. For analyzing a typical relatively complex star pattern, Bourgoin looks for the allover réseau created by a set of imaginary

[20] p. 3.

lines connecting the centers of the primary stars, while Hankin draws lines through the tips of the stars at right angles to the axes of those star-tips, thus coming up with polygons surrounding the stars (like the design he discovered in the dome interior--see above, p. 13). That both methods work is simply a testimony to the central truth of the geometric laws underlying and embodied in the design in question. Admittedly Hankin's method of having a set of polygonal templates can speed and sometimes simplify the process of drawing. But if one has as a problem the filling of a given space of a given size with a given design, those templates must be of precisely the right size; and all regular polygons are circle-based. This brings us back around to the bedrock of Bourgoin's proceedure, which would have one strike the required circles (with the required ratios of radii to distance center to center) in which to inscribe the stars, etc. One wonders, then, what is the necessity for making the preliminary polygons at all? Thus several of Hankin's examples seem to involve more circuitous methods than are necessary when one uses "Bourgoin's method"[21] (all methods go back to him).

Another interesting and useful contribution of Hankin is in his discussion of what type of panel shape is suited to a given design, and how to lay these out. A short discussion of this subject is to be found in "On Some Discoveries..." (p.471);

[21]For a relatively obvious example, see "On Some Discoveries ...", Fig. 9 (identical with "The Drawing of Geometric Patterns ...", pl. V, Fig. 28). Also, for a variant to his method which seems easier and more natural, compare "On Some Discoveries...", Figs. 6 & 7 (identical with "The Drawing of Geometric Patterns ...", pl. III, Fig. 21) with my drawing, K-12.

and a much more detailed discussion is to be found at the beginnings of the sections on "Hexagonal Patterns" and "Octagonal Patterns", in "The Drawing of Geometric Patterns..." (pp. 4-7). For the hexagonal group he even shows how to draw patterns in perspective. This is done, not because it has any connection with "Saracenic" art, but to show the "utility" of his method.

The last problem dealt with by Hankin in "The Drawing of Geometric Patterns in Saracenic Art" is that of the application of ten-point star-patterns to the interiors of domes, analyzing several such examples from Fathpūr Sīkrī. This is a fine and interesting bit of analysis which makes one wish he had applied himself to the problem of other star-pattern systems on domes (such as, to mention one example among many, that of the nine- and twelve-point pattern on the dome of the Mausoleum of Gānī Bek at Cairo). For the ten-point designs as analyzed by Hankin, one uses however many interradial segments from a decagon necessary to produce a cone of approximately the curvature of the dome in question. These interradial segments from a decagon naturally have proportions on which ten-point patterns fit; one simply covers one of them with one or more units of the pattern and this is repeated around the dome, each of the pre-determined interradial segments being treated alike.[22]

As indicated in the discussion of Gayet above, Bourgoin's

[22]This problem of applying patterns to domes seems to be dealt with to some extent in a 16th century manuscript published by Rempel, Architectural Ornament of Uzbekistan (see discussion below under section for this work).

Les Arts Arabes contains an extensive, if not absolutely exhaustive, section on the polygons which may be assembled on a plane surface; so, in every sense his work contains the foundation for any of the proceedures used by Hankin. But Bourgoin does not deal with the problem of the curved surface; and it is perhaps relative to this problem that Hankin makes his greatest contribution.

4. J. Collin, Etude Pratique de la Décoration Polygonale Arabe, Paris, [1911].

> Le présent ouvrage n'étant qu'un recueil de modèles, nous n'étudirons pas la décoration arabe, ni au point de vue historique; ni au point de vue religieux ou philosophique: nous nous bornerons à rappeler que la décoration polygonale se forme vers la fin du règne des Khalifes fatimites en Egypte (a l'époque de la 1ère Croisade) avec les éléments fournis par les architectes ou décorateurs chrétiens Coptes, pour se developper et disparaître avec la fortune des armes arabes. Pour le reste, nous renvoyons aux ouvrages spéciaux. Comme ouvrage élémentaire nous recommanderons "L'Art arabe" par Al. Gayet ...[23]

We are, I think, in a position to reject entirely Collin's contention about the early Islamic geometric motifs being of Coptic (or even Egyptian) origin. In the first place, Umayyad art (which happens to be in Syria) shows a tremendous development of "decoration polygonale" or "entrelacs", particularly of the hexagonal family. Secondly, as far as allover repeating geometric patterns are concerned, most of those found in Fāṭimid art can be shown in examples from Persia and/or Central Asia of considerably earlier date than any known Egyptian occur-

[23] p. 1. See above discussion of the work of Gayet, as well as my comments about Hankin's inclusion of Gayet along with Bourgoin as an authority (footnote 18).

ence.[24]

In light of Collin's introductory statements (what exactly does he mean when he refers to his work as "n'étant qu'un recueil de modèles"?) as well as certain other facts, his technical methods should perhaps come under less criticism than one would otherwise be inclined to offer. The stress on application presumably derives from Collin's position as "Inspecteur du Travail Manuel et du Dessin dans les Ecoles de Tunisie"; his work under consideration was "...publié sous les auspices de la commission officielle pour le relèvement des industries d'art indigènes de Tunisie" (from title page). If it were merely and simply a case of stress on application, one could just write the work off as such. But in his drawings he always includes strapwork (the same type and width in each drawing, ruling out their relating to the specific object from which they have been copied); that is, the drawings are not merely of basic analytical lines--the lines have width. To provide this line width, Collin introduces calculations, percentages, ratios and degrees in a fashion and to an extent which is totally unnecessary. One can always widen the basic line and arrive at the desired result with a fraction of the operations he resorts to. As a concrete example, I shall call attention to a design which is very popular in Mamlūk (especially 14th. century) Egypt, and which goes back at least to the tomb tower of Mu'mina Khātūn--K-8. Not finding this design in the Trait des Entrelacs, I decided to draw it myself; for, while it is to be found in

[24] Particularly relevant in this connection are T. des E. 12, 18, 20, 25 and 89. See, for general discussion of the development of geometric design in Islām, my final chapter.

Collin's work (pl. 19--where the Mu'ayyad Qur'ān occurrence is cited), Collin's prescription for drawing it is ridiculously formula-ridden and only serves to cloud the great simplicity of the design.

Though Collin recommends Gayet and makes no mention of Bourgoin by name, he in the most general way follows Bourgoin's method of establishing the réseau, then striking circles from the apexes of the réseau-polygons; and he seems to be referring to Bourgoin when he says:

> Au sujet de la répétition, certains auteurs ont écrit que la construction du réseau se ramenait à la question de géométrie appelée "problem du dallage" [not Bourgoin's phrase] par laquelle on se propose d'assembler autour d'un point des polygones réguliers égaux de manière qu'il n'y ait pas d'espace vacant adjacent à ce point. Cette proposition ne peut être généralisée, car si elle est vraie pour des dessins tels que ceux des planches 20, 21, etc., elle ne l'est plus pour ceux des planches telles que Nos. 10, 28, etc.[25]

If this criticism is levelled at Bourgoin (and I do not know to whom else he could refer), then it would seem that M. Collin has not been fair enough to study Bourgoin fully. In the first place, Bourgoin is far from asserting that the réseau will always be composed of regular polygons in juxtaposition; and his works contain many designs (with their visual and verbal analyses) in which the réseau develops from the division (radii, interradii, etc.) of a basic (star) unit and its extension. This proceedure is particularly noteworthy in his "Famille Pentagonale" and "Famille Heptagonale"; it can be used for many other types of designs, for example those with 11 (or other odd

[25] p. 2.

number) points.[26] Most devastating to Collin's argument in the above quotation is the fact that the two designs he cites as not being repeatable on the basis of polygons arranged around a point are so repeated. His "28" is to be found in the T. des E. as No. 97; and as Bourgoin shows and explains, it is on a réseau of a particular type of lozenge. Collin's "10" is on a rectangle réseau, and the positions of the stars are related directly to each other by way of extensions of the lines forming their tips, thus determining the proportions of the rectangle.

The only real value in Collin's work lies in the fact that he has provided the sources from which he has derived his designs;[27] although even these are sometimes mistaken, as in his plate 75. This design he pedigrees, "Le Caire--Mosquée El Moyed: marqueterie de marbre". I know of no such design at Mu'ayyad's mosque; whereas it does occur inside the portal (carved, not in marquetry) of Sultān Ḥasan. But even so, Collin's drawing, though unmistakably this arrangement, is somewhat incorrect in its proportions (see my list under T. des E. 61, variant No. 2; and drawing No. KT-5).

Thus it is partly for his inaccuracy; partly for his general casualness (for example, he doesn't tell from what part of a monument the design comes--nor does he tell even the approximate date); and partly for the fact that the majority of the occurrences he cites seem to be late Tunisian examples, that I have not incorporated his citations in my

[26] See my drawings K-21 & K-22 for an 11- and 13-point combination drawn in this way.

[27] In all, he has 90 motifs, including "encadrements".

list of occurrences. I have weighed each instance and I do not feel that the correctness or incorrectness of his data would make a great difference in any historical conclusions one might draw. Below I shall append a list of his designs which correspond to drawings in the Trait des Entrelacs. Beside these designs shared with Bourgoin's Trait, one may point out that a great many of the designs in Collin's work are of the square/octagon system and of a type which is apparently typical of the Islamic West, having no significance for Cairo and eastward. Finally, I make special mention of the design in his plate 65, an interesting ten-point pattern I have not seen elsewhere. It is identified "Perse--Revêtement extérieur en faïence du dôme d'une mosquée" and is closely related to T. des E. 171.

5. Archibald Christie, Traditional Methods of Pattern Designing, Oxford 1929. This work contains some interesting discussion of the use of geometric patterns of the 60° system by 13th century European artists, such as the Cosmati mosaic workers (p. 250, ffl.). He also publishes a drawing after a sketch in da Vinci's Il Codice Atlantico (Fig. 327) and discusses certain plates made from designs by Leonardo, pointing out that all of these drawings of da Vinci are of Islamic derivation, perhaps from Mamlūk metalwork.[28] Although Christie does not go into great detail in analyzing Islamic designs, his work is generally sound.

6. Ernst Herzfeld, Archäologische Reise im Euphrat-und

[28] pp. 287-88. Bourgoin (Le Trait des Entrelacs, p. 9) had already noted "qu'en pleine Renaissance italienne, Léonard de Vinci lui-même, à ce que nous apprend Vasari, perdait son temps à combiner laborieusement des entrelacs".

List of Designs in Collin Which Are Also in the *Trait des Entrelacs*

Collin pl. no.	= *T. des E.*		Collin pl. no.	= *T. des E.*	
1.	1	1a	15.	61	171
2.	2	5	16.	62	187a
3.	4	2b	17.	63	179
4.	6	18	18.	64	187b variant--as at Sālih Talā'i', Taybarsīya; & Timrāz al-Ahmadī
5.	7	21	19.	66 (partly curvilinear)	175
6.	16	38	20.	67	164
7.	21	76	21.	68 (different in interior of 7-point)	167
8.	22	77	22.	75	61 variant--see previous page
9.	23	94	23.	79	104
10.	24	93			
11.	26	96			
12.	27	120			
13.	40	48			
14.	48 (incorrect in proportions, although identified as ibn Tūlūn minbar design)	143			

Note: There is a curious set of coincidences in the numbers Collin has used for certain of his patterns in relation to the numbers used for the same patterns in the *Trait des Entrelacs*. Thus: No.1 (identical numbers); No.6 (*T. des E.* 38 is a curvilinear pattern with the same elements as *T. des E.* 16); Nos. 7 & 8 (is visual similarity enough to explain these two patterns being successive in both works?); Nos. 9 & 10 (see immediately preceeding comment). These coincidences seem of themselves to suggest awareness on Collin's part of the work of Bourgoin.

Tigris-Gebiet (with F. Sarre, but the geometric drawings and discussion are Herzfeld's), Berlin, 1911-20; "Damascus: Studies in Architecture", in Ars Islamica IX, X, XI-XII and XIII-XIV (1942-48). Herzfeld presents us with the almost unique phenomenon of a scholar who deals with architectural problems of a general type, and at the same time deals personally with geometric decoration as he encounters it. That he did not shrink from difficulty is shown by his analysis of a design with ten-, eleven-and twelve-pointed stars from the Maqām Ibrāhīm in Aleppo (which he dates 616 H., though his reasonsfor so doing are not clear). The design is from a wooden panel and he calls it "the most complicated design ever produced by that branch of art", asserting further (in his footnote 76) that only one other of its type exists, being found in Hankin's "The Drawing of Geometric Patterns in Saracenic Art", Fig. 38, and drawn from Fatḥpūr Sīkrī. Exactly what constitutes the type of which he is speaking seems to be clarified when he adds (speaking now of his Aleppo example), "the almost unsolvable problem of a design based on horizontal groups of eleven-pointed stars is solved by alternative intercalation of a parallel group of twelve-pointed and one of ten-pointed stars between them".[29] Hankin's example to which Herzfeld refers contains stars of 8, 11 and 12 points; but the 11-pointed stars are not in "horizontal

[29] Ars Islamica X, p. 65 and Fig. 27.

groups"--rather in groups of four forming a square.[30]

In light of the fact that Herzfeld classes Hankin's pattern with his own, we can lengthen the list of designs illustrating solutions to the problem of combining eleven-pointed stars with other types of stars in harmonious patterns.

The earliest design of this type known to me is a combination of stars of eleven and twelve points in the miḥrāb (3rd blind arch panel, numbering outward from center, "first tier of stalactites") of the mosque at Barsiyān, near Iṣfahān, dated [11] 34.[31] I was unsuccessful in my attempts to reconstruct the design, the greatest difficulty arising from the fact that so small a section of the pattern is shown in the panel.

Dating from 1186-87, on the tomb tower of Mu'mina Khātūn at Nakhichevan, is a design which I consider the most perfect resolution of the problem of the pattern with eleven-pointed stars; and it is a design which to my knowledge is unique in Islamic art, for it contains also thirteen-pointed stars.[32]

[30]Although a diagrammatic drawing is shown and a full page of discussion is devoted to the design by Hankin, it all comes very close to being unworthy of the name "analysis". Hankin says he "apparently" figured out how it was to be drawn when he made the original sketch twenty years previous to his publication of the design, but that his notes were smudged and that what he gives is "so far as it can be deciphered", adding at the end (p. 21) that while a certain amount of "freehand rectification" was necessary to make it work, that it is "not so much as would be the case if the above directions are not followed." [!]

[31]M.B. Smith, "Material for a Corpus of Early Iranian Islamic Architecture", II, in Ars Islamica IV, Fig. 27.

[32]For the analysis of this design, see my drawings K-21 & K-22. While (unlike Hankin in the case cited above) I state clearly what I have done and believe my analysis to be essentially sound, it might perhaps have been facilitated (and maybe even more correct) had I had 11-sided and 13-sided polygonal templates with sides of the same length to work with. This only occurred to me after the drawing was made.

Next in time among 11-point star patterns known to me is one in a false-arch panel on the base of a minaret at Sinjār.[33] In this case, almost nothing more is shown than the 11-pointed star and its corona of five-pointed stars; but it is undoubtedly from a repeating design.

If one accept Herzfeld's dating of 616 H., his Maqām Ibrāhīm design would come next in our list of patterns with 11-pointed stars (see discussion above, p. 23). While Herzfeld's analysis seems precise and sound in the sense of being an accurate re-construction, he introduces an unnecessary and confusing factor by designating radii and interradii in terms of degrees and minutes, which we may be sure the original designer did not do; and these degree-designations do not seem to add anything even to Herzfeld's analysis as it stands.

The rectangular carved-stone frame of an interior doorway at the Karatay Han (1230-40) is decorated with a pattern combining very successfully stars of 9, 10 and 11 points (see Grabar and Hill, Fig.491). It would not be surprising to find other 11-point star patterns on Seljūq Anatalian monuments, given a careful survey.

The bronze-plated door of the Mosque of 'Abd al-Ghanī in Cairo (1418) presents us with a design in which vertical rows of 11-pointed stars alternate with vertical rows of stars of

[33] Sarre and Herzfeld, Archäologische Reise..., III, pl. IV, left. The minaret is dated 1201 (see Vol. 1, p. 9 for dating inscription). It is redundant but perhaps worthwhile to point out that here is another 11-point star pattern in a plate of a work of which Herzfeld himself was co-author.

8 and 10 points.[34] The visual appearance of this design is closer to the Maqām Ibrāhīm design than any other in the series. I have not made an analysis of it.

The last example in the series is that of Hankin from Fatḥpūr SīkrĪ. Visually this is the "odd man" of the series, its stars not having the elongated tips and irregular-hexagon surrounds that the others have.

So much for Herzfeld's almost-unique pattern. As the works of Bourgoin contain no patterns with 11-pointed stars, the assertion by Herzfeld that only two such patterns were "known" afforded a good opportunity to list those I have come across. And in view of the 7 examples just described, it is clear that Herzfeld should have added the insertion, "to me", to the statement, "there is only one more example known of this class..." (Ars Islamica X, p. 65, footnote 76).

In the same place referred to above in which he is citing Hankin's design, Herzfeld continues: "Hankin tries to find out the way in which the artists actually constructed these designs. My own inquiries lead me to believe that they start from the fillings, experimenting with them as with a jigsaw puzzle, but do not start from the geometrical framework". While he goes on to cite the terms used by al-Jazarī (to describe the pattern of the door he made for the prince of Āmid) and by modern craftsmen in Baghdād and Mōṣul, these constitute no sort of evidence as to the method of creation of the designs. And if it is their

[34] See Ḥasan ʿAbd al-Wahhāb, Taʾrīkh al-Masāgid al-Āthāriya, fig. 149; and Zakī M. Ḥasan, Aṭlas, Fig. 530.

creation (not the mere putting together of an object once the proportions and size of the polygons has been determined) that he is speaking of, then his theory is patent nonsense: for while certain designs, especially certain 10-point patterns,[35] will allow for rearrangements of the parts, these patterns are the exception to the rule--and even in their case the original determination of the precise size and shape must be derived from the "geometrical framework".

For other designs analyzed by Herzfeld (but which are also included in my list as drawn by Bourgoin or myself) and my comments about them, see: T. des E. 48, No. 4; 66a, No. 1; 123; 170, No. 1; 178; 187a, No. 1; and K-7, No. 2. Analyses of other designs are scattered throughout the above-mentioned (other?) works of Herzfeld. He is aware not only of the work of Hankin but also that of Bourgoin; and whenever he encounters and/or draws a design which is to be found in the Trait des Entrelacs, he mentions the fact, giving the épure number (with one exception--see T. des E. 35).

That Herzfeld had time for the study, practice and mastery of methods for analyzing complex star patterns, considering the vast range and quantity of his scholarly output, makes him an instructive and normative exemplary.

7. K.A.C. Creswell, Early Muslim Architecture I, Oxford, 1932; The Muslim Architecture of Egypt II, Oxford, 1960. Although Creswell has generally not shown much interest in the

[35] See below, my introductory comments to the "Famille Pentagonale" in my list of occurrences of designs from the Trait des Entrelacs.

geometric design of the monuments he otherwise has so thoroughly covered, his first volume of Early Muslim Architecture is noteworthy for providing several analyses of designs, both pre-Islamic and Umayyad. There is an interesting demonstration of the difference between patterns with octagons drawn on the basis of a small-square grid (in which case the octagons are not regular), and those where the octagons are regular (i.e., inscribed in a circle divided into eight equal parts). Creswell also analyzes designs in the 60° system, relating Umayyad to pre-Islamic examples.

The precision and historical orientation of Creswell's work in this regard (as in all others) makes one wish he had applied himself more to this problem, particularly for the periods dealt with in The Muslim Architecture of Egypt. But I have found in this work only one piece of geometric design documentation (aside from his superb photographs); in speaking of the Qalā'ūn complex, he says, "the pattern of the marble mosaic of the western basin is the same as that which fills the spandrels and the semi-dome of the mihrāb in the Mausoleum",[36] It is true that the pattern of the basin in question is the same as that of the spandrels of the mihrāb in question, being a pattern of 12-pointed stars on an equilateral triangle plan;[37] but the design in the hood of that mihrāb is one of eight-pointed stars on a square plan.[38]

[36] Muslim Architecture of Egypt II, p. 210, footnote 1.

[37] T. des E. 89; see, under it in my list, No. 9.

[38] T. des E. 42; " " " " " " " 6.

Creswell also has some comments to make about the prevalence and development of geometric design in the Fāṭimid period (in Vol. I of The Muslim Architecture of Egypt), and I shall discuss these in my last chapter.

8. R.W. Hamilton, Khirbet al-Mafjar: An Arabian Mansion in the Jordan Valley, Oxford, 1959. Though Hamilton himself apparently did not do any of the drawings in the work, but had them done by professional draftsmen, there is a highly commendable focus on and illustration of the tremendously significant collection of geometric art embodied in the balustrade panels and window grilles of this monument. The designs are clearly and accurately analyzed in very good drawings. If not a model to follow (there is no systematic study relating the designs to others before and after), this book is certainly conspicuous for its excellence in dealing with geometric design.

9. L.I. Rempel, Arkitekturnyi Ornament Uzbekistana, Tashkent, 1961. Although in a language unknown to me, this book I can confidently commend in its treatment of geometric design. A large work, it is full of analytical drawings which sometimes seem to be made following the "Hankin method", and sometimes look like purest Bourgoin; but the method always seems perfectly suited to the design at hand. I do not know whether there is awareness on the part of the draftsman (one Z. Basit Khanof) of Bourgoin, Hankin, et. al., though I would suspect there is. I also do not know whether the author has made analyses; and if not, to what extent he understands the designs and relates them to others occurring at other times and places. In any case, the analyses are so clear and numerous that in themselves

they give the work unusual value.

Greatly increasing the value of the book--indeed, making it unique--is the publication of a 16th century manuscript containing drawings of geometric designs. Curiously enough, most if not all the drawings shown from the manuscript are relatively simple and drawn free-hand, suggesting that the person who drew them was extremely familiar with the design involved. This would not seem inconsistent with a period of decadence and paucity with respect to geometric design; and this characterizes the Persian world of the sixteenth century. One of the most interesting parts of the manuscript is that which apparently deals with the problem of the application of geometric repeat patterns to the curved surfaces of domes.[39] Although what is shown here is not so full-blown in practice, and less complicated, perhaps, in design than Hankin's examples and analyses discussed above, there is clearly here the principle of segmentation of the surface to be covered into wedge-shapes and the fitting of the design to the wedge.

Finally, for the publication and analysis of a large number of patterns of early date (notably from the palace at Tirmidh, placed by the author in the twelfth century), this book forms a fundamental document in the history of Islamic geometric art.[40]

[39] See Figs. 207, 208 and 210 for the manuscript drawings and relation of them to existing monuments by Rempel.

[40] The palace at Tirmidh provides the earliest example I know of the use of the polygons of the pentagonal system in an allover pattern without any stars (see discussion in introductory comments to "Famille Pentagonale"); and it provides a wealth of designs involving the principle of "pentagonal adjustment", probably also the earliest known (see discussion of development in the last chapter of this thesis).

It seems to me that it should be translated into a widely-known language.

10. Semra Ögel. Anadolu Selçuklulari'nin Taş Tezyinati, Ankara, 1966. (Some discussion above, Chapter I, at end of section on non-analytical works and in footnote 8). Although this is another work in a language I cannot read, it fortunately includes a thirty-page English "Summary" (English title, "Anatolian Seljuq Stone Ornamentation"), which will form the basis of my comments here. While there are in the entire work no visual analyses of designs, it has been included here for certain verbal comparisons made between designs.

The author's fundamental distinction between types of geometrical patterns is between "open" and "closed" systems (p. 165). Under the former she classes those "to which we give the name 'star patterns'" (citing here the portal of the Sivas Hospital). The "open" type she says are "brought into being by the intersection of 'open' lines not tied to any definite shapes", whereas the "closed" type is "produced by the intersection of polygonal forms." These comments only display a lack of understanding of the polygonal basis of all geometric patterns; and beyond indicating that some patterns are "star patterns" and that some are not, we are not led anywhere by them. She admits that it is "frequently hard to distinguish" the "closed" from the "open" systems.[40a]

More concrete statements than the above are made in two cases which I would like to consider here. The first of these statements (p. 166) is to the effect that the design framing the

[40a] All the above from p. 165.

portal of the Alay Han is to be found on the 1026 Damghan and the 1110 Sāva minarets. While the Sāva and Damghan designs are identical, they are far from being identical with the Alay Han design. All that the two designs share is eight-pointed stars and a square plan. The Sāva/Damghan design is T. des E. 67, which has its star drawn "2 en 2", and its radius equals ¼ of the distance apex to apex of the réseau square; the Alay Han design has its star drawn "3 en 3" with a distance of eight radii along the sides of the basic square. In addition to being grossly erroneous from the factual point of view (even a layman, it would seem, would be able to distinguish the two designs visually), Ögel compounds the problem by saying that this "Alay Han design" (as she calls it) is "especially important". Even if one establishes a Persian origin for this design, neither it nor T. des E. 67 (which latter in fact does turn up in Anatolia) would seem to be nearly so "important" as other, more sophisticated designs which also come over, such as T. des E. 48, 51/143, 118, 171, 175 and 179.

The latter design (179) brings us to our second criticism of specific statements; it is the design framing the portal of the Huand Hatun Mosque at Kayseri (not, of course, identified by Ögel as T. des E. 179), which is said (p.168) to be paralleled by the design in the tympanum of the Mashhad Imām Yaḥyā at Mōṣul and that it (Huand Hatun portal design) is "one of the complex geometric systems characteristic of Anatolia." In fact, the only thing these two designs in question have in common is the device of pentagonal adjustment, a practice shared by numerous designs with practically every type of plan and number of

points to the stars, and spread from the twelfth century to our day over a vast geographical area. In the case of the Mōṣul design (T. des E. 123), the plan is that of the equilateral triangle and the stars are of twelve and nine points; and I have found it in this occurrence only. The Kayseri design is one of the more popular ten-point patterns, which so far I have recorded from Persia, Anatolia and Cairo.

This book proposes to deal with a truly vast and important subject. In dealing with Anatolian Seljūq stone ornamentation, it is impossible to avoid the geometric problem; in the great period of building (up to about 1250), geometric art is the great school. And the complexity and profusion of the designs here demands a highly competent and conscientious study covering some years. It remains to be done.

11. David Stronach and T. Cuyler Young, "Three Seljūq Tomb Towers", in Irān, Vol. IV (1966). The authors of this work devote a good deal of space to the decoration of the towers. That at Demāvend is of no interest to us as its decoration is for the most part merely chevrons and the like which are typical of Seljūq and earlier brickwork; it contains only one star- pattern (or for that matter, geometric repeating pattern of any complexity), which is that numbered by us "K-4".[40b] For the two Kharraqān towers (each of which is an absolute repertory? dictionary of early Seljūq geometric designs) the authors show a great eagerness to discuss and relate the various designs, but there is no actual analysis and the

[40b] See pl. IVa, Stronach and Young for illustration.

relation of the designs to others leaves much to be desired. Like so many writers on Seljūqid architecture, the most concrete bits of comparison are largely confined to the meander and fret patterns of the actual brickwork.

One finds, true enough, the comment (p. 19) that "the Kharraqān patterns...are astonishingly advanced for their time". But in light of the fact that virtually nothing is established concerning the development of geometric art in Islām, it would seem incumbent upon the authors to provide some support for such statements. Impressionistic statements of this type are to be found throughout the article; and when such statements are emitted in relation to the development of Islamic geometric art, they are not only invalid but usually factually wrong and often perniciously misleading.

They remark that the tympanum of the 1067-68 tower contains an "elaborate, interlaced geometrical design" (p. 9). But in an apparent desire to show a great development in the twenty-six year span between the two towers (a desire evident throughout the article), the authors say of Tower II, "the sumptuous interlaced design in the tympanum already recalls the wonderfully elaborate, partly glazed patterns that distinguish such later monuments as the neighbouring Öljaytü mausoleum at Sulṭānīeh," (p. 15). One cannot say that this design does not recall the Öljeytü designs -- <u>to them</u>. The design does involve the placing of one set of shapes over another, pre-existing framework, which is so salient a feature of the Öljeytü tilework; but its structural basis is fairly simply based on a grid

of small squares, unlike any designs I have seen from the Mausoleum at Sulṭānīya. One doubts that there is any sort of connection between our tower and Öljeytü's tomb.

As for the design of the tympanum of the entrance of the 1067-68 tower, it will be found to be T. des E. 89 (see my entry 1), and is indeed the earliest straight-line twelve-point star patternI have ever come across.[40c] Perhaps the most misleading of statements in this article also concerns our 1067-68 entrance: "outstanding parallels to both the medallions and the design in the tympanum come from the later Masjid-i Jāmi' at Gulpayagan (Survey, pls. 308-9)".[40d] Again, one wonders whether "outstanding" here may not have a similar meaning to "recall" above. As for the roundels, pl. 309 of the Survey does show roundels similarly placed in spandrels (this time flanking a corner squinch of the transition zone). The only one of these which I can make out from the photo is an epigraphically constructed five-pointed star; this motif is unlike either of those above the entrance at Kharraqān, but one can grant the similarity of the usage as an aspect of composition. As for the resemblance of the pattern of the tympanum to that at Gulpayagan, it is of the most superficial sort. The pattern at Kharraqān is of twelve-pointed stars on an equilateral-triangle plan, while that at Gulpayagan is of ten-pointed stars on the inherent plan of the pentagonal system.

[40c] See my introductory comments to T. des E. 89 (as well as my drawing K-18 and my photo, Fig. 188) for Umayyad curvilinear prototype to this design.

[40d] "Notes on the Plates", No. IXa.

To show that such distinctions are important, we may say that if the Kharraqān design were of the pentagonal system, it would be the earliest so far brought forward, the ten-point family would seem to predate the twelve-point, etc., etc. More research before writing would have shown the authors (in their own province) the same design as at Gulpayagan in a 1088 occurrence, obviously of more interest as closer in time to the Kharraqān tower.

I do not feel it justified to make here a point by point criticism of all the statements made in this article concerning the patterns present; I only would caution anyone to be very much on guard and examine each comment in relation to the illustration cited; this one should do with any author's remarks on this subject.

CHAPTER II.

THE WORK OF J. BOURGOIN.

It would seem that Bourgoin was in Cairo collecting notes and making drawings by some time in the 1860's, to judge only by his publication in 1873 of Les Arts Arabes. And in a foreword to the just-mentioned work, E. Viollet-Le-Duc (after discussing the work of Coste) says: "Un jeune architecte, M. Bourgoin, a séjourné lui aussi quelque temps au Caire; il fait partie de cette seconde couche d'explorateurs qui ne se contentent plus des apparences, qui veulent découvrir les causes et en tirer des conséquences." (p. [ii]) I do not know whether Bourgoin's residence was continuous until 1884,[41] but it seems at least likely that he spent a good part of the '70s in Cairo, judging from the amount of on-the-spot work necessary for the production of Le Trait des Entrelacs, published in 1879. In

[41]He was named a member of the Comité at the first meeting (Procès-verbal No. 1, Exercice 1882-83, p. 9), "chargé de la surveillance des dessins et des plans" (p. 12). In Procès-verbal No. 6 is the account of his reporting that the "Ecole des Arts et Métiers" at Būlāq was making very commendable efforts and that the Comité must help find the best way of using the school's most distinguished pupils in the works he was directing; whereupon the Comité set up a committee, composed of Tigrane Pasha, Franz Bey, Baudry and Bourgoin, charged with visiting the school and making a report with the end of forming "une Ecole supérieure des Beaux Arts" which would take the better graduates of the school of arts and crafts. "Cette école [des Beaux Arts] sera destinée à fournir les artistes qui executeront les travaux les plus délicats dans la réparation des mosquées." Bourgoin was present at Procès-verbaux 8 (2 Jan. 1884), 9 (19 April 1884), 10 (26 April 1884) and 11 (17 May 1884), after which I find no mention of him until Procès-verbal 24 (Exercice 1886, p. XXVII), where Franz Pasha calls the attention of the commission to the need to appoint new members to replace those lost in one way or another: among them, "MM. Bourgoin et Amb. Baudry ont quitté le pays sans esprit de retour."

any case, I have found no evidence of his presence after 1884, and presumably the Précis de l'Art Arabe of 1892 (though forming volume VII of the Mémoires of the French Archeological Mission in Cairo) was published from material he had collected before leaving the country almost ten years earlier.

Each of Bourgoin's works contain plates illustrating (often in color) objects or architectural details in which geometric art is seen, not merely in épure or skeleton form, but executed in some material by an Islamic artist. Les Arts Arabes has 92 such plates; the Précis has 297; and even Le Trait des Entrelacs has ten (all colored). Beside these three major works, Bourgoin published three small articles, all on single individual works of art.[42] I have pointed out above (pp. 1 & 2) that Bourgoin's works constitute the largest collection of such details we have; needless, perhaps, to say, they are of a surpassing accuracy and beauty of execution; and for each he includes an explanation, visual or verbal, of its structural basis. These plates are valuable as source material, as anyone interested in the subject will immediately see.

The foundation of all of Bourgoin's work and of our understanding of it (especially of our understanding of the explanations of the 190 épures in Le Trait des Entrelacs) is to be found exactly where it should be: beginning with page one of

[42] All in Revue générale de l'Architecture et des Travaux publics. They are: 1) "Petite fontaine, au Caire" (XXXV, col. 4-5, & pl. 2, 1878; 2) "Claire-voie en bois (XVIIe siècle) dans la mosquée Mahllah, au Caire" (XXXVI, col. 241 & pl. 57, 1879); and 3) "Claire-voie (XVIe siècle) dans la grande mosquée de Damas" (XXXVII, col. 247 & pl. 54, 1880).

his first work, Les Arts Arabes. This section is 28 pages in length and is called "Le Trait de l'Art Arabe". It begins from the most elementary principles and procedes in the most progressive, rational and systematic way possible to the last part of the section, which deals with the drawing of "entrelacs" or complex patterns, both star patterns and "meander" types.

Bourgoin calls the type of geometry involved in Islamic art, "géométrie esthétique"; and he explicitly says, "c'est ce système de décoration que nous voulons faire connaître aujourd'hui."[43] In speaking of his first part of "Le Trait de l'Art Arabe" (in which he gives such fundamental information as the possible types of polygons, their construction and indications of which ones may be assembled together on a plane surface), he maintains:

> Ces notions de géométrie sont fort simples et il suffit de les énoncer pour qu'elles soient aussitôt comprises et facilement retenues. Néanmoins nous engageons vivement nos lecteurs à ne point s'en tenir à une simple lecture qui n'avancerait à rien; il est indispensable de suivre un à un tous les tracés et de les effectuer réellement... [my underlining].[44]

Although the latter may be more than one can expect from most readers, anyone who tries to make close comparisons of these patterns (or, more especially, tries to draw them), and who also studies Bourgoin's book closely, will surely see that the above prescription is extremely sound. It is not that one cannot otherwise comprehend anything about the designs, nor that one cannot compare and identify them; but to say in precisely what way one differs from the other (in lieu of actually

[43] Les Arts Arabes, "Introduction", p. vii.

[44] loc. cit.

drawing the design confronted, this is an indispensable function of cataloging occurrences) requires a comprehension of structure. And, to reiterate, "Le Trait de l'Art Arabe" gives the most complete and lucid explanation of the structure of plane "esthetic geometry" which exists; it is impossible to comprehend it fully without actually doing the operations he describes.

Just as the above-discussed essay is the most exhaustive elucidation of the construction, Les Eléments de l'Art Arabe: Le Trait des Entrelacs is the most exhaustive of all collections of the type of complex geometric patterns under consideration. It would seem that insomuch as the T. des E. has been examined at all by scholars of Islamic art, it has most often been considered to contain designs which, if inspired by Islamic art, were not necessarily direct and precise copies and analyses of Islamic designs. How else explain the fact that the book has been available for 91 years, during which time no one has considered it worthwhile to make a compilation of occurrences of the various designs? That Bourgoin's work is of great value, at least for the technical principles involved in geometric decoration, was recognized almost from the beginning. Carré (speaking of Charles Blanc, the art popularizer), says:

> Enfin il est le premier, je crois, à reconnaître la valeur de Bourgoin et à rendre hommage à son magnifique travail sur Les arts arabes: "Il est prouvé aujourd'hui, notamment dans le bel ouvrage de M. Bourgoin (les Arts arabes) que la confusion de ces trapèzes dispersés, de ces triangles interrompus, de ces polygones emmêlés, de ces disques intermettents, n'est qu'une confusion apparente: il est prouvé qu'une méthode parfaitement simple à présidé à l'embrouillement aimable de ces arides figures et que l'on peut aisément retrouver le fil de ce mystérieux labyrinthe."[45]

[45] Voyageurs et Ecrivains..., p. 311.

Carré's quotation from Blanc is from the latter's Voyage de la Haute-Egypte: Observations sur les arts égyptiens et arabe, published in 1876. S. Lane-Poole, says:

> M. Bourgoin's Les Arts Arabes, and the smaller Eléments, are finely illustrated, but their text is occupied almost entirely with a minute examination of the principle of geometric ornament in Saracenic decoration, for which there is no better authority.[46]

Despite the apparent unawareness on the part of scholars of the historicity of the designs in the T. des E., it would seem that there is ample evidence in the text of the Trait that the designs are taken from historical Islamic sources. For instance. Bourgoin cites certain types of designs as being typical of certain countries: the "treillis" of Persia; the "entrelacs mauresques" being almost all constructed either on the triangular/hexagonal or the square/octagonal basis; the pentagonal type being relatively recent and found most particularly in Turkey; "les grands et beaux entrelacs à rosettes, comme..." (gives numbers of several épures) pertaining particularly to Egypt, but also to Syria.[47] He continues:

> Une même épure peut être traduite et mise en oeuvre suivant les modes les plus divers. La plupart d'entre elles, répandues dans tout l'Orient, sont ouvrées indifféremment en menuiserie d'assemblage ou d'application, en découpures ou en claires-voies, en ciselures et en engravures, en mosaïques et en marqueterie, en application de bronze ciselé, engravé et damasquiné, en compartiments de broderie et de décoration, etc.[48].

[46] p. vii of the preface to The Art of the Saracens in Egypt (1886).

[47] pp. 11-12. For a discussion of the reliability of these generalizations, see last chapter of this thesis.

[48] p. 12 (my underlining). Again, on the question of "la plupart d'entre elles, répandues dans tout l'Orient", see my "List" and final chapter.

A much stronger kind of evidence for the historicity of the designs in the T. des E. is provided by certain of the paragraphs which are devoted to the explanation of the individual designs. Under "Pl. 119" (p. 30) we find:

> Les fleurons qui accompagnent l'octagone a côtés cavés, sont indépendants de la construction géométrique, mais étant dans le mouvement des lignes, ils les accompagnent si naturellement, que nous avons cru bien faire de les indiquer dans l'épure; d'ailleurs ils existent dans l'original. [my underlining]

And again under "Pl. 120" (p. 30), after perhaps the knottiest prescription in the book: "Mais il était de notre devoir de donner l'épure telle que nous l'avons recueillie, c'est-à-dire conforme a l'objet qui la recélait." This last passage is particularly explicit in showing to what degree Bourgoin's attitude was scientific, and should counter any tendency to think his imagination had any part in the drawings in the collection. I have seen nothing to indicate that these drawings are anything other than superaccurate analyses of the structure embodied in specific historic works of art.

Finally, one may call attention to the fact that a number (in fact, most) of the panels, windows, etc., which are represented in the ten color plates at the end of the T. des E. are identified as to source; and, where applicable, also to the épures to which they correspond.

CHAPTER III.

THE WORK OF THIS THESIS: THE RECORDING OF HISTORICAL OCCURRENCES

We may certainly regret (as surely others have) that, for some unfathomable reason, Bourgoin has not provided us with the sources from which he has derived the 190 épures in Le Trait des Entrelacs. For, while the task of recording as many occurrences as possible of each design would still have remained to be done, we would at least have one historical pivot for each design. The major part of my work as represented in this thesis has been the former, i.e., recording every possible occurrence of these designs. This has been a preoccupation of mine for the past two years; it started immediately upon my discovery of the Trait. At first (and to a large extent since) this identification was done from photographs (and sometimes drawings) in books. But the amount of material one can collect in this way will always be vastly less than that which is available: the number of photographs which can be included in a given book is always severely limited; and there almost seems to be a perversity in the infrequency with which any details shown are those needed.[49] By an incredible combination of fortunate circumstances, I was able to collect my material directly from the original sources

[49] I, like Bourgoin (although I did not realize at first that I was following him in this respect), have collected the vast majority of my material from architecture (and its furnishings). Two reasons for this stand out: 1) architecture was the greatest place of usage of the designs involved; and 2) it is usually dated or datable. But I have eagerly looked for occurrences in every material, from any country or period.

used by Bourgoin. I found myself in Cairo (the largest concentration of Islamic architecture in the world, covering a span of 1000 years), with access to Bourgoin's Trait, which contains 190 drawings taken, as it turns out, largely from that same architecture. So, in addition to poring over photographs in books, I went about making photographic records of as much as possible of the geometric art of Cairo, concentrating on the pre-Ottoman periods.

An amazingly large percentage of the motifs one encounters in Cairo can be found among Bourgoin's 190 drawings (and many of these are to be seen in other Islamic countries). But one is also constantly encountering those which cannot be found in the Trait, and thus cannot be recorded by a mere addition of references to Bourgoin's drawing. For some of these designs I have made analytical drawings myself, and these are included in the thesis. In other cases, when one finds a motif so closely related to one of Bourgoin's drawings that they actually have the same polygons with the same proportions, differing only in arrangement, one can trace over the polygons in his drawing and by replacement come up with the structure of the occurrence in question. Though this is not as valuable as a drawing constructed from the very basis by oneself, it is incomparably more valuable than a tracing made from a photograph or non-analytical drawing; for it will be related directly to the visual and verbal explanation of Bourgoin (or whomever the analyst in question); and it will have precise and correct geometrical proportions. The amount of time required for constructing a drawing from the "ground up" often makes these constructed tracings

seem worthwhile (it should not be exclusively one's practice, for the result might be that one never really learns how the thing is constructed originally). I have used the method for a number of my "drawings", but they are clearly labelled as such, with reference to the drawing from which the units were traced (having their number prefixed by "KT", whereas my drawings properly so called have the prefix, "K").

Note: Le Trait des Entrelacs and the Problems of Classifying Designs

To facilitate comparison as well as, I suppose, to some extent ease the way for anyone wanting to draw the designs in the T. des E., Bourgoin has arranged the designs into groups according to basic figure(s) of structure: thus, drawings 1 through 41 constitute the "Famille Hexagonale"; 42 through 67, the "Famille Octogonale"; 68 through 105, the "Famille Dodécagonale"; 106 through 142, "Etoiles et Rosettes de Deux Nombres Différents"; 143 through 153, "Plan Octogone et Carré Assemblés"; 154 through 164, "Etoiles et Rosettes Groupées par 3 et par 4"; 164 through 170, "Famille Heptagonale; and 171 through 190, "Famille Pentagonale". Bourgoin points out (p. 10) that the designs of the "Familles" hexagonal, heptagonal and pentagonal result from the "croissance organique et naturelle d'une figure initiale"; that is, their basis is a set of parallel lines going in as many directions as there are sides to the initial figure--keeping in mind that the basic figure of the "famille hexagonale" is really the equilateral triangle. Bourgoin goes on to say that the alternative plan arrangement is a combination of

figures composed together, as, for example, the octagon and square assemblage. Other, more complex and less regular arrangements are, of course, met and dealt with.

Despite the basic soundness of Bourgoin's classification, a long and careful consideration of his actual grouping of designs in the Trait des Entrelacs leaves one disturbed by overlapping categories and even seemingly misplaced designs. For example, if there is a category for the octagon-square assemblage (separate from the "Famille Octogonale"), one wonders why not a separate group of the duodecagon-hexagon-square assemblage, of which there are five examples.[50] And this question is just as valid logically for the hexagon-square-triangle assemblage, even though there are only two examples.[51]

Because of overlapping categories and the sharing by one design of several of these basic characteristics which Bourgoin uses as titles for his series, it is admittedly very difficult to arrive at a really good classification system. And of course (as Bourgoin points out in the Trait, p. 11), many other classi-

[50] Nos. 92 (which has three different stars--so why not under "Etoiles et Rosettes Groupées par 3 et par 4"?); 104 (which has two different six-point stars and no 12-points--so why under "Famille Dodécagonale"?); 105 (which has a 12-point and a six-point); 110 (which also has 12- and 6-points--since several 12/6-point combinations are found under "Famille Dodécagonale", why is this one here?); 140 (which has 24-point, 12-point, and 8-point stars--so why is it not under "Etoiles et Rosettes Groupées par 3 et par 4"?); and 141 (which again has 12-point and 6-point stars--see comment for No.110 above.

[51] Nos. 36 (which has 12-pointed stars, not 6-points); and 102 (which is not said in its description to be on this plan, which it uncontestably is). In connection with No. 102, one may ask why Nos. 101, 102 and 103 are under "Famille Dodécagonale" when none of them contains either a duodecagon, or any star at all, not to mention a 12-point.

fication headings beside his own can be used, especially if one goes by certain striking visual (which often, one may add, means somewhat superficial) characteristics such as the "tricèle révolvé", etc. While his classification system is immeasurably better than that just mentioned, it does seem that one might more rigorously classify designs than he has: first, by separating them strictly according to plan (equilateral triangle, square, hexagon-square-triangle assemblage, or whatever); and, within these classes, grouping them by point-number and type of star (or absence of star). Bourgoin's classification criteria seem to shift, but most weight seems most often to go to actual number of points in the star(s); this seems to me less basic than the plan. Nevertheless my task was altogether enough, without rearranging or re-numbering his drawings. I will, however, subtend a list of designs whose placement seems to me a hinderance to finding them, while accepting his classifications.[52]

A. "Ire Serie: Famille Hexagonale".

Designs with 12-Pointed Stars.

1. No. 21 (this design is structurally identical with Nos. 85 and 89, which are, of course, under "Famille Dodécagonale").

2. No. 36 (No 6-points--see footnote 51).

[52] My own drawings (but not my "constructed tracings") I have arranged rigorously according to plan. (Except for K-14h, which is placed there because of its ability to be constructed by grouping small equilateral triangles--Bourgoin would call its plan "rectangle de l'hexagone").

B. "IIr Série: Famille Octogonale"

I. Designs with 16-Pointed Stars and No 8-points (There is really no reason why these should not be here, but one must keep them in mind, as many more 16-point star patterns are under the IVth., Vth. and VIth. series).

1. No. 57.

2. No. 65.

II. Design Combining Stars of Two Different Numbers

No. 66 (8- and 6-pointed stars).

III. A Special Snag (as far as I know, the only one of its kind in the "Explication") awaits he who would study the structures of the designs, in the form of a mix-up in numbering: the description given under No. "54" in the "Explication des Epures" applies to the drawing numbered "53"; and vice-versa.

C. "IIIe Série: Famille Dodécagonale"

I. Design with 6-Pointed Star Only

No. 100.

II. Design with Stars of Two Different Numbers, Other than 12-and-6.

No. 91 (12- and 8-points).

III. Designs with Stars of Three Different Numbers.

1. No. 92 (6-, 4- and 12-points--see footnote 50).

2. No. 104 (this design has two different 6-points, plus an 8-point. The latter is not "regular", i.e., not inscribed in a circle, but rather is the result of the continuation of other lines; but one still experiences it as an 8-pointed star--see also footnote 50).

IV. Designs with No Stars and No Duodecagons (see footnote 51).

1. No. 101.

2. No. 102.

3. No. 103.

D. "IVe Série: Etoiles et Rosettes de Deux Nombres Différents"

I. Designs Combining Stars of 12 and 6 Points
(Why are these not under "Famille Dodécagonale"?).

1. No. 110 (see footnote 50).
2. No. 111.
3. No. 112.) These three designs would seem to be
) classics for the "familles" "Hexagonale"/
4. No. 113.) "Dodécagonale" (compare them with Nos.
) 88, 90, 98 and 105).
5. No. 114.
6. No. 141. (See footnote 50).
7. No. 142.

II. Designs with One Star or Rosette Only

No. 119.

III. Designs with Stars of Three Different Numbers

1. No. 133 (16-, 12- and 7-points).
2. No. 134 (16, 12- and 7-points).
3. No. 135 (identical with No. 134, except that 16-points are turned a half-radius and are curvilinearized).
4. No. 140 (24-, 12- and 8-points).

E. "Ve Série: Plan Octogone et Carré Assemblés".

By Bourgoin's own description and by a careful examination of the actual drawing, we find that No. 147 is not on the plan of the octagon/square assemblage, but rather on a lozenge plan.

LIST OF HISTORICAL OCCURRENCES

For every design listed below I provide all of the following (when possible): 1) position on object or monument; 2) material (and sometimes type of technique); 3) name and location of object or monument; 4) date; and 5) reference to place from which identification was made.

Usually, I have located architectural monuments outside Cairo by city; conversely, if only the monument name and no city is given, the monument is in Cairo (except for such obvious examples as Khirbet al-Mafjar, etc.).

All dates given are "A.D." unless followed by "H.", which of course stands for "of the Higra". I have not usually included a specific note on the source for my dating. Most dates for Egyptian monuments are from Creswell's invaluable Brief Chronology, unless otherwise stated. Some are from the Index to the Map of Islamic Monuments of Cairo. Often for Persian or Turkish monuments (and for identifications of Egyptian occurrences made from books), the date is taken from the source given for illustration; of course, it is always so when the date is enclosed in quotation marks. I believe I have been sufficiently careful and responsible in cases of problematic dating.

For the references to various works, I have employed certain abbreviations. These may take the form of the author's name, if only one work by him is included in the "Bibliography" (e.g., "Grabar and Hill", "Jacobstahl", "Riefstahl"); or a shortened title (e.g., "Anadolu Selçuk...", "Ta'rīkh al-Masāgid",

"Survey" -- for the latter I also have not given volume No., as the plates are numbered consecutively throughout); or an even more abbreviated reference for certain well-known works (e.g., "M.A.E.").

I have included in a special section prints of all of my photographs given as reference (except, of course, color slides). Private photographs referred to as by individuals other than myself are not included. These latter cases, along with those in which "direct observation" is given as reference, are the only ones where the reader may not be able to check my identification; such cases are relatively few. For my photographs which are included, I have written next to them the numbers of the various analytical drawings to which they correspond; and in difficult cases and/or cases in which the presence of more than one design in one photograph might lead to confusion, I have tried to clarify.

I have included a reproduction of each of the drawings (Bourgoin's as well as mine[53]) for which occurrences are recorded in the list, in the belief that such a list as this will only "come alive" when the reader can look and see, e.g., that it is this design which is T. des E. 48 and which is so popular; or that one which is apparently so rare or even unique. This is not to mention that any but the simplest technical discussion of geometric design is totally meaningless for most people unless they can look at the design in question.

[53]Only three of my drawings have so many recorded occurrences that I have felt it necessary to include them in the list; they are at the end. For the others, the occurrences are written on the drawing itself.

Bourgoin's drawings are arranged in the same order that they have in the Trait, and I have placed a title sheet for each "série" between it and the one which comes before. For the "Familles" "Hexagonale", "Octogonale", "Dodécagonale", "Heptagonale" and "Pentagonale" I have also included brief excurses (partly technical and partly historical) which precede the appropriate "Série".

In his drawings in the Trait, Bourgoin often has two different variants included in the same plate, the first labeled with a simple number, the second with the same number plus a short slash (e.g., "66" and "66′"). To avoid possible typographical confusion, I have substituted "a" and "b" in such cases.

What follows constitutes, as far as I know, the only such systematic documentation of occurrences of Islamic geometric designs ever brought to light. I have tried to make it as large and inclusive as possible, consistent with specificity regarding location and reasonable reliability of dating. As a document of "hard" information (particularly when conjuncted with the photographs here included), I believe it has value and suggests conclusions far beyond what I will be able to deal with or even note in my last chapter. If others can make use of this list, and will feel it worthwhile to add to, it will be more than justified.

Ire SERIE

FAMILLE HEXAGONALE

Of all linear systems, the "hexagonal" or (more properly, it seems to me) "triangular" is the most natural; it is absolutely inherent in the circle, that figure which is the basis, the mother, of all regular polygons (and thus of all linear "familles"). By "absolutely inherent", I mean that if one takes the radius of any circle and applies it to the circumference of the same circle as chords, one comes up with the circle divided into <u>exactly</u> six parts.[54] When dividing the circle with the original compass opening, if one makes full circles with each division of the original circle as center, and one continues this for all the circles thus created, one will go outward from the original center in all directions, creating an allover pattern of overlapping circles, each divided into six equal parts and each with six circumferences passing through its center. If then the centers of all these circles be connected up, one gets an allover gridwork of equilateral triangles. So, this 60-degree system (three sets of equidistant parallel lines at an angle of 60 degrees to each other) grows out of the essence of the circle without any secondary operations

[54] Perhaps it should be pointed out that there is some tendency for people to confuse this most mystifying property with the ratio between the radius and the circumference. Among those who apparently have been so confused are none other than J. Bourgoin; in the first part of <u>Les Arts Arabes</u>, under "Division de la Circonférence" (p. 8), his first sentence starts: "Le rayon étant égal à la sixième partie de la circonférence, on obtient immédiatement la division en 6 parties...."

(for this development, see drawing K-13).[55]

The ratio between the radius and the distance around the circumference is irrational, which was proven in 1761.[56] This irrationality of the relationship of radius to circumference holds, of course, throughout such determinations as the area of a circle, the surface of a sphere and the solid contents of a sphere. In what contrast stands this problem in (quantitative) measurement and calculation to the unitary harmony, the inherent, absolute qualitative truth which makes itself intuitively and indubitably clear when a plastic juxtaposition of circles takes place. Tangent circles in their closest possible juxtaposition create with their centers (or, for that matter, with their points of contact) an allover equilateral triangle réseau (see drawing K-16). Certainly man must have had the example of these tangent circles before him long before he recognized the flat pattern, straight line implications of it. But it is interesting to see in the well-known Early Sumerian cone mosaics, where the units (the exposed bases of the cones) create this tangent circle situation, that there was already in Archaic times(Uruk V period) an exploitation of the inherent properties of the situation by making allover patterns of 60

[55]For the division of the circumference into any other number of equal parts, one must resort to various more or less complex proceedures, for most of which there are one or more multiple-step precise methods. Of course, the circumference can ultimately be divided into any given number of equal parts by adjustment with a set of dividers.

[56]By J.H. Lambert: see Cajori, A History of Mathematics, "Introduction", p. 2.

degree triangles and lozenges.[57]

The more-or-less regular allover hexagon pattern as such has, of course, been before the observant man since time immemorial in the form of the nests of various wasps and the "comb" of honey-bees. That the bees "know" that they have made the allover hexagon pattern is doubtful; rather the hexagon pattern is inherent and comes about, it seems to me, because it is the most effecient cross-section in which to store cylindrical shapes (larvae).[58]

An occurrence of allover hexagons is reported by Petrie as represented on the garment of "Bast" in the tomb of Seti I.[59] This is the only design I know of from Ancient Egypt which implies the 60-degree system. It was a period of Egyptian imperialism and international influence and counter-influence.

[57]See Parrot, Sumer: The Dawn of Art, Fig. 84, a & b; and (better) Moortgat, The Art of Ancient Mesopotamia, pls. 1 & 2, and p. 3, where the author states that the mosaic technique grew out of the need for protecting the mud walls and that it is characteristic of "the whole Protohistorical period."

[58]Simple tangent circles would waste space (and wax) between the cells; square cells would waste space in the interior corner areas; and no polygon with a larger number of sides (and therefore more nearly circular) than six can form an allover pattern with adjacent sides and no empty space between them. This beehive cross-section is an essentially two-dimensional demonstration. But just as an irrationality in the relationship of the radius to the circumference runs through not only the two-dimensional realm, but also the three-dimensional, so it is with the harmony, the unity experienced in the juxtaposition of the circle. That is, not only do radii applied to their circumferences as chords produce perfect six-part division; not only do circles in their closest tangent relationship also produce the hexagonal system; but when spheres are in their closest possible relationship, they also give the same system in three dimensions (see Weyl, Symmetry, p. 85; and Fuller, "Conceptuality of Fundamental Structures", pp. 68, ff., and Fig. 2.

[59]Egyptian Decorative Art, p. 47.

This same pattern I have found in two later Assyrian examples.[60] The earliest example I have found (indeed the only pre-Roman one) of the allover pattern of overlapping circles creating the 60-degree grid is also apparently Assyro-Babylonian.[61]

Beginning as early as the Middle Minoan III ("about 1550-1520 B.C.") in Crete one finds a series of occurrences of a certain design of connected spirals based on allover 60-degree triangles. The same pattern also appears commonly in Mycenae at a similar period.[62] It is to be noted that the Aegeans had borrowed the square-based connected-spiral design of Theban ceilings from Egypt;[63] and I am strongly inclined to believe that the 60-degree triangle network at the minimum, if not the actual pattern discussed above, was borrowed from Mesopotamia,

[60] See Parrot, Assur. pl. 109, for an 8th century B.C. example in a wall-painting (on the garment of a bird-headed "génie") from the palace at Tell Ahmar; and Moortgat, pl. 269, where the pattern is engraved in lines on top of the "base of throne of Shalmaneser III in limestone, from "Fort Shalmaneser" in Nimrud . . . . Baghdad, Iraq Museum."

[61] Owen Jones (The Grammar of Ornament, pl. XIII, No. 15) reproduces this design from "Layard" ('Nineveh and its Remains'?- - I have not seen this work, but it is listed on the title page of the same author's Early Adventures in Persia, Susiana, and Babylon London, 1887); in Jones, the design is labelled, "Ornament from a Bronze Vessel, Nimroud. - Layard." (see my drawing K-13). This pattern I know from Egypt only in the Roman period, in a floor mosaic in the Alexandria Museum.

[62] See Spyridon Marinatos, Crete and Mycenae: pl. 60, schist mace-head, "1650-1600 B.C."; pl. 80, "Pithos . . . Late Minoan I, about 1550-1552 B.C."; pls. 170, 194 and 198 provide four examples of the same design on objects excavated in the Citadel of Mycenae.

[63] See Marinatos, op. cit., pl. 147, for a grave stela "originally over grave V of the Citadel of Mycenae", on which the design appears (with a crude charioteer scene in relief below); and pl. 161, for a ceiling from the "so-called Treasury of Minyas" at Orchomenos, nicely carved with this same square-plan spiral meander design. Orchomenos is stated by the author (p. 165) to have been compared to Thebes in Egypt by Homer, to have had granaries and an irrigation system like those of Egypt: "indeed, Orchomenos was like Egypt in Greece".

possibly through those other sea-farers, the Phoenecians.

The "Babylonians" had the number six (conjuncted with ten and its multiples) as the basis of their whole mensuration. They had a sexagesimal number system, including sexagesimal fractions and decimals (e.g., $\frac{1}{2}$ = 30; 1.4 = 64, etc.). To them is attributed the division of the day into 24 hours the hours into 60 minutes and the minutes into 60 seconds. Furthermore they seem to have divided the day into 60 hours. Excavations at Nippur turned up clay tablets with a series of results of the sum of 60^4 divided by 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 16, 18, etc. Now 60^4 is the "Platonic number", supposedly borrowed first by the Pythagoreans and then Plato.[64]

Certainly it is clear that Mesopotamia was the seat of ancient mathematics, not the Aegean or Crete. Egypt's importance as a cradle of geometry is shown by the relatively well-known fact that a large number of the early Greek philosophers, geometers and mathematicians (among them Thales, Pythagoras, Plato and Democritus) took long lessons in Egypt (and probably also, at least in the case of Pythagoras, in Mesopotamia).[65]

But whatever may be the ultimate origin of the 60 degree system, it is clear that it was quite current at least by the last millenium-and-one-half B.C. It was in considerable use in Roman and Byzantine art; in fact it was the most fertile system

[64] Information in above paragraph from Cajori, pp. 4-6.

[65] Cajori is very much of the opinion (although he does not give his reasons) that it was the "Babylonians" who accomplished the division of the circumference into six parts by its radius (pp. 6 and 7).

for geometric-repeat pattern invention in the Roman/Byzantine (as well as the Umayyad) period. Countless beautiful designs were evolved from it by striking circles from various centers, by mega-grouping small equilateral triangles, etc. For our purposes here it is important to note that Umayyad usage grew out of pre-Islamic Syrian usage, and that certain specific designs actually carried over into Islamic art (e.g., T. des E. 1a, K-15-III, K-17 etc.); but that the Umayyad period is characterized by an astonishing fertility of invention much more marked than the immediately pre-Islamic period. With designs like T. des E. 14 (window "P1" from Khirbet al-Mafjar) and more especially K-18 (from Qaṣr al-Ḥayr al-Gharbī -- window "25" by my numbering), as well as several other designs from these two monuments we have something which is a truly new departure. The design analyzed in "K-18" I regard as belonging to the 60° system or "Famille Hexagonale", despite its star having 12 points; but I also so regard T. des E. 89, K-18's straight-line version which appears in Seljūq times. In fact I reject Bourgoin's "Famille Dodécagonale" as separate from the "Famille Hexagonale", as the former is merely a multiple of the latter.[66] Patterns with stars of six, nine, twelve, eighteen, twenty-four, points, etc., have a natural affinity for being arranged on the triangular plan and commonly are so based.

The basic simplicity and naturalness of the 60-degree system has made it probably the most popular in Islamic geometric art.

66 See above, Chapter III, p. 41.

T. des E. 1 (a)

Earliest example known to me is in a Roman/Byzantine mosaic at the Damascus Museum (see my photo, Fig. 1; and drawing K-16). This design is so common in the Islamic periods that I have not bothered to record the occurrences.

T. des E. 2

1. (Slightly altered) inside bottom of bowl, "overglaze, Raay 13th. c." --Survey, pl. 656b.
2. Ceiling of entrance passage, Mosque of Aḥmad al-Mihmandār (1324-25) --My photo, Fig. 2.

T. des E. 4

Mosaic panel "encastrée dans les parois de la grande mosquée de Damas" (Probably Mamlūk) --Précis ("Les Applications"), pl. 12, Fig. 1.

T. des E. 5

1. (Star radius=one-third of side of réseau-triangle) Brickwork frieze above blind arch panel, side 4, later Kharraqān tomb tower (1093) --Stronach-Young, pl. XIXb.
2. Punched plaster inside floral element, miḥrāb of Masjid-i Haydariya, Qazvin (early 12th. c.)--Survey, pl. 471.
3. Creating of central part of S.E. (ṣaḥn) facade, Mosque of al-Azhar (probably 1130-49)--M.A.E. I, pl. 89.
4. Plaster roundel, tomb of Shaykh Faḍl Safid Bulānd, "wohl ende 12. Jahrh.". --Cohn-Wiener, Turan, pl. XVIII.

5. Window (plaster) in drum of "second mausoleum", Khānqā Bunduqdārī (1283-84)--My photo, Fig. 3.
6. Mosaic panels (narrow horizontal panel above second window from N.E. corner and small vertical panel on right side by door to inner maqṣūra), Mausoleum of Qalā'ūn (1284-85) --Direct observation.
7. Circular stucco window, drum of Mausoleum of al-Ashraf Khalīl (1288) --M.A.E. II, pl. 77.
8. Marble mosaic above column capitals at sides of miḥrāb, Mosque of Almās (1329-30) --Direct observation.
9. (Star radius=one-third of side of réseau-triangle) Marble mosaic spandrels of miḥrāb, Zāwīyat Aydumur al-Bahlawān ("before 1346"--Brief Chron.)--Direct observation.
10. Marble mosaic, Musāfir Khāna (1779-88)--Précis ("Les Applications"), pl. 49.

T. des E. 6

1. Without hexagon in interstice) brickwork panel above blind niche, side 8, earlier Kharraqān Tomb Tower (1067-8) --Stronach and Young, pl. XI c.
2. Terracotta strapwork panel, wall of palace of Lashkari Bazaar (1155-64) --Schlumberger, "Le palais...", Syria XXIX, fasc. 3 & 4, pl. XXXII, 4.
3. Wood strapwork, inside of front door, minbar of Aqṣā Mosque, Jerusalem (1168-69) --Mayer, Islamic Woodcarvers, pl. II.
4. Rail panel (one unit of the design), minbar of 'Alā' ad-Dīn Mosque, Ankara (1197) --Mayer, Islamic Woodcarvers, pl. III.

5. (Without hexagon in interstice) Carved on $\frac{3}{4}$-round corner molding, Huand Hatun Türbe, Kayseri (1238) --Ögel, Anadolu Selçuk..., Lev.XXIV, Res. 45.
6. Plaster roundels (at least 17 different ones) of inscription band of ṣaḥn, Madrasa Zayn ad-Dīn Yūsuf (1298) --Direct observation; see also M.A.E. II, pl. 110b.
7. Roundels at bends of inscription band, stucco miḥrāb of Great Mosque of Qūṣ (1300) --M.A.E. II, pl. 90a.
8. Stucco roundel of inscription band to right of miḥrāb in courtyard, Madrasa-Mausoleum of Salār and Sangar (1303-04) --M.A.E. II, pl. 112 c.
9. Lobed-arch panels at sides of niche, Mosque of the Amīr Ḥusayn (1319) --M.A.E. II, pl. 104a.
10. Vertical panels, wooden cabinet doors in Mausoleum of Aṣlam as-Silaḥdār (1344-45) --My photo, Fig. 5.
11. (With triangle in interstice, not hexagon) Round iron grille in center of marble roundel, facade of Mosque of Āqsunqur (1346-47) --My photo, Fig. 6.
12. Alternate stucco windows (new?), Qubbat Yashbak min Mahdī (1477) --Tā'rīkh al-Masāgid, Fig. 192.
13. (Without hexagon in interstice) V-cut in wooden door facing in sanctuary, Madrasa-Mausoleum of Qānībāy Amīr Akhūr (1503) --My photo, Fig. 7.
14. Carved in step-risers (at least three) of minbar of Lāǧīn at Mosque of Ibn Ṭūlūn (1296? According to Comité, Exercice 1882-83, 3ème Rapport, p.48 - these steps weren't present when they set about to restore the minbar). --My photo, Fig. 4.

T. des E. 7

1. Filling of lower floral elements (stucco), spandrels of miḥrāb of Mosque of al-Guyūshī (1085) --Hautecoeur and Wiet, pl. 25; and M.A.E. I, Fig. 80, and pl. 48 c.
2. Several occurrences (including a narrow framing band), brickwork of later Kharraqān Tomb Tower (1095) --Seherr-Thoss, pl. 18, etc.
3. Wide vertical framing band of portal, Gunbād-i ʿAlaviyān, Hamadān ("2nd half of 12th. c.") --Survey, pl. 329.

This design is quite common, in Egypt and Persia, and perhaps even more so in Seljūq Anatolia; and, as with T. des E. 1a, I have not made a practice of recording every occurrence I have seen.

T. des E. 10

All recorded Egyptian occurrences of this design (as well as those at Natanz) have the "V-shapes" revolving about the hexagon in the clockwise direction; whereas in Bourgoin's drawing and at Iṣfahān and Akhlāt, the "spin" about the hexagon is counter-clockwise.

1. (Closely related design in which solid equilateral triangles, not "V's", revolve about hexagon) Arch spandrel, N.E. dome chamber, Masjid-i Jāmiʿ, Iṣfahān (1088) --Survey, pl. 289; also, see Seherr-Thoss, pl. 10.
2. Carved-stone window-lintel on remains of S.W. facade, Madrasa of Baybars I (1262-63) --M.A.E. II, pl. 44 c.
3. Lintel over window, south side of "Grosses Mausoleum", Akhlāt (1273) --Bachmann, Kirchen und Moscheen, pl. 47.

4. Carved stone lintel over window, N. facade, Mausoleum of Salār and Sangar al-Gawlī (1303-04) --Direct observation.
5. Hood of niche flanking entrance, facade of Khānqā at Natanz (1317) --Pope, Persian Architecture, Fig. 234; and Survey, pl. 368a; see also torus beside entrance of this Khānqā, Grabar and Hill, Fig. 269.
6. Design in painted stucco work of interior, Qubbat al-Fadāwīya (1479) --Bourgoin, Les Arts Arabes, pl. 62 ("une mosquée...près l'Abbasieh...XIVe siècle").
7. Window lintel, "Mosquée d'el Ghoury" (1503-04? Where?) --Ibid., pl. 8.

T. des E. 12

1. In intrados of arch to sanctuary, Mosque at Sīn (1134-35) --Smith, in Ars Islamica VI, No.1, Fig. 17.
2. Brick mosaic in blind niche of dome transition zone, Masjid-i Jāmi', Zawāré (1135-36) --Gabriel in Athār-é Irān I, Fasc. i, Fig. 203.
3. Carved in niche, Miḥrāb of Sayyida Ruqayya (1154-60) --Pauty, Les bois sculptés, pl. LXXX, etc.
4. Carved in back of Imām's seat (miḥrāb niche), Minbar of Ṣāliḥ Ṭalā'i' in Great Mosque of Qūṣ (1155) --Pauty, "Le minbar de Qous", Mélanges Maspero (Fig. 2 of Pauty's article).
5. Carved on bottom of several supporting brackets of the wooden octagon for the suspension of lamps, Mausoleum of the Imām ash-Shāfi'ī (1211) --M.A.E. II, pl. 26 c.

6. (One unit) Square panel on front of wooden Ayyūbid tābūt from the Mashhad Husaynī (13th. c.) --Ta'rīkh al-Masāgid, Fig. 59 ffl.; and Fikry, Masāgid al-Qāhira, Al-Guz' Ath-Thānī, pl. 1a.
7. Small horizontal panels at bottom of wooden doors to Mausolea, Khānqā Farag ibn Barqūq (1400-11) --Précis ("La Menuiserie"), pl. 15.
8. "Soffite de l'entrée d'une mosquée", Alexandria (date ?) --Bourgoin, Les Arts Arabes, pl. 19.

T. des E. 14

1. (Curvilinear design with this general structure) Plaster window ("Pl"), Khirbet al-Mafjar (2nd, qtr. 8th. c.) --Hamilton, Fig. 241 & pl. LXIX.
2. (Visually related design--six-pointed stars drawn "5 and 6" with 12-part division, touching at tips at center of réseau-triangle) Lower panel of blind niche, side 8, later Kharraqān Tomb Tower (1093) --Stronach and Young, pl. XXIb.
3. Carved stone spandrels of niche inside left of portal, Madrasa Muẓaffar Burūjīrdī, Sivas (1272) --Gabriel, Les Monuments II, pl. XLIX.
4. Small horizontal wood mosaic panel at bottom of cabinet door, Madrasa Farag ibn Barqūq (before 1409) --My photo, Fig. 8.
5. Panels between triple colonnettes on octagonal shaft of Minaret of Qāytbāy at al-Azhar (1468) --My photo, Fig. 9.

6. At sides of joggled lintel above entrance "de la fontaine Kaid-Bey" (probably the Sabīl of his Wekāla near al-Azhar --See S. Lane-Poole, The Art of the Saracens, Fig. 24) --Bourgoin, Les Arts Arabes, pl. 1.
7. Alternate stucco windows (new?), drum, Qubbat Yashbak min Mahdī (1477) --Ta'rīkh al-Masāgid, Fig. 192.
8. Tile mosaic, "Moschee des Schech Safi: Dekoration der Richten Schmal-seite in Grossen Vorhof" (Ardebīl) Sarre, Denkmäler Persischer Baukunst, pl. "50".
9. Large mosaic faience panel, court facade of S.W. (sanctuary) Īwān, Masjid-i Jāmi', Iṣfahān (1700-01 ?) --Seherr-Thoss, pl. 84.

T. des E. 15

1. Stucco windows of alternate sides of octagonal drum, Mausoleum of Sayyida Ruqayya (1133?) --M.A.E. I, pl. 86a.
2. Tile band, Masjid-i Jāmi', Varamīn (1322) --Pope, Persian Architecture, pl. 237.

T. des E. 16a

1. Carved stone panel over pointed-arch doorway, Halivet Gazi Türbe, Amasya (1142-46) --Grabar and Hill, 1st. ed., Fig. 352.
2. (With overlay of irregular nonagons forming 12-pointed stars; and with further overlay of double-line allover hexagons) Tympanum of Gunbad-i Surkh, Marāgha (1147) --Seherr-Thoss, pls. 30, 31.

3. "Panel No. 18. Namāzgah Mosque at Bukhārā, mosaic of terracotta slabs, XIIc." --Rempel, Architectural Ornament of Uzbekistan, Fig. 100, 1 (analysis) and 2 (drawing).
4. "Slab (no. 19) from Aksyket/Akhsikāth, Namangan Museum, carved terracotta, XIIc." Rempel, op. cit., Fig. 100, 3 (analysis) and 4 (photo). (The above two would seem likely to be the earliest occurrences of this design, but for lack of solid dating, I have placed them conservatively).
5. Large marble mosaic panels lining casement of southernmost window of qibla wall; also mosaic panel over 2nd. window from west corner, S.W. wall, Mausoleum of Qalā'ūn (1284-85) --Direct observation.
6. (A curvilinear relative; not T. des E. 38) --Stucco window surrounded by original stucco decoration, al-Azhar (date? --I suspect it of being early Mamlūk) --M.A.E. I, pl. 9.
7. In rail of wooden minbar of Çorum Ulu Cami (706 H.) --Oral, in Vakiflar Dergisi V, Res. 25 and p. 59.
8. (Modification) wooden grill from the tomb of Öljeytü (1305-13? Pope says "possibly Safavid") --Pope, Persian Architecture, pl. 229.
9. Several tile and terracotta panels, Khānqā at Natanz (1316-17) --Grabar and Hill, 1st ed., Figs. 268 and 270.
10. Pierced wood rail, minbar of Sunqur Āghā at Niğde (now in Dîsh Cami) (between 1326 and 1335) --Gabriel, Les Monuments, Vol. 1, pl. XLIII.
11. Framing band around grand brass door and in painted ceiling of sanctuary, Mosque and Madrasa of Sultān Barqūq (1384-85) --Mosques of Egypt, Vol. II, pls. 95 and 99.

12. Openworked "boxes" projecting from middle set of windows above ṣaḥn, Madrasa Maḥmūd al-Kurdī (1395) --Direct observation.
13. Border of ceiling of side Iwān, in raised and painted strapwork, Mosque of Gānī Bek (1426-27) --My photo, Fig. 10.
14. Lower border, "koursi de la mosquée de Kaitbai (Musée Arabe)" (no date given) --Gayet, L'Art Arabe, Fig. 115.
15. Carved in alternate voussoirs of great arches of Iwāns; also carved on joggled voussoirs of lintel in oblique recess in sanctuary wall, Madrasa of Azbak al-Yūsufī (1494-95) --My photos, Figs. 11 & 12.
16. Carved on octagonal stone columns, Mosque of Shaykh Sulṭān Shāh (before 1495) --My photo, Fig. 13.
17. Lower horizontal panel of front, "pupitre pour la lecture du Coran, au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 98.
18. V-cut on inside of rail of minbar; and v-cut in facing of cabinet door, Madrasa of Qānībāy Amīr Akhūr (1503) --My photos, Figs. 14 & 15.
19. Main side panel (openwork) and middle rail panels, minbar, Ibrahim Çelebi Cami, Manisa (dated 1575) --Oral in Vakiflar Dergisi V, Fig. 42.
20. Band around bottom of kursī in Madrasa of Qāḍī ʿAbd al-Bāsiṭ (I suspect this of being recent work -- it is of the plainest strapwork with no polygons between--see this list, T. des E. 77, No. 29e; and T. des E. 118, No. 31)--My photo, Fig. 16.

T. des E. 17

All observed instances of this design are a variant, for which see drawing KT-6.

1. Horizontal panels of cabinet doors, Madrasa of Īnāl al-Yūsufī (1392-93) --My photo, Fig. 17.
2. (Identical even in composition) Four vertical panels on cabinet door in N.E. wall of sanctuary, Madrasa of Farag ibn Barqūq (before 1409) --My photo, Fig. 18.
3. (Composition ditto) Main panel, back end, kursī, Madrasa Ashrafīya (1423-24) --My photo, Fig. 19.
4. V-cut in door facing of interior, Īnāl Complex (1451-60) --My photos, Fig. 20.
5. Lower horizontal band, front end, kursī, Madrasa of al-Ghūrī (1503-04) --My photo, Fig. 21.
6. (Composition like 1, 2 & 3) Upper pair of stone-carved panels above entrance, Mosque of Amīr Qurqumās (1506-07) --My photo, Fig. 22.

T. des E. 18

1. Brickwork frieze, side 7, earlier Kharraqān Tomb Tower (1067-68) --Stronach and Young, pls. XIb & XIId.
2. Wood mosaic, front of miḥrāb of Sayyida Nafīsa (1138-46) --Pauty, Les Bois Sculptés, pls. LXXV & LXXVI; Weill, Les Bois à Epigraphes, pl. XIV; etc.
3. Roundel in niche of main miḥrāb, Mausoleum of Yaḥyā ash-Shabīhī (1150) --Hautecoeur and Wiet, pls. 41 & 42.

4. In niche of carved stone miḥrāb, Mosque at Dunaysir (dated 1200) Grabar and Hill, 1st ed., Fig. 511.
5. Faience strapwork, central niche, interior of tomb of Kaykāvūs in his hospital at Sivas (1218) --Gabriel, Les Monuments, Vol. II, pl. XXXVII.
6. Etched in stone framing arch of doorway, entrance of Ẓāhirīya Madrasa, Aleppo (1223) --Grabar and Hill, 1st. ed., Fig. 516; and Sauvaget, Alep, pl. XXXV.
7. Carved on corner column flanking doorway of Haci Kiliç Cami at Kayseri (1275) --Ögal, Anadolu Selçuk..., Lev. LV, Resim 106; and Grabar and Hill, 1st. ed., Fig. 480.
8. Two upper panels (both look new) stucco miḥrāb, Great Mosque of Qūṣ (1300) --M.A.E. II, pl. 90.
9. Stucco window grills, Mosque of Qūṣūn (1330?) --Taʾrīkh al-Masāgid, Fig. 81.
10. Carved stone lintel over door of courtyard, Bayt as-Saḥaymī (1648-1796) --Direct observation.
11. Stucco window grille, Mosque of al-Ḥākim (date ?? A window of this design and identified as from Ḥākim's Mosque was published by Hessemer in 1853--pl. I, 31-- any chance of its being after an original of Ḥākim's time?) --A. Fikry, Masāgid al-Ẓāhira, I, pl. 663.
12. Ubiquitous in iron grilles made at the present day at Damascus --Direct observation.

T. des E. 20

All instances of this design I have observed have not the small six-pointed star between each three larger ones, but rather a simple equilateral triangle, which is the basic natural form of the design; to create the smaller star it is necessary to overlay an independent equilateral triangle on the basic one.

1. Tympanum design of 'Arab Ātā Mausoleum at Tīm, near Bukhārā (997-98) --Pugachenkova, Mavzolei Arab-Ata, pls. 16, 41 & 44.
2. Frieze, side 6, earlier Kharraqān Tomb Tower (1067-8) --Stronach and Young, pl. XIIc; and Seherr-Thoss, pl. 24.
3. Brickwork band around shaft of minaret at Dawlatābād (1108-09) --Sourdel-Thomine, "Deux Minarets..." in Syria XXX (1953), Figs. 3, 4, 5 & 6.
4. Central wood panels on sides of Miḥrāb of Sayyida Ruqayya (1154-60) --Pauty, Les bois sculptés, pl. LXXXI; and Précis III, pl. 92.
5. Tilework on inside of entrance arch, Tīmūr's palace at Shahr-i Sabz (1399-1400) --Grabar and Hill, Fig. 98.
6. Tilework in courtyard of Blue Mosque at Tabrīz (1465) --Sarre, Denkm. Pers. Bauk., pl. "24"; and Grabar and Hill, frontispiece.

T. des E. 21

1. (Variant in that large overlain six-pointed stars are slightly "obtuse" -- but its basic network is T. des E. 1a, unlike that of T. des E. 22) In painted stucco of interior, Qubbat al-Fadāwīya (1479) --Les Arts Arabes of Bourgoin, pl. 61 ("une mosquée...près l'Abbasieh...XIVe siècle").
2. Marble mosaic panels at each side of roundel, main entrance, Mosque of Qijmās al-Isḥāqī (1480-81) --My photo, Fig. 23.

T. des E. 22

1. Rail panel, first balcony from roof, minaret, Madrasa of Abū Bakr ibn Muzhir (1479-80) --My photo, Fig. 24.
2. (Variant in interior of small 6-point) Lower rear panel, minbar, Mosque of Sultān Shāh (mosque before 1495 --minbar now in Br. Mus.) --Ta'rīkh al-Masāgid, Fig. 202.
3. (Like Sulṭān Shāh) Lower rear panel, minbar, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 107.
4. (Variant in interior of small six-point) "Grand vantail du Caire" (no date given) --Précis, "La Menuiserie", pl. 51.

T. des E. 23

1. Tympanum, Mausoleum of Yūsuf ibn Kuthayyir, Nakhichevān (1161-62) --Grabar and Hill, 1st. ed., Fig. 228.

2. Framing band of pointed arch (next to $\frac{3}{4}$-round molding), Huand Hatun Türbe, Kayseri (1237-38) --Ögel, Anadolu Selçuk.., Lev. XXIV, Resim 45.
3. Engraved lines in stone, hood of stalactite doorway, Ribāṭ Khāqān, Aleppo (Firdaus) (1237-38) --M.A.E. II, Fig. 78.
4. Carved vertical framing band of portal, Hatun Han, Tokat (Pazar) (1238-9) --Gabriel, Les Monuments, Vol. II, pl. XXXI; Ögel, Anadolu Selçuk..., Lev. XXV, Resim 48; and Grabar and Hill, 1st. ed., Figs. 349 & 351.
5. (Spaced-out version (i.e., with pentagonal adjustment) with star drawn "3 en 3" with 12-part division) Marble mosaic panels at sides of lintels, entrances of Madrasa and of Mausoleum of al-Ghūrī (1503-04) --My photo, Fig. 25.

T. des E. 25

1. Wood strapwork and polygon-panel side of minbar of Badr al-Gamālī and al-Mustansir now in the Ḥaram al-Khalīlī in Hebron (dated 484 H.) --Ta'rīkh al-Masāgid, Fig. 31; and Pauty, "Le minbar de Qous", pl. Vb (in Mélanges Maspero).
2. (Slight variation) Front of wooden miḥrāb of Sayyida Ruqqaya (1154-60) --Pauty, Les Bois Sculptés, pl. LXXX; Weill, Les Bois à Epigraphes, Vol. I, pl. XVI; Mosques of Egypt, Vol. I, pl. 25; etc.
3. (Double-line version with star decreased in size) Side panel of minbar of Ṣāliḥ Ṭalā'i' in Great Mosque of Qūṣ (1155) --Pauty, "Le minbar de Qous", pl. II; Ta'rīkh al-Masāgid, Fig. 47; and Comité, Exercice 1900, pl. 3 (Arabic Edition).

4. (Completely identical with drawing and Hebron minbar design) Central wood panel of back side of door, Mosque of aṣ-Ṣāliḥ Ṭalā'i' (1160) --M.A.E. I, pl. 102.
5. In six different window grilles, exterior of Madrasa of Qalā'ūn (also two grilles above miḥrāb of Madrasa) (1284-85) --M.A.E. II, pls. 65a & 75a respectively (number of exterior grilles from direct observation).
6. Like Sayyida Ruqayya variation) "Piece of ceiling" in wood mosaic with fine foliate carving in polygons ("14th. c.") --Wiet, Album du Musée Arabe du Caire (1930), Fig. 32.
7. Tile and brickwork decoration of wall "at rear of building", 'Ishrat Khāneh, Samarqand (1464) --Grabar and Hill, 1st ed., Fig. 59.
8. Mosaic panel (marble) "encastré dans les parois de la Grande Mosquée de Damas" (date? probably Mamlūk) --Précis, "Les Applications", pl. 14, Fig. 1.

T. des E. 28

Colored and incrusted stucco from "maisons de Damas" -- Le Trait des Entrelacs, C.P. IX, 4.

T. des E. 31

1. (Identical except for inner six-pointed star and its surround) Brick mosaic false-arch tympanum in N.E. dome chamber, Great Mosque of Iṣfahān (1088) --Seherr-Thoss, pl. 10.

E. des E. 32

1. Tympanum of blind arch panel, North Dome Chamber, Great Mosque of Iṣfahān (1088) --Article on the Great Mosque by Godard in Athār-é Irān, 1936, Tome I, Fasc. I, Fig. 148.

T. des E. 33

(All observed occurrences of this design are without the lozenge inside the "double pentagon", or "Tabl" shape).

1. Rear vertical panel, minbar of Ulu Cami of Siirt (611 H.) --Oral in Vakiflar Dergisi V, Figs. 9 & 10.
2. Exhibited page in Cairo Millenary Exhibition (Ex. No. 281) from Qur'ān of Öljeytü (1313) --Cairo Exhibition Catalog, pl. 51.
3. Panel on "Tabouret en marqueterie du Caire (XIVe siècle)" --Précis, "La Menuiserie", pl. 93.
4. Tilework of wall of small recess on court, Mosque of Gawhar Shād, Mashhad (1418) --Pope, Persian Architecture, Fig. 269.
5. Wooden door leaf, dated 1499 --Pope, Survey, pl. 1465 c.

T. des E. 35.

(Bourgoin's drawing corresponds exactly not only in structure but also in actual section shown to) Iron-plated door of the Māristān of Nūr ad-Dīn at Damascus (1154) --My photo, Fig. 26; also Herzfeld ("Damascus: Studies in Architecture", I, Fig. 46, in Ars Islamica IV) publishes a drawing of this door in which the general types of shapes and their positions are the same as in Bourgoin's drawing and in the actual door, but his drawing is, nevertheless, structurally wrong because he has the 5-point stars resulting from other lines, rather than being regular as they are in the original and in the T. des E. He makes no mention of Bourgoin's drawing, though he customarily does so when he draws a

design already drawn by Bourgoin.

T. des E. 37

1. Two panels flanking stalactite hood of doorway, Mosque of "Izz ad-Din al-Khatiry" at Būlāq "(XVe siècle)" --Précis, "L'Architecture", pl. 48 (The Arabic Index gives 1336 as date of Mosque of al-Khaṭīrī).
2. Marble inlay at ends of stone lintel over S.W. doorway, Mosque of Aṣlam as-Silaḥdār (1344-45) --Mosques of Egypt, Vol. I, pl. 70; and Précis, II, pl. 24.
3. Carved, raised wooden strapwork of ceiling of Ḥūd, Madrasa Asanbughā (1370) --My photo, Fig. 27.
4. Portal border of raised stone strapwork inlaid with rēd and blue glass, Mosque of Mu'ayyad Shaykh (1415-20) --Précis, II, pl. 24; and Hautecoeur and Wiet, pls. 167 & 168.
5. Two carved panels flanking stalactites above window in "Portail de la Mosquée du Cadi Yahya à Boulak...1448" (this is the S.W. door) --Hautecoeur and Wiet, pl. 186b.
6. Identical vertical rectangular panels on square lower part of minaret, Mosque of al-Mar'a (1468-69) --My photo, Fig. 28.

T. des E. 38

(For a closely similar design at al-Azhar, see No. 6 under T. des E. 16).

1. Carved as panels on plane surfaces of stalactites above entrance Mama Hatun Türbe, Tercan (ca. 1200) --Grabar and Hill, 1st. ed., Fig. 348.
2. Carved on stone dikka, Mosque of Shaykhū (1349) --Direct observation.
3. In niche of miḥrāb (carved stone), Īnāl Complex (1451-60) --My photo, Fig. 30; also see Hautecoeur and Wiet, pl. 189.
4. In niche of miḥrāb, Mosque of Amīr Qurqumās (1506-07) --My photo, Fig. 31.
5. In two different window grilles, Mosque of ibn Ṭūlūn (one is eighth window from left in N.E. ziyāda; the other in qibla wall) (date?) --Former, direct observation; latter, my photo, Fig. 29.

IIr SERIE

FAMILLE OCTAGONALE

The "Famille Octagonale" (90-45 degree system) is based on the square and thus upon a problem of division of the circle which is best accomplished by adjustment (see drawing i). The allover square grid was the main basis of Pharaonic infinite-repeat patterns and in the most ingenious and beautiful of these, small squares are grouped to form a single complex shape which by repetition and interlocking with itself covers the whole field (see drawings K-1 and K-2). A number of Pharaonic square grid based designs (and I shall not document all this here) passed over to Mycenae, Persia (Sasānid), Umayyad Syria (Khirbet al-Mafjar), Seljūq brickwork, and even on the columns on the

facade of the Great Mosque at Diyār Bakr.[67]

Certain basic patterns involving octagons, regular and irregular, were current in the 500-year period preceeding the Hijra, such as the pattern of octagons in contact at their apexes, etc., which persisted in Islamic art.[68]

For the Umayyad period, it seems to me that the most noteworthy developments are: 1) the design of tangent 8-pointed stars ("deux en deux") on square plan(Qaṣr al-Ḥayr al-Gharbī -- see drawing K-4) and 2) T. des E. 43 (Khirbet al-Mafjar, window "P5") and its variant, K-5 (Qaṣr al-Ḥayr al-Gharbī, window "16"). The former, the famous "star and cross" design is perhaps the most well-known Islamic design and had much subsequent usage in Islamic decoration, though not in Egypt. The latter, T. des E. 43 and its variant, is a prototype to the straight line T. des E. 42, which I have not discovered before the end of the twelfth century.[69]

Persia and the Islamic West seem to be especially rich in designs on the octagonal basis; but they are spread throughout the Islamic world. The square plan, like that of equilateral triangles, has been extremely popular as a basis for centers of stars of various numbers of points. It has an especial affinity with stars of 4, 8, 12, 16, 20, 24 points, etc.; but perhaps surprisingly it has been the basis of stars of point numbers

[67]For a large number of the motifs, see Prisse d'Avennes, L'Art Egyptien (plates unnumbered).

[68]On this, see discussion in E.M.A. I, pp. 139 ff.; and Figs. 86-88.

[69]This forms a striking parallel to K-18, which in the same sense is an Umayyad prototype for a later straight-line design, T. des E. 85, which as far as I can discover, appears first just after the mid-eleventh century.

apparently inconsistent with it. For example we have on the square plan stars of seven points (T. des E. 170); stars of ten points (T. des E. 177); stars of fourteen points (T. des E. 169); and other complex designs with many different types of stars, some of which are not multiples of four, as in T. des E. 169 and 163.

T. des E. 42

1. One unit in rail of minbar of Mosque of 'Alā' ad-Dīn at Ankara (dated 1197) --Mayer, Islamic Woodcarvers, pl. III; and Oral in Vakiflar Dergisi V, Figs. 3 and 4.
2. Carved in stone in upper left square (also minor variant --in that the lines are not carried through to form secondary star in 8-ponts--in lower left square) of band framing lintel of entrance, ath-Tha'āliba (Mausoleum Abū Mansūr Ismā'īl -- 1216) --M.A.E. II, pl. 27c.
3. One unit in each of two square panels, N.W. face of Mausoleum of the 'Abbāsid Khalifs (before 1242) --Hautecoeur and Wiet, pl. 56.
4. Stucco window in drum above entrance, second mausoleum, Khanqa al-Bunduqdārī (1283-84) --M.A.E. II, pl. 61e; also see my photo, Fig. 3.
5. Bronze strapwork door of main entrance; marble mosaic panel above first window to right of miḥrāb in mausoleum; marble mosaic in hood of miḥrāb of mausoleum; central lower stucco window grille, facade of forecourt of mausoleum: Qalā'ūn complex (1284-85) --M.A.E. II, pl. 67 ; direct observation;

direct observation (also see Hautecoeur and Wiet, pl. 77); M.A.E. II, pl. 68 (respectively).

6. Carved stone window lintel (first left of entrance), N.E. facade, Madrasa of Zayn ad-Dīn Yūsuf (1298) --Précis, "L'Architecture", pl. 24; and M.A.E. II, pl. 82 c.

7. Represented on a railing in a painting from the Demotte Shāh Nāma, "Nushirwan's fifth banquet for the sage Buzurdjmihr" (early 14th. c.) --D. Brian in Ars Islamica VI, pt. 2, Fig. 27.

8. Rectangular and round stucco windows above and left of minbar, Masgid Ahmad al-Mihmandār (1324-25) --My photo, Fig. 32.

9. (Minor variation in which lozenge takes place of four-pointed star) Window grilles, facades of Mosque and Khānqā of Shaykhū (1349) --My photo, Fig. 33.

10. Carved in wood, frame of panel "de vantail d'une porte d'entrée du Sahn", Mosque of Sultān Hasan (1356-63) --Herz, Sultan Hasan, Pl. XX, 1.

11. Two sets of two windows each, above and both sides of mihrāb, Mosque of Amīr Mithqāl (1361-62) --My photo, Fig.34.

12. Carved as first tier of stars in strapwork of dome, Mausoleum of al-Ashraf Barsbāy in the Northern Cemetery (1432) --Mosques of Egypt II, pl. 114; Hautecoeur and Wiet, pl. 179.

13. Carved wood border, door of sahn; and small incrusted panel at top of another door of sahn, Madrasa Abū Bakr ibn Muzhir (1480) --Précis, "La Menuiserie", pls. 54, No. 2 and 55.

14. Polychrome ceiling of tribune, Muradiye Cami, Manisa (1583-86) --Riefstahl, pl. 22 f.

T. des E. 43

1. (More natural variant in which arc of star tip continues rather than reversing, thus forming in interstice an octagon with concave sides instead of the four-pointed star as in the drawing of Bourgoin -- see my drawing K-5) Windows 9 and 16 (my numbering) from Qaṣr al-Ḥayr al-Gharbī (now in Damascus Museum) (724-27) --My photo, Fig. 35 (window "16").
2. (Like Bourgoin's drawing) Window "P5" from Khirbet al-Mafjar (2nd. qtr., 8th. c.) --Hamilton, Khirbet al-Mafjar, pl. LXIX, Fig. 246.
3. Decorative band on page of Kūfic "Ḳur'an. II-III century". --Moritz, Arabic Palaeography, pl. 22.
4. (Like No.1) Inlaid marble, main side panel, stone minbar, Mosque of Āqsunqur (1346-7) --Mosques of Egypt I, pl. 72.
5. (Like No. 1) Stone relief strapwork panels in entrance bay flanking window, Bīmāristān Mu'ayyadī (1418-20) --My photo, Fig. 36.
6. (Like No. 1) Square stone-carved panel at base of octagonal stage, minaret, Mosque of Qarāqogā al-Ḥasanī (1441-42) --My photo, Fig. 37.
7. (Like No. 1) Large carved-stone panel on square base of minaret; also, upper pair of panels flanking stalactite hood of small window above entrance of Madrasa opening on court, Īnāl Complex in Northern Cemetery (1451-60) --Former, Hautecoeur and Wiet, pl. 187, and my photo, Fig. 38; latter, my photo, Fig. 39.

8. (Like No. 1) Stone strapwork encircling circular stage, shaft of minaret, Madrasa al-Qāḍī Abū Bakr ibn Muzhir (1479-80) --My photo, Fig. 24; and Hautecoeur and Wiet, pl. 201 (r.).

T. des E. 44

1. (Same structure but with eight-pointed stars drawn "5 en 5" with 16-part division, resulting in slight difference in interstice) Pavement "de la maison Hamâdy, à Damas" (date ?) --Précis, "Les Applications", pl. 56, Fig. 4.

T. des E. 48

1. Far left blind pointed-arch niche, "first tier of stalactites", miḥrāb, Mosque at Barsiyān (11 34) --M.B. Smith in Ars Islamica IV, Fig. 24.
2. Main side panel, minbar, Aksaray Ulu Cami (time of Mas'ūd ibn Qilij Arslān, i.e., 1116-56) --Oral in Vakiflar Dergisi V, Fig. 1.
3. Main side panel, minbar, 'Alā' ad-Dīn Cami,Konya(dated 1155) --Oral, op. cit., Fig. 2.
4. Brick panel on base of minaret, Great Mosque, Mōṣul (1st. half, 12th. c., +/- 25 years) --Sarre and Herzfeld, Arch. Reise, II, Abb. 240; and III, Tafel XC.
5. Main side panel, minbar, Mosque of 'Alā' ad-Dīn, Ankara (dated 1197) --Mayer, Islamic Woodcarvers, pl. III; and Oral, op. cit., Fig. 3.

6. Carved in stalacites (2nd. tier), portal, Mama Hatun Türbe, Tercan (ca. 1200) --Grabar and Hill, 1st. ed., Fig. 345.
7. Main side panel, minbar, Ulu Cami, Siirt (611 H.) --Oral, op. cit., Figs. 9 and 10.
8. Three bands of carved stone strapwork framing doorway, Mosque of ʿAlāʾ ad-Dīn, Niğde (1223) --Private photo, Shahīra Mehrez.
9. Etched line in stone, panels at sides of miḥrāb, Ẓāhirīya Madrasa, Aleppo (1223) --Grabar and Hill, 1st. ed., Fig. 517.
10. Wood assemblage, tābūt of Ṣāliḥ Nagm ad-Dīn Ayyub(1250) --My photo, Fig. 40.
11. Carved-stone band above niche inside doorway, Gök Madrasa, Sivas (1271-72) --Photo Shahīra Mehrez.
12. Second window left of the one above entrance, second mausoleum, Khānqā Bunduqdārī (1283-84) --My photo, Fig. 3.
13. Lower windows in 1st., 3rd. and 6th. recesses from right, facade, Mausoleum of Qalāʾūn (1284-85) --Direct observation; see also M.A.E. II, pls. 65b and 66b.
14. Main side panel (carved from solid planks), minbar, "Ahi Şeref üd-Din Cami" (also known as Arslān Khāne Mosque--mosque dated to 689 H.) --Oral, op. cit., Fig. 20 (I feel I should point out here that Oral's Fig. 21 shows a detail supposedly of the same minbar, which I regard as highly unlikely, even though it is also T. des E. 48; for it is executed in very fine qānāt work, and both photos seem to show the west side of a minbar!)

15. (Identification almost sure--photo very bad) Main side panel, minbar, "Beyşehir Esrefoglu Cami" (687 H.) --Oral, op. cit., Fig. 24.

16. Stone-carved lintel, second window left of entrance, N.E. facade; and all shutters of windows of N.E. and S.E. facades (restoration), Madrasa Zayn ad-Dīn Yūsuf (1298) --Précis, "L'Architecture", pl. 25; and direct observation.

17. Two stucco roundels, interior of Turbe Takrītīya, Damascus (1298) --Direct observation.

18. Carved stone strapwork, blind arch panel, tomb tower at Jūga, near Nakhichevān (probably 13th. c.) --Grabar and Hill, 1st. ed., Fig. 231.

19. Wooden polygon-and-strapwork door from the Madrasa of Ẓāhir Barqūq, dated 1386, but stated to be more likely from the thirteenth century (now in Museum of the Faculty of Arts, Cairo University) --Zakī M. Ḥasan, Aṭlas, Fig. 400; see also Cairo: A Life Story of 1000 Years, pl. 197 (where it is said to be from the twelfth century!)

20. Painted stucco gallery vault, Tomb of Öljeytü at Sulṭānīya (1305-13) --Pope, Persian Architecture, Fig. 227.

21. In second small blind-arch panel from front, lower tier, marble mosaic miḥrāb of Ṭaybarsīya Madrasa at al-Azhar (1309-10) --M.A.E. II, pls. 99b and 113b; and my photo, Fig. 176.

22. Panels in wooden cabinet doors, Mausoleum of Sunqur Sa'dī (1315) --My photo, Fig. 41.

23. Main side panel (planks carved to resemble qānāt), minbar, "Birgi Ulu Cami" (722 H.) --Oral, op. cit., Fig. 26.

24. Beautifully carved true qānāt doors to Mosque of Sunqur Bey at Niğde (1338) --Grabar and Hill, 1st. ed., Fig. 456.

25. Window, "Kuppelgrab in Sarachs" (1356) --Diez, Islamische Baukunst in Churâsân, pl. 57.

26. Small panel, second page of a Qur'ān ordered by Khawand Baraka, mother of Sulṭān Sha'ban (was in the Madrasa of Umm as-Sulṭān Sha'ban--1368-69?) --Précis, "Les Manuscrits", pl. 1.

27. Carved as raised strapwork on facings of door to "Maqām" and to cabinet in sanctuary, Madrasa Baqarīya (before 1374) --My photo, Fig. 42.

28. Panels of the wooden doors (qānāt with plain uncarved polygons, mean in appearance, but doors inscribed with the name of Barqūq) in sanctuary and mausoleum, Madrasa Barqūqīya, Bayn al-Qaṣrayn (1384-86) --Direct observation and my photo, Fig. 43.

29. Stucco in interior, Tomb Tower of 'Imād ad-Dīn, Qumm (1390) --Pope, Persian Architecture, Fig. 253.

30. Vertical panels of door to cabinet in sanctuary, Mosque of Īnāl al-Yūsufī (1392-93) --My photo, Fig. 17.

31. Interstitial area used as square panels of doors to mausoleum, Khānqā Farag ibn Barqūq (1399-1411) --Précis, "La Menuiserie", pl. 15.

32. V-cut lines in wooden door facing of cabinet in N.E. wall of sanctuary, Madrasa Farag ibn Barqūq (before 1409) --My photo, Fig. 44.

33. Border frame in mosaic faience, miḥrāb, Yeşil Türbe at Bursa (1413-24) --Seherr-Thoss, pl. 123.

34. Tile strapwork on body of minaret above balcony, Mosque of Gawhar Shād, Mashhad (1418) --Pope, Persian Architecture, Fig. 266.

35. One-unit panels of rail, minbar, Madrasa Baqarīya (Minbar given in 1420) --My photo, Fig. 45.

36. Mosaic tile panel, sanctuary of Shrine of ʿAbd Allāh Anṣāri, Gāzur Gāh (1425) --Scherr-Thoss, pl. 66.

37. Two different panels on kursī moved from the Mosque of al-Ghamrī, now in the Khānqā of al-Ashraf Barsbāy (ca. 1439) --Taʾrīkh al-Masāgid, Fig. 165.

38. Upper (vertical) panels of doors to cabinets in N.W. wall, mausoleum of Gawharīya Madrasa at al-Azhar (1440) --My photo, Fig. 46.

39. Vertical panels of cabinet doors, N.E. wall; and 1/8-radius panels inside seat of kursī, Mosque of Qāḍī Yaḥyā, Bayn an-Nahdayn (1444) --My photos: former, Fig. 47; latter, Figs. 57 and 117.

40. Main side panel, minbar, Mosque of al-Marʾa (1468-69) --My photo, Fig. 48.

41. Central ornament of first page, Qurʾān made for al-Maqarr al-Ashrafi Khānī Bek, Amīr Akhūr (1474) --Précis, "Les Manuscrits", pl. 31.

42. Main side panel; and end rail panels, minbar, Mosque of ibn Bardbek ad-Dawadārī (ca. 1475) --My photo, Fig. 49.

43. Panel of back side of front door; and on riser of seat of imām, minbar, Madrasa of Abū Bakr ibn Muzhir (1479-80) --Latter, my photo, Fig. 76; and direct observation.

44. Carved in square panel of zone of transition from square to octagon, minaret, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 50.

45. Upper 1/8-radius panels, "pupitre pour la lecture du Coran, au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 97.

46. Carved in joggled voussoirs of lintel over door to college, ṣaḥn; and end panels of rail, minbar, Madrasa of Qānībāy Amīr Ahkūr (1503) --My photos: former, Fig. 51; latter, Fig. 52.

47. In wood mosaic and in v-cut wood panels inside shaykh's seat, kursī; and carved in voussoir above door to shop, facade, Madrasa of al-Ghūrī (1503-04) --My photos: former, Fig. 53; latter, Fig. 54.

48. Several occurrences in woodwork of Bayt as-Sahaymī (1648-1796) --Direct observation.

49. Mosaic "de la maison de Hassan-bey (ainsi dénommée sur le plan de l'Expédition de l'Egypte). Aujourd'hui ruinée" --Précis, "Les Applications", pl. 17, Fig. 2.

50. "Un pavement de la maison Hamâdy, à Damas" --ibid., pl. 57, Fig. 1.

T. des E. 51

This design shares the polygonal shapes and much of the overall structure of T. des E. 143, so that if a certain section is shown from either of them, it is impossible to say from which of the two designs the section is taken. Instances where this is the case are indicated (by "Or...") and entered under both.

1. (Or 143) Running border making rectangular frame around wooden miḥrāb of Nūr ad-Dīn in Maqām Ibrāhīm in citadel of Aleppo (begun 564 H.) --Herzfeld, "Damascus: Studies in Architecture", II, Fig. 81, in Ars Islamica X.
2. Monumental stalactite-hooded blind niche panel, exterior of Mausoleum of Mu'mina Khātūn, Nakhichevān (1186-87) --Jacobstahl, Abb. 14; and Grabar and Hill, 1st ed., Fig. 229.
3. (Or 143) Brickwork band framing niche-panel, base of "Minaret einer Hochschule" at Sinjār (dated 1201 --Sarre and Herzfeld, Arch. Reise, Vol. III, pl. IV.
4. Horizontal framing band above niche inside portal, Aksaray Sultan Han (1229) --Photo Shahīra Mehrez.
5. Rectangular band framing pointed-arch opening inside main entrance, Karatay Han (1230-40) --Grabar and Hill, 1st. ed., Fig. 492.
6. Window grille; and (or 143) on ends of tābūt in mausoleum, Qalā'ūn complex (1284-85) --Former M.A.E. II, pl. 64; and latter, direct observation.
7. Wood strapwork of door (no polygons between) to right of mihrāb, Mosque of al-Amīr Mithqāl (1362-63) --My photo, Fig. 55.
8. (Or 143--section like on Qalā'ūn tābūt) Upper panel of cabinet doors in Madrasa Gawharīya at al-Azhar (1440) --My photo, Fig. 56.
9. (Or 143--section like on Qalā'ūn tābūt) Small horizontal panel inside where shaykh sits, kursī, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photos, Figs. 57 and 117.

10. (Or 143) Rectangular carved-stone panels on four sides of minaret's octagonal stage, Madrasa Gaqmaq (near Shāri' al-Azhar) (1451) --My photo, Fig. 58.
11. (Or 143) At least two occurrences in voussoirs of great arches (to side Īwāns); and at least two in voussoirs of lintels over doors to colleges, Madrasa of Qāytbāy at Kabsh (1475) --My photos: Fig. 59 (former); and (latter) Fig. 142.
12. (Or 143) Carved with lines as raised strapwork, wood facings of door in ṣaḥn, Madrasa Azbak al Yūsufī (1494-95) --My photo, Fig. 60.
13. (Or 143--section like on Qalā'ūn tābūt) "Balustrade de la tribune de la mosquée el Bourdeyneh (XVIIème siècle)" --Précis, "La Menuiserie", pl. 32.

T. des E. 52

1. Colored and incrusted stucco from "maisons de Damas" --Trait des Entrelacs, C.P. IX, 2.

T. des E. 53

1. (Exactly like Bourgoin's drawing except for inside of stars) Marble mosaic of niche of miḥrāb in S.E. corner, Mausoleum of Imām ash-Shāfi'ī (work of Qāytbāy, 1480, see M.A.E. II, p. 75) --My slide.
2. (One unit, with the pentagons regular and center of square turned into octagons) 1st., 3rd. and 5th. panels of rail, minbar, Mosque of Abī l-'Alā (ca. 1485) --Ta'rīkh al-Masāgid, Fig. 210.

3. (Related) Upper square panel of front, "pupitre pour la lecture du Coran au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 97.

T. des E. 54

1. Large stucco and terracotta panel, "Īwān in der Qal'ah", Baghdād (time of Khalif an-Nāṣir, i.e., 1180-1225) --Sarre and Herzfeld, Arch. Reise, Vol. III, pl. CXI.
2. Six (all) lower windows, N.E. and S.E. facades, Madrasa Qalā'ūn (1284-85) --Direct observation; see also M.A.E. II, pl. 65a.
3. Stucco gallery vault, Mausoleum of Öljeytü, Sulṭānīya (1305-13) --Pope, Persian Architecture, Fig. 230b.
4. Design above entrance, "Kuppelgrabes in Sarachs" (1356) --Diez, Islamische Baukunst in Churasan, pl. 77.
5. V-cut into wooden facings of large doors opening off court, Mosque of Qijmās al-Isḥāqī (1480-81) --My photo, Fig. 61.
6. Carved marble panels flanking lintel, entrance, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 62.
7. Carved in spandrels of miḥrāb, Mausoleum of Qānībāy Amīr Akhūr (1503) --My photo, Fig. 63.

T. des E. 56

1. (Related--on square plan with eight-pointed star drawn "2 en 2", whose radius = 2/9 of side of réseau square) Framing band of portal, Ak Han (1253-54) --Ögel, Anadolu Selçuk..., pl. XXX, Fig. 58.

2. (Related) Square panel, ceiling of 1st. travée of sanctuary, Mosque of Mu'ayyad Shaykh (1415-20) --Précis, "La Menuiserie", pl. 61, Fig. 2.

T. des E. 57

1. (Variant in that star tips are rotated half a division, thus changing slightly the interstital matter) Wide carved-stone framing panel around door of "masjid" in courtyard, Kayseri Sultan Han (1232-36) --Photo Shahīra Meḥrez.
2. (Variant in that outside of elongated hexagons of star complexes is determined by a regular 16-sided figure, unlike Bourgoin's drawing; this results in the five-pointed stars being more regular, the hexagons at the corners of the octagon being larger and the octagon itself smaller--also unlike Bourgoin's drawing is the fact that the 16-pointed star is drawn exactly "7 en 7") Qur'ān stand in Mausoleum of Sulṭān Ḥasan (1356-63) --Hautecoeur and Wiet, pl. 136b.
3. (Identical with design of Sulṭān Ḥasan kursī) Main side panel, minbar, Mosque of Algāy al-Yūsufī (1375) --My photo, Fig.64.
4. (Identical with design of Sulṭān Ḥasan kursī) Front end (direction in which shaykh faces) kursī, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photo, Fig. 65.
5. (Identical with design of Sulṭān Ḥasan Kursī) Front end, Kursī, Mosque of Qāḍī Yaḥyā at Būlāq (surely the work of Fu'ād I --see comments, this list T. des E. 116) --My photo, Fig. 103.

T. des E. 58

1. Mosaic panel "encastrée dans les parois de la Grande Mosquée de Damas" (probably Mamlūk) --Précis, "Les Applications", pl. 14, Fig. 2.

T. des E. 59

1. Colored and incrusted stucco from "maisons de Damas" --Trait des Entrelacs, C.P. IX, 3.

T. des E. 60

1. Panel from "une maison de Damas" --Précis, "Les Applications", pls. 34 and 35 (one color plate).

(A design which I suspect of being the "ancestor" of the above is one I have observed in three late Mamlūk monuments in Cairo. It is developed by substituting an eight-pointed star for the octagon in T. des E. 48; whereas in T. des E. 60 the eight-pointed stars are so close together that when one tries to "revert" the design to 48, one gets very awkward five-pointed stars. The occurrences of the "ancestor" design are:

1. Two square panels above entrance, "Zawiya Djoulak" (1466) --Hautecoeur and Wiet, pl. 186.
2. In square stone-carved panel on S.E. face of transition zone; and in balcony rails of next-to-top balcony, Minaret of Qāytbāy at al-Azhar (1468) --My photos, Figs. 66 and 67.
3. Lower pair of stone-carved panels in entrance bay, Mosque of Timrāz al-Aḥmadī (1472) --My photo, Fig. 68.

T. des E. 61

1. V-cut in piece of original wood mounted on wall in entrance passage, Madrasa Asanbughā (1370) --My photo, Fig. 69.

(Though the above is the only occurrence I have round of the exact design in Bourgoin's drawing, I have found several designs using the same polygons with different arrangements, listed below)

1. (Thin section with same polygons and star, differently arranged) Carved as raised strapwork, facings of cabinet doors in Mausoleum of Aṣlam as-Silaḥdār (1344-45) --My photo, Fig. 5; dee drawing KT-4.
2. (Section repeating interstitial matter from 61 but not including stars) Tall rectangular stone-carved framing band of lateral niches in entrance bay, Mosque of Sulṭān Ḥasan (1356-63) --Mosques of Egypt I, pl. 83; and Herz, pl. XI (r.) and see my drawing KT-5. (Note: An apparently identical design occurs as the carved marble framing band of the miḥrāb of the Karatay Cami, Antalya [1250] --See Riefstahl, pl. 93).
3. (Related Central square of first page, "Coran légué en 770 (1368)" by Sulṭān Sha'bān --Précis, "Les Manuscrits", pl. 3.

T. des E. 66

(This is a design which seems to have been peculiarly susceptible to variation, keeping the same basic structure and proportions, but often surprisingly different in superficial visual appearance. For this reason, I have drawn four variants based on Bourgoin's

two, which latter have somewhat different proportions).

1. (Variant on "b" --see my drawing K-T-O) Identical square panels on two different Ayyūbid tābūt fragments (Nos. 2130 and 2131) from the Mausoleum of al-Imām ash-Shāfi'ī (ca. 1211) --Weill, Les bois à épigraphes jusqu'à l'époque Mamlouke, pl. XXII.
2. (Simplification of "a" --see my drawing KT-2) Wide framing band around door, palace of Malik al-'Azīz Muḥammad in citadel of Aleppo (628 H.) --Herzfeld, "Damascus: Studies in Architecture", III, Ars Islamica XI-XII, Fig. 104 (drawing by Herzfeld).
3. (Identical with 66 "b") Panel of marble mosaic over southernmost window of qibla wall, Mausoleum of Qalā'ūn (1284-85) --Direct observation; see detailed drawing in Précis, "Les Applications", pl. 9, Fig. 3.
4. (Simplification of "a" --see my drawing KT-1) Wood strapwork window-shutters opening on street, facade, Mosque of Aḥmad al Mihmandār (1324-25) --My photo, Fig. 70.
5. (Another variant on "a") Large marble mosaic panel in niche of miḥrāb, Madrasa Aqbughāwīya at al-Azhar (1333-39) --My photo, Fig. 71.
6. (Simplification of "a" --like Mihmandār, except that 8-points created by overlaying another square on one present) Small panels flanking central one (just under hood) in niche of miḥrāb, Madrasa Baqarīya (before 1374) --My photo, Fig. 72.
7. (Simplification of "a" --like occurrence in palace of al-'Azīz at Aleppo) Great wooden strapwork door from vestibule to corridor, Madrasa Barqūqīya (1384-85) --My photo, Fig. 73.

8. (Simplification of "a") Upper rear panel, minbar, Mosque of Qarāqogā al-Ḥasanī (1441-42) --My photo, Fig. 74; and drawing KT-3.
9. (Identical with design of Mihmandār shutters) Panels of door in sanctuary; also back of seat of Imām, minbar, Madrasa of al-Qāḍī Abū Bakr ibn Muzhir (1479-80) --My photos, Figs. 75 and 76; for latter see also Mosques of Egypt II, pl. 227 (r.).
10. (Identical with "a") "Un pavement de la maison Hamâdy, à Damas" --Précis, "Les Applications", pl. 57, Fig. 2.

T. des E. 67

1. (Closely related design) Brick strapwork of outer framing band of doorway, Naṣr ibn ʿAlī Mausoleum, Uzgend (11th. c., according to Hrbas and Knobloch; 1012-13, according to Schroeder, Survey, p. 1037) --Hrbas and Knobloch, pls. 44 and 45; see my drawing K-6.
2. Brick entrelac encircling shaft of minaret at Damghān (1026-29) --Pope, Persian Architecture, Fig. 163; and Grabar and Hill, Fig. 196.
3. As development of shafts of Kūfic inscription, panel in south corner of sanctuary, Masjid-i Jāmiʿ, Gulpayagān (1104-18) --Pope, Survey, pl. 308a.
4. Encircling shaft of minaret at Dawlatābād (1108-09) --Sourdel-Thomine, "Deux minarets...", Syria XXX, Figs. 1, 2, 3 and 4.
5. Band encircling shaft, minaret at Sāva (1110) --Survey, pl. 358a; and Grabar and Hill, Fig. 214.

6. Ellipse-shaped panel, minaret at Jām (1153-1203) --Pope, Pers. Arch., Fig. 97-8
7. Marble inlay in courtyard, ʿĀdilīya Madrasa, Damascus (finished 619 H.) --My photo, Fig. 77.
8. Stone-carved band framing window on side oposite staircase, "masjid" in courtyard of Kayseri Sultan Han (1232-36) --Photo Shahīra Mehrez.
9. Framing band of doorway, "Bostam,Moschee des Schech Bajesid" (probably 1299-1313) --Sarre, Denkmäler Persischer Baukunst, pl. 86.
10. Painted plaster arch soffit, Imāmzāda Yaḥyā, Varamīn (1307) --Pope, Pers. Arch., Fig. 181.
11. Arrangement of epigraphic tile panel, south corner, Masjid-i Jāmiʿ, Yazd (1375) --Pope, ibid., Fig. 245.
12. As development of shafts of square Kūfic around edges of square panels, south wall of entrance to sanctuary, Blue Mosque at Tabrīz (1465) --Seherr-Thoss, pl. 77.

III^{e} SERIE

FAMILLE DODECAGONALE

(See introductory comments to "Famille Hexagonale" concerning the fact that I do not consider the "Dodécagonale" to constitute a distinct "Famille"; also Chapter III, note on the problems of classifying designs, pp. 40-44.

T. des E. 68

1. (The Mosque of Baybars I (1266-69) has on the flanks of its N.W. entrance roundels with the star-complex unit from 68, but a close examination reveals that the surrounding "interstitial matter" is overlapped and repeated circumferentially around the edge of the roundel and that as such the design could not continue over a surface. This manner of composing within a roundel is a practice which is particularly common in Seljūq Anatolia. Compare 8 and 12-point medallions of Baybars (M.A.E. II, pl. 49) with 8 and 10-points on Niğde ʿAlāʾad-Dīn Mosque (1224--Grabar and Hill, Fig. 454); Kayseri Daruṣṣifa (1205--Ögel, Anadolu Selçuk... pl. III, Fig. 4); the roundel (10-pointed star) on a 13th, century Anatolian Seljūq door from Anqara (see Zakī M. Ḥasan, Atlas, Fig. 387); and on church of Hagia Sophia at Trabzon (probably early 13th. c. --Grabar and Hill, Fig. 408). I have personally tried to construct an allover design on the basis of what is implied in these Anatolian 10-point star roundels as found in the large projecting roundels of the Kayseri Daruṣṣifa, etc., and it is on the basis of this experience that I say that they and the Baybars 8-point are only composed for the space, while seeming to be from an infinite star-pattern. I only know of this type of roundel on one other Egyptian monument (excluding the minbar--marble and typically Costantinopolitan --in the Mosque of Malika Ṣafīya (1610), where the star is a 10-point); this is a 12-pointed star on alternating sides of

a hexagonal silver-inlaid bronze table ("Kursī"), probably dating from the early 14th. c. (Islamic Museum Invoice No. 138; see Catalogue of 1969 Cairo Exhibition of Islamic Art, No. 63, p. 72; and Zakī Ḥasan, Atlas, Fig. 521). But for Anatolia, many more examples (on architecture) can be found.

2. Stucco roundel, interior, Turbe Takrītīya, Damascus (1297) --Direct observation.

3. (With outside of star unit determined by lines drawn "3 en 3" with 24-part division, not "2 en 2" with 12-part division).

11. Upper window of three-window set on four sides of transition zone, Mausoleum of Sunqur Sa'dī (1315) --My photo, Figs. 78, 97 and 98.

4. Hexagon-shaped tile panel, portal, Masjid-i Jāmi', Varamīn (1322) --Pope, Pers. Arch., Fig. 240.

5. Stucco windows of transition zone of dome, mosque of an-Nāṣir Muḥammad in the Citadel (1318-35 ?) --Mosques of Egypt, I, pl. 58.

6. Window grilles of N.W. facade, Madrasa of Sarghatmish (1356) --My photo, Fig. 79.

7. Two horizontal rows of brass openwork, Chandelier from the Mosque of Sulṭān Ḥasan (1356-63) --Mosques of Egypt, II, pl. 232c.

8. Stucco window (with armorial badge) in side wall of N.W. Īwān, Madrasa of Algāy al-Yūsufī (1373) --My photo, Fig. 80.

9. (Variant like Sunqur Sa'dī windows, in which outside of elongated hexagons is determined by a line drawn from its apex to the third division-point over, the circle being

divided into 24 parts. This results in the five-pointed stars being more regular and the interstitial hexagon irregular, as opposed to Bourgoin's drawing, in which the line is drawn to the second division-point over, the circle being divided into twelve parts). Large pomegranate-shaped panel of brass-plated door of entrance, Madrasa of Maḥmūd al-Kurdī (1395) --My photo, Fig. 81.

10. Two carved stone panels at ends of lintel, Bāb al-Ghūrī at Mosque of al-Imām al-Layth (1506) --Ta'rīkh al-Masāgid, Fig. 132.

11. (Free curvilinear version) On floor in painting, "Sultan Mustafa thronend. Istanbul, Mitte 16 Jh. Univ. Bibliothek, Istanbul" --Kühnel, Islamische Kleinkunst, Fig. 30.

12. Several occurrences in woodwork ceilings, Bayt as-Saḥaymī (1648-1796) --Direct observation.

T. des E. 69

1. (Variant in space directly along side of réseau-triangle between each two stars) Top panel, left side, miḥrāb of Sayyida Ruqayya (1154-60) --Pauty, Les bois sculptés..., pl. LXXXIV; and Précis, III, pl. 92.

2. (Closely similar design) Minaret at Jām (1153-1203) --Maricq and Wiet, pl. VII, 4.

3. Wooden door, N.E. side, Mausoleum of al-Imām ash-Shāfi'ī (1211) --M.A.E. II, pl. 24c.

4. Rear vertical panel, minbar of mosque of Aḥmad Shāh (Ulu Cami), Divriğ (1240) --Ülgen's article on Ulu Cami of Divriğ in Vakiflar Dergisi V, Fig. 17.

5. Wide vertical framing band of portal, Haci Kiliç Cami, Kayseri (1249) --Gabriel, Monuments, I, pl. IX, 1.
6. Carved stone niche in east side of doorway, Cifte Minare, Erzerum (1253) --Bachmann, Kirchen und Moscheen, pl. 67.
7. Wooden cenotaph in the name of Malik al-Muẓaffar III, Ḥamā (1285) --Riis and Poulsen, Ḥamā, Fig. 5.
8. Middle stucco panel under stalactite balcony, E. side, minaret of Madrasa of an-Nāṣir Muḥammad (1295-1303) --My photo, Fig. 82.
9. Side of wood strapwork cenotaph, (identical original panel mounted on wall), Mausoleum of Salār (1304) --My photo, Fig. 83.
10. Small marble mosaic false-niche panels (second panel from front, upper tier) in miḥrāb of Ṭaybarsīya Madrasa at al-Azhar (1309-10) --M.A.E., II, pls. 99b and 113b.
11. Middle stucco roundel of inscription band framing doorway to street, interior; also another roundel in inscription band, N.E. side of interior, Mausoleum of Sunqur Sa'dī (1315-21) --My photo, Fig. 84; and direct observation.
12. Strapwork and polygon wooden shutters on S.E. side of Mosque of Aṣlam as-Silaḥdār (1344-45) --My photo, Fig. 85.
13. Rectangular carved stone panels on E. and W. faces of lower part of octagonal shaft of minaret of Qāytbāy at al-Azhar (1468) --My photo, Fig. 9.
14. Inside face of wooden door to grand downstairs room, Bayt as-Saḥaymī (1648-1796) --Direct observation.

T. des E. 71

1. V-cut in wooden window shutters above college doors; Madrasa Barqūqīya (1384-85) --My photo, Fig. 86.
2. In two 1/4-radius panels on front end of kursī, Madrasa Barqūqīya (1384-85 perhaps of Barsbāy's time) --My photo, Fig. 87.
3. Raised and painted strapwork panel in ceiling of side Īwān, Mosque of Qarāqogā al-Ḥasanī (1441-42) --My photo, Fig. 88.

T. des E. 72

1. (A quite similar though not so spaced-spart design which may perhaps be considered as a prototype although it does not involve "pentagonal adjustment") In stucco window grille on west facade, Mausoleum of Qarāsunqur (1300-01) --My photo, Fig. 89.
2. Wooden doors to mausoleums in sanctuary, Mosque of Mu'ayyad Shaykh (1415-20) --Mosques of Egypt, pl. 110 and Direct observation.
3. Central panels of rail, minbar, Mosque of al-Mu'ayyad (1415-20) --My photo, Fig. 90.
4. Outside panels of front door, minbar, Madrasa of Qāḍī Abū Bakr ibn Muzhir (1480-81) --My photo, Fig. 76; also Hautecoeur and Wiet, pl. 200, bottom.
5. Lower rear panel, minbar, Mosque of Qijmās al-Isḥāqī (1480-81) --My photo, Fig. 91.
6. 1st., 3rd. and 5th. panels of rail, minbar, Madrasa of al-Ghūrī (1504-05) --My photo, Fig. 92; and Hautecoeur and Wiet, pl. 211b.

T. des E. 74

1. (A badly distorted design, not exactly like but closely related to this; seems most likely it was or was intended to be this design) In hexagon-shaped panel in Mausoleum of Muṣṭafā Bāshā (1269-73) --M.A.E. II, pl. 56b.
2. One square unit in panels of pierced bronze work, chandelier from the Mosque of Qūṣūn (1330) --Ta'rīkh al-Masāgid, Fig. 14.

T. des E. 75

1. Upper rear panel, minbar, Madrasa of ʿAbd al-Ghanī (1418) --Hautecoeur and Wiet, pl. 162; see also my photo, Fig. 120.
2. Carved stone lintel of window above and left of entrance, Mosque of Qāḍī Yaḥyā at al-Ḥabbānīya (ca. 1449-53) --Ta'rīkh al-Masāgid, Fig. 183.

T. des E. 76

1. Painted stucco gallery vault, tomb of Öljeytü at Sulṭānīya (1305-13) --Pope, Pers. Arch., Fig. 230b.
2. Rail panels 2 and 4, minbar, Madrasa of al-Ashraf Barsbāy (1424) --Ta'rīkh al-Masāgid, Fig. 157.
3. Upper rear panel, minbar, Mosque of Barsbāy at Khānqā (1437) --Comité, 1895 Fascicule, pl. IX.
4. Upper and lower rear panels, minbar, Mosque of Taghrī Birdī (1440) --Direct observation.

5. Horizontal bottom panel of cabinet door in vestibule, Mosque-Madrasa-Mausoleum of Qāytbāy in the Northern Cemetery (1472-74) --My photo (color slide).
6. Carved in at least six voussoirs of great arch to sanctuary, Madrasa of Qāytbāy at Kabsh (1475) --My photo, Fig. 93; and see Mosques of Egypt II, pl. 127.
7. Lower part of niche-head, miḥrāb of Mosque of Qijmās al-Isḥāqī (1480-81) --My photo, Fig. 94.
8. On base of gold-and-silver inlaid bowl in the name of Sulṭān Qāytbāy (in Istanbul Museum) --Zakī M. Ḥasan, Aṭlas, Fig. 516.
9. Marble mosaic panel in niche of miḥrāb, Mosque of Sulīmān Bāshā in the Citadel (1528) --Pauty, L'Architecture au Caire... ottomane, pl. V6.

T. des E. 77

1. Stone-carved panel inside left of entrance portal, Karatay Han (1230-40) -- Grabar and Hill, Fig. 488.
2. Carved stone band framing a doorway, Kayseri Sultan Han (1232-36 --Photo Shahīra Mehrez.
3. (Design with same basic structure) Front door of minbar of Lāǧīn at Mosque of ibn Ṭūlūn (1296) --My photo, Fig. 95.
4. Carved stone blind niche panel, exterior, Tomb Tower at Juga, near Nakhichevan (probably 13th. century) --Grabar & Hill, Fig. 232.
5. Main side panel, minbar, Great Mosque of Ḥamā (1302) --Riis and Poulsen, Fouilles..., Figs. 6 and 7.
6. (Probably this design -- photo too poor for certainty) Main

side panel, minbar of Çorum Ulu Cami (dated 706 H.) --Oral in Vakiflar Dergisi V, Fig. 25.

7. Bronze strapwork on wood door to street; at least three grilles of drum (on axes of mausoleum); and at least two stucco panels of transition zone (on N.E. and N.W. corners), Mausoleum of Sunqur Sa'dī (1315-21) --M.A.E. II, pl. 102d for second of the three; and my photos: first, Fig. 96; second and third, Figs. 97 and 98.

8. Main side panel, minbar, Mosque of al-Māridānī (1338/9-40) Mosques of Egypt I, pl. 67.

9. Main side (only) panel, minbar, Mosque of Aṣlam as-Silaḥdār (1344-45) --My photo, Fig. 99.

10. Central ornament of first page, "Coran legs (1368) du Sultan Chaaban, écrit par Yacoub ibn Mohammed ibn Abderrhaman [sic] el Hanéfi, fini en 1356" --Précis, "Les Manuscrits", pl. 24.

11. Painted page of "Ḳur'an of Khonde Berekeh" "bequeathed" in 1368 --Moritz, Arabic Palaeography, pl. 52.

12. Second page of a Qur'ān "légué par" Sha'ban, "écrit par Ali ibn Mohammed al-Mokattil al-Achrafi en 774 (1372)" with "arabesques" and "vignettes par Ibrahim al-'Amadi" --Précis, "Les Manuscrits", pl. 17.

13. Main side panel, minbar, Madrasa of 'Abd al-Ghanī (1418) --Hautecoeur and Wiet, pl. 62; also see my photo, Fig. 120.

14. Main side panel, minbar, Madrasa of 'Abd al-Bāsiṭ (1420) --Mosques of Egypt II, pl. 226a.

15. 1st., 3rd. and 5th. panels of rail, minbar, Madrasa of Barsbāy at Sūq an-Naḥḥāsīn (1424) --Ta'rīkh al-Masāgid, Fig. 157.

16. Main side panel, minbar, Mosque and Mausoleum of Gānī Bek (1426-27) --My photo, Fig. 100.
17. Main side panel, minbar, Mosque of Qarāqogā al-Ḥasanī (1441-42) --My photo, Fig. 74.
18. Main side panel, minbar, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photo, Fig. 101.
19. Two square carved stone panels above entrance on each side of inscription panel, Madrasa of Gaqmaq (Mon. No. 180 -- 1451) --Direct observation.
20. Main side panel, minbar, Mosque of Qāḍī Yaḥyā at al-Ḥabbānīya (1452) --Ta'rīkh al-Masāgid, Fig. 181.
21. Four vertical panels of wooden door of cabinet in vestibule, Mosque-Madrasa-Mausoleum of Qāytbāy (1472-74) --My photo (slide).
22. Main side panel, minbar; and in at least six voussoirs to great īwān arches Madrasa of Qāytbāy at Kabsh (1475? -- see Creswell's comments in Bibliography, column 1277, about a minbar in Victoria and Albert Mus. "presumably from his [Qāytbāy's] mosque at Qal'at al-Kabsh"). --My photo: former, Fig. 102; latter, Fig. 59.
23. Upper rear panel, minbar, Mosque of ibn Bardbak ad-Dawādārī (mosque about 1475) --My photo, Fig. 49.
24. Main side panel, minbar, Qubbat al-Fadāwīya (1479?) --Direct observation.
25. Main side panel, minbar, Madrasa of Qānībāy Amīr Akhūr (1503) --My photo, Fig. 52.
26. Square openwork panels, bronze chandelier from Madrasa of al-Ghūrī (1503-04) --Mosques of Egypt II, pl. 233c.

27. Wooden ceiling of grande salle in N.W. side of court, Bayt as-Saḥaymī (1648-1796) --Direct observation.

28. Mosaics "de la maison de Hassan Bey (ainsi dénommé sur le plan de l'Expédition de l'Egypte), aujourd'hui ruinée" --Précis, "Les Applications", pl. 18, Fig. 1.

This design is popular in woodwork up to our times as evidenced by a series of undoubtedly recent pieces of mosque furniture:

29. (a) Main side panel, minbar, Mosque of Qāḍī Yaḥyā at Būlāq (made "انشئ" in reign of Fu'ād I, according to inscription over door) --My photo, Fig. 103.

(b) (Just strapwork, no polygons) Lateral panel, kursī in Khānqā of Baybars II --Hautecoeur and Wiet, pl. 100.

(c) Main side panel, minbar (similar workmanship to "b" above), Mosque of Almās --Direct observation.

(d) (Same type of workmanship as two immediately above) Kursī in Madrasa of Ināl al-Yūsufī --Direct observation.

(e) (Straps, no polygons) Lateral panel, kursī in Madrasa of Qāḍī 'Abd al-Bāsiṭ --My photo, Fig. 16.

T. des E. 78

1. Terracotta and stucco mosaic panel, "Baghdād. Īwān in der Qal'ah: Ziegeldekoration" (time of Khalif an-Nāṣir, i.e., 1180-1225) --Sarre and Herzfeld, Arch. Reise, III, pl. CXII.

2. Two inner stucco panels just under hood, miḥrāb on north wall, Mosque of 'Amr (1303/4) --M.A.E. II, pl. 906.

3. Stucco roundels above and on each side of miḥrāb, Mosque of Amīr Ḥusayn (1319) --M.A.E. II, pl. 104a.
4. Second and fourth panels of rail, minbar, Madrasa of ʿAbd al-Ghanī (1418) --Hautecoeur and Wiet, pl. 162; see also my photo, Fig. 120.

T. des E. 80

1. Six stucco roundels in inscription band (including two over door to mausoleum), court and Īwāns of Madrasa of Zayn ad-Dīn Yūsuf (1298) --My photo, Fig. 105 and direct observation; see also M.A.E. II, pl. 84b.

T. des E. 82

1. Two stucco panels, N.W. end of transept (second from right is exactly like Bourgoin's drawing; fourth from right has small regular hexagon overlain in interstice), Mosque of Baybars I (1266-69) --M.A.E. II, pl. 52c; and Mosques of Egypt II, pls. 236 c and d.
2. Stucco roundel in inscription band (southernmost on qibla wall) Madrasa of Zayn ad-Dīn Yūsuf (1298) --My photo, Fig. 106.
3. Carved on rail of stone minbar, Mosque of Shaykhū (1349) -- Direct observation.

T. des E. 83

1. In panels 1, 3 and 5 of rail, minbar, Mosque of Qijmās al-Isḥāqī (1479-81) -Mosques of Egypt II, pl. 226b.

2. Lower rear panel, minbar, Mosque of Abī l-'Alā' (ca. 1485) --Ta'rīkh al-Masāgid, Fig. 210.
3. Main side panel, minbar, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Figs. 126 and 107.
4. 1/8-radius panels, front end, "Pupitre pour la lecture du Coran, au Caire (XVe siècle) " --Précis, "La Menuiserie", pl. 96.
5. "Un pavement de la maison Hamâdy, à Damas" --Précis, "Les Applications", pl. 57, Fig. 1.

T. des E. 84

1. (Slight variation in details) "Mosaïques d'Italie (Amalfi, Chapelle Palatine, etc., XIIe siècle)" (dating reliable?) --Précis, "Les Applications", pl. 16.
2. (Variant in detailing of star interior--not like above) Stucco roundels at ends of inscription band over miḥrāb, Mausoleum of Aḥmad ibn Sulīmān ar-Rifā'ī (1291) --My photo, Fig. 108; also see M.A.E. II, pls. 79a and 80a.
3. In blind losed-arch panels (two) on S.E. face of minaret, Madrasa of an-Nāṣir Muḥammad (Bayn al-Qaṣrayn (1295/6 - 1303/4) --M.A.E. II, pl. 88b.
4. (With trefoil in centers of stars) Stucco window grille, Mosque of ibn Ṭūlūn (date? Would trefoils indicate early Mamlūk?) --My photo, Fig. 109.

T. des E. 89

This is perhaps the simplest of the 12-pointed star patterns,

as the star tips touch directly (on triangle plan) as in T. des E. 1, the only difference between the two designs being that 1 has only six points (see my drawing K-19 for a method of developing 89 from 1 by repeated overlaying of 1's star unit). The simplicity of 89 surely accounts both for its early occurrence and its popularity (simple, basic geometric designs are invariably aesthetically pleasing). As for its early date we find its curvilinear prototype (bearing to 89 a relationship similar to that which T. des E. 43 bears to T. des E. 42) already in a stucco window grille from Qaṣr al-Ḥayr al-Gharbī (724-27--see my drawing K-18 for analysis). In the straight-line form (i.e., like Bourgoin's drawing) the earliest occurrence known to me is the 1067 Kharraqān tympanum; and this is the earliest recorded of all (straight-line) 12-point star patterns. The popularity of the design will be demonstrated by the list of occurrences. One's attention should be called to the sample of star-interior variants shown by Bourgoin in 89, and to the fact that yet another is shown in T. des E. 85, a design identical with 89 except for it extraneous network of all-over hexagons. In 85's precise form I have never encountered the design. Finally, one should note that T. des E. 21 is identical in structure with this design.

1. Brick strapwork, tympanum, earlier Kharraqān Tomb Tower (1067-68) --Stronach and Young, pls. VIIa and IXa and b.
2. Top rear panel (carved solid plank), wooden miḥrāb of Sayyida Ruqayya (1154-60) --Pauty, Les bois sculptés, pls. LXXXI and LXXXII.

3. Upper and lower panels, wood side of door, Mosque of Ṣāliḥ Ṭalā'i' (1160) --M.A.E. I, pl. 102 (r.).
4. End of tābūt (lower part) of Imām ash-Shāfi'ī (1178) --Mosques of Egypt II, pl. 223a; and Ta'rīkh al-Masāgid, Fig. 55.
5. Central panel in exterior of drum, Mausoleum of Kaykāvūs, Sivas (1217-18) --Gabriel, Les Monuments, II, pl. XXXVIIa.
6. Carved in strapwork inside the octagons of an overall pattern of regular octagons and four-pointed stars, panel above door lintel, portal of Hospital at Divriğ (1228) --Ögel, Anadolu Selçuk, pl. XXVIII, Fig. 32.
7. Framing band around pointed arch opening of portal, Karatay Han (1230-40) --Ögel, Anadolu Selçuk..., pl. XXVIII, Fig. 54.
8. Two different window grilles in drum of mausoleum two, Khānqā al-Bunduqdārī (1283-84) --My photo, Fig. 3.
9. Following are observed occurrences in Qalā'ūn Complex (1284-85): marble mosaic of basin, N.W. Īwān of Māristān (M.A.E. II, pl. 63b); horizontal panel of marble mosaic just under hood of miḥrāb, Madrasa (M.A.E. II, pl. 108c); marble mosaic, spandrels of miḥrāb in Mausoleum (M.A.E. II, pl. 108b); large horizontal panel of marble mosaic over northernmost window, interior of Mausoleum (direct observation); two stucco window grilles in Mausoleum (Mosques of Egypt, II, pl. 239); small upper windows above miḥrāb, Madrasa (M.A.E. II, pl. 75a); round windows above arches in 2nd and 3rd bays, right arcade of center aisle, Madrasa (M.A.E. II, pl. 75b).
10. Stucco roundel, interior, Turbe Takrītīya, Damascus (1297) --Direct observation.

11. Marble mosaic in hood and spandrels of niche, miḥrāb, Mausoleum of Salār (1303-04) --M.A.E. II, pl. 112a.
12. Soffit of gallery arch, Mausoleum of Öljeytü, Sulṭānīya (1305-15) --Pope, Persian Architecture, Fig. 230a.
13. At least three stucco grilles of drum (above north, east and west corners), Mausoleum of Sunqur Sa'dī (1315-21) --M.A.E. II, pl. 102d; and my photos: N.E. corner, Fig. 97; N.W., Fig. 98.
14. Tile and terracotta panel, Masjid-i Jāmi', Varamīn (1322) --Pope, Persian Architecture, pl. 240.
15. Spandrels above arch of entrance, Mosque of Shaykh Bayazid, Bistam (1st. qtr., 14th. c.) --Sarre, Denkmäler Persischer Baukunst, pl. 86.
16. In center of interior of dome, Mausoleum of Tughāy (pre-1348) --Photo by Creswell in files of Dr. Christel Kessler.
17. Three windows in interior (Nos. 2, 4 and 5 by my numbering of which "2" and "5" seem new), Mosque of Mangak al-Yūsufī (1349) --My photo, Fig. 110 (window "4").
18. Window above miḥrāb, Madrasa of Sulṭān Ḥasan (1356-63) --Mosques of Egypt I, pl. 87.
19. Partially remaining stucco panel (central of three-window set), N.E. side of transition zone, interior, Mausoleum of Sīdī Ibrāhīm al-Anṣārī (1370) --Direct observation.

T. des E. 90

1. Carved stone band framing window of small mausoleum, Akhlāt (1281) --Bachmann, Kirchen und Moscheen, pl. 49a.

2. (With a simpler treatment of 90° crossing) Carved roundel in 13th. century Anatolian wooden door (in Istanbul Museum) --Zakī M. Ḥasan, Atlas, Fig. 384.
3. Marble mosaic panel (above third window from S.W. corner), S.W. wall of interior, Mausoleum of Qalā'ūn (1284-85) --Direct observation.
4. Mosaic panel "encastré dans les parois de la Grande Mosquée de Damas" (probably Mamlūk) --Précis, "Les Applications", pl. 13, Fig. 2.

T. des E. 92

1. (Very similar in forms involved but with four-pointed star replaced by a lozenge; not drawn on the basis of the duodecagon-hexagon-square reseau, as is Bourgoin's drawing -- see my drawing K-19-A) Panels from (tābūt) the Mausoleum of Imām ash-Shāfi'ī (Islamic Museum invoice Nos. 408 and 409 -- probably 1211 A.D.) --Weill, Les bois à épigraphes I, pl. XXIII.
2. Stucco panel, N.W. end of transept, Mosque of Baybars I (1266-69) -M.A.E. II, pl. 52c.
3. (Identical with Bourgoin's drawing) Marble mosaic panel above second window from S.W. corner, interior, Mausoleum of Qalā'ūn (1285) --M.A.E. II, pl. 70 and direct observation.
4. (Like Ayyūbid tābūt design) Marble mosaic, all vertical panels of miḥrāb, Mausoleum of Qarāsunqur (1300-01) --M.A.E. II, pl. 110c.

T. des E. 93

1. Central and two end small blind niche panels just under hood, miḥrāb, Mausoleum of Madrasa Aqbughāwīya at al-Azhar (1333-39) --My photo, Fig. 111; also Hautecoeur and Wiet, pl. 106.
2. Lower rear panel, minbar, Madrasa of Qāytbāy at Qal'at al-Kabsh (1475? On the question of date see this list, T. des E. 77, No. 23) --My photo, Fig. 102.
3. Mosaic panel "encastré dans les parois de la Grande Mosquée de Damas" (probably Mamlūk) --Précis, "Les Applications", pl. 12, Fig. 3.

T. des E. 94

1. Main side panel, minbar of the Amīr Baktimur al-Gūkāndār in the Mosque of as-Ṣālih Ṭalā'i' (1300) --Mosques of Egypt II, pl. 223b.
2. Framing band of large panel in niche, marble mosaic miḥrāb, Ṭaybarsīya Madrasa at al-Azhar (1309-10) --M.A.E. II, pls. 99b and 113b; also my photo, Fig. 176.
3. Central ornament of first page, Qur'an "écrit par le cheikh Mohammed ibn Kamal el-Ansary el-Mothabbib au Caire, année 734 (1333)" --Précis, "Les Manuscrits". pl. 35.
4. Narrow horizontal bands above and below small false-arch panels and large panel, in niche of marble mosaic miḥrāb, Mosque of al-Māridānī (1338/9-40) --Comité, 1905, pl. VII.
5. Painted wood strapwork under eaves of entrance, Türbe of Murād II, Bursa (1451) --Ünsal, Turkish Islamic Architecture, Fig. 94a.

6. Marble and mother-of-pearl mosaic, Great Mosque of Damascus (probably Mamlūk) --Trait des Entrelacs, C.P. VII, 2.

T. des E. 97

1. Wooden door leaf from "Mosque" of Qalā'ūn (1284-85), now in "Musée Arabe"--Al. Gayet, L'Art Arabe, Fig. 72; and J. Collin, La Décoration Polygonale..., pl. 28.

T. des E. 99

1. (With very minor variation) Northern of two carved stone lintels, N.W. facade, Mausoleum of Sunqur Sa'dī (1315-21) --My photo, Fig. 112.
2. Carved on rail of stone minbar, Madrasa of Shaykhū (1349) --Direct observation.
3. (With interior of star drawn "9 en 9" with 24-part division of circumference, whereas in Bourgoin's drawing it is drawn "5 en 5" with 12-part division) Carved on stone lintel in N.W. Īwān, Madrasa of Qāytbāy at Qal'at al-Kabsh (1475) --My photo, Fig. 113.
4. (Variant like Qāytbāy lintel) Carved on lintel in N.W. Īwān, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 114.
5. Carved stone panels (unfinished) at sides of relieving lintel above N. entrance, Mosque of Amīr Qurqumās (1506-07) --My photo, Fig. 115.

T. des E. 100

1. Southern of two carved stone lintels, N.W. facade, Mausoleum of Sunqur Sa'dī (1315-21) --My photo, Fig. 116.

T. des E. 101

1. Painted stucco relief design in large trilobed medallion in pendentive, Qubbat al-Fadāwīya (1479) --Hautecoeur and Wiet, pl. 203; and Bourgoin, Les Arts Arabes, pl. 59, top ("d'une mosquée ... près de l'Abbasieh").

T. des E. 102

1. In painted stucco of interior, Qubbat al-Fadāwīya (1479), called "une mosquée... près l'Abbasieh... XIVe siècle" --Bourgoin, Les Arts Arabes, pl. 62.

T. des E. 104

1. "Claire-voie" "de l'ancien Moristan à Damas" (apparently not Nūr ad-Dīn's--I saw no such design there) --Trait des Entrelacs, C.P. IV, 1.

T. des E. 105

1. Upper and lower full rail panels in openworked wood, "Manissa Ulu Cami minberi (Hatuniye Cami minberi)" (900 H.) --Oral in Vakiflar Dergisi V, Fig. 41.

IVe SERIE

ETOILES ET ROSETTES DE DEUX NOMBRES DIFFERENTS

T. des E. 106

1. Design of bronze-plated side, door of Mosque of Sālih Talā'i' (1160?) --M.A.E. I, pl. 102(L).

T. des E. 108

1. (Without the hexagon drawn around the six-pointed star which makes five-pointed stars of the extensions of the six-pointed stars--but structurally identical) Section shown in mosaic faience decoration of "Turkish triangles" of transition zone of dome, interior, Mosque of 'Alā' ad-Dīn at Konya (1219-22) --Yetkin, L'Architecture Turque en Turquie, pl. V.

T. des E. 110

1. Bronze-plated door, Mosque of Almās (1330) --Ta'rīkh al-Masāgid, Fig. 79.
2. Two marble mosaic panels above door in entrance bay, Khānqā Sa'd ad-Dīn ibn Ghurāb (ca. 1400-06) --Comité, Exercice 1912-14, Pls. III and IV.
3. Front door (front and back sides), minbar, Mosque of Gānī Bek (1426-27) --My photo (back side), Fig. 100.
4. Second and fourth panels of rail, minbar, Mosque of Abī l-'Alā (ca. 1485) --Ta'rīkh al-Masāgid, Fig. 210.

5. Marble mosaic floor of mastaba of entrance, Mosque of al-Ghūrī (1503-04) --Ta'rīkh al-Masāgid, Fig. 222; and Précis, "Les Applications", pl. 47, Fig. 1.

b) Bronze-plated foor of Mausoleum of al-Ghūrī (1503-04) --Précis, "La Menuiserie", pl. 43.

c) Bronze-plated door of Madrasa of al-Ghūrī --Bourgoin, Les Arts Arabes, pl. 80 (where he has drawn the points of the 12-pointed stars "5 en 5", unlike in T. des E. 110 and unlike the two doors).

T. des E. 111

1. Carved stone strapwork panel in vestibule of Mosque of Sulṭān Ḥasan (1356-63) --Trait des Entrelacs, C.P. III, 1.

T. des E. 115

1. Ceiling in polychrome (minor variant), Jāmi' Murādīya, Manisa (1583-84) --Riefstahl, pl. 22.

T. des E. 116

1. (With interior of eight-pointed star treated differently) Marble mosaic framing panels around lintels, doors to two colleges (flanking S.W. Īwān), Madrasa of Sulṭān Ḥasan (1356-63) --My photo (slide), and direct observation.
2. (Different proportions in interior of twelve-pointed star) Panels at each end of rail, minbar, Mosque of al-Mu'ayyad (1415-20) --My photo, Fig. 152.

3. (Interior of eight-pointed star like Sulṭān Ḥasan mosaic; interior of twelve-pointed star also different from Bourgoin's drawing but they are structurally identical) Main side panel, minbar, Madrasa Baqarīya (minbar given in 1420) --My photo, Fig. 45.
4. (Like Mu'ayyad variant) Upper square panel on "lateral front", kursī, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photo, Fig. 117.
5. (Identical with Bourgoin's drawing) Carved stone strapwork panels flanking relieving lintel above doorway, Complex Īnāl (1451-60) --My photo, Fig. 39.
6. (Like Mu'ayyad variant) Upper square panel on "lateral front", kursī Mosque of Qāḍī Yaḥyā at Būlāq (this kursī is an exact companion-piece to the minbar, which is inscribed with the name of Fu'ād I, and the former is surely also his work) --My photo, Fig. 104.

T. des E. 117

1. Grand panel, "lateral front", kursī, Madrasa of al-Ghūrī (1503-04) --Hautecoeur and Wiet, pl. 209a.

T. des E. 118

1. In alternately regular and elongated hexagon-shaped panels, stucco and terracotta, Īwān in the Citadel, Baghdād (time of Khalif an-Nāṣir, 1180-1225) --Sarre and Herzfeld, Arch. Reise, III, pl. CXII.

2. (Identical except that twelve-pointed star is drawn "5 en 5" and outside of twelve-point complex determined by a regular duodecagon) Brick strapwork vertical panel, Furumad Jāmiʿ (1221) --Ögel, Anadolu Selçuk, pl. LXV, Fig. 131.
3. (Identical with Bourgoin's drawing except for minor variation between 12-point complexes, creating "heptagons") Vertical carved stone framing band, portal, Sirçali Madrasa, Konya (1242) --Ünsal, Turkish Islamic Architecture, Fig. 75.
4. (Like Sirçali Madrasa) Carved stone panel, Döner Kümbet, Kayseri (1276) --Cahen, pl. 25.
5. Ceiling (soffit) of doorway in carved and painted wood, main entrance, Qalāʾūn complex (1284-85) --My photo, Fig. 118.
6. Carved stone vertical framing panel, portal, Madrasa Yāqūtīya, Erzerum (1310) --Ünal, Les monuments de la ville.., pl. 32.
7. Etched in stucco wall decoration, Mosque at Āshtārijān (ca. 1315) --Grabar and Hill, Fig. 300.
8. Marble and mother-of-pearl framing band to destroyed panel, left side of qibla wall, Mosque of al-Māridānī (1338/9-40) --My photo (color side).
9. Carved panel, minbar of "Zawiyat Negâzîya" "(XIVe siècle)" (1360) --Précis, "La Menuiserie", pl. 80.
10. Mosaic faience and terracotta panel, Masjid-i Jāmiʿ, Yazd (1324-64) --Pope, Persian Architecture, Fig. 211.
11. (Floralized version) Mosaic faience panel in miḥrāb, Masjid-i Jāmiʿ, Yazd (1375) --Pope, Persian Architecture, Fig. 247.

12. Great panels of (lateral) front and back, kursī, Madrasa of Barqūq (1384-85? --see discussion of problem of date of this kursī under T. des E. 166) --My photo, Fig. 119, and direct observation.
13. Main side panel, minbar, Ahi Elvan Cami, Ankara (1413) --Oral in Vakiflar Dergisi V, Fig. 38.
14. Panels 1, 3 and 5 of rail, minbar, Mosque of ʿAbd al-Ghanī (1418) --My photo, Fig. 120.
15. All panels of rail, minbar, Madrasa of Qāḍī ʿAbd al-Bāsiṭ (1420) --Taʾrīkh al-Masāgid, Fig. 136.
16. (Like Sirçali Madrasa variant) Glass and stone mosaic around lintel of entrance door, Madrasa Ashrafīya (1425) --Direct observation.
17. All panels of rail, minbar, Mosque of Gānī Bek (1426-27) --My photo, Fig. 100.
18. Front end panel, kursī, Khānqā of Barsbāy in Northern Cemetery (kursī moved from Mosque of al-Ghamrī, ca. 1439) --Taʾrīkh al-Masāgid, Fig. 165.
19. Vertical panels of cabinet doors, Madrasa Gawharīya at al-Azhar (before 1440) --My photo, Fig. 56.
20. All five panels of rail, minbar; and long horizontal panel of "lateral front", kursī, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photo, Fig. 101; and direct observation.
21. Square panels of rail, minbar, Mosque of Qāḍī Yaḥyā at al-Ḥabbānīya (ca. 1449-53) --Taʾrīkh al-Masāgid, Fig. 181.
22. Square panel on zone of transition (square to octagon) of minaret, Mosque of Mogholbāy Ṭāz (1466) --My photo, Fig. 121.

23. Panels 1, 3 and 5 of rail, minbar, Madrasa of Qāytbāy at Kabsh (1475? see this list, T. des E. 77, No. 23) --My photo, Fig. 102.

24. Main side panel, minbar, Mosque of Timrāz al-Aḥmadī (minbar dated 1477) --My photo, Fig. 122.

25. Occurrences at Madrasa of Abū Bakr ibn Muzhir:
    a) panel of door of ṣaḥn --Précis, "La Menuiserie", pl. 54, 3.
    b) v-cut in door facings in sanctuary --My photo, Fig. 123.
    c) (curvilinearized) main side panel, minbar (dated 1480-81) --My photo, Fig. 124; and Hautecoeur and Wiet, pl. 202.

26. V-cut into facings of four doors in N.W. and S.E. Īwāns, Mosque of Qijmās al-Isḥāqī (1480-81) --My photo, Fig. 125.

27. Panels 1, 3 and 5 of rail, minbar, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 126.

28. Panels 1, 3 and 5 of rail, minbar, (now in Br. Mus.), Mosque of Sulṭān Shāh (before 1495) --Ta'rīkh al-Masāgid, Fig. 202. (This design, like T. des E. 77, was popular in both historical and recent woodwork in Cairo; recent occurrences are:

29. All five panels of rail, minbar; and long horizontal panel of "lateral front", kursī, Mosque of Qāḍī Yaḥyā at Būlāq (work of Fu'ād I) --My photos: former, Fig. 103; latter, Fig. 104.

30. Kursī, (only strapwork, no polygons), Zāwīyat Aydumur al-Bahlawān --Direct observation.

31. (Only straps, no polygons) End panel, kursī, Madrasa Qāḍī 'Abd al-Bāsiṭ (1420) --My photo, Fig. 16.

T. des E. 120

1. (Modification between nine-pointed stars like that between twelve-points in Sirçali Madrasa occurrence of T. des E. 118) Large framing band of east portal, Divrig Ulu Cami (1228) --Ögel, Anadolu Selçuk..., pl. XVI, Fig. 24.
2. (Variant in that 12-point complex has diameter equal to one-half the side of the réseau-triangle and the 12-pointed star is drawn exactly "5 en 5") Bronze "Porte de la Mosquée Sultan Daahir-Bibars, au Caire" --Bourgoin, Les Arts Arabes, pl. 74, (from the Madrasa 1262-63).
   See M.A.E. II, p. 146 for discussion of this door (as well as the other door from this Madrasa which is now at the French Embassy at Gīza, the design of which is T. des E. 171).
3. Rectangular carved stone panel inside portal, Sahibiye Madresesi, Kayseri (1262-68) --Photo Shahīra Mehrez.
4. (With 12-pointed stars drawn "5 en 5") Wide framing band of portal, Taş Medrese, Eğridir ("1250 tarihlerinde yapilmiş olmasi mümkün Eğridir'daki Taş Medrese'nin beyaz mermer portali, ..." --p. 45) --Ögel, Anadolu Selçuk..., Fig. 61; and Sarre, Reise in Kleinasien, pl. LXIV.
5. (Almost certainly--difficult to tell from photograph) Upper rear panel, minbar, Great Mosque of Ḥamā (1302) --Riis and Poulsen, Fig. 6.
6. (Design like Baybars 1 door except for interior of 9-pointed star) Bronze-plated door of the Khānqā of Baybars al-Gāshankīr (1306-10) --M.A.E. II, pls. 95 c and d.

7. Painted stucco of a gallery vault, Mausoleum of Oljeytu, Sulṭānīya (1307-13) --Grabar and Hill, Fig. 240 (top).
8. (Like Bourgoin's drawing in T. des E.) Grand inlaid brass door to south of miḥrāb, qibla wall, Madrasa of Sulṭān Ḥasan (1356-63) --My photo, Fig. 127; also Hautecoeur and Wiet, pl. 130 (r.).
9. (Like Baybars II design) Panels 2 and 4 of rail, minbar, Mosque of al-Mu'ayyad (1415-20) --My photo, Fig. 128.

T. des E. 121

1. Bronze-plated doors in N.E. and S.W. walls of qibla Īwān, Madrasa of Sulṭān Ḥasan (1356-63) --My photo (slide).
2. Wood qānāt-work front door, minbar, Great Mosque of Manisa (minbar dated 1376) --Riefstahl, pl. 13b.

T. des E. 123

1. Stucco and terracotta strapwork panel doorway, exterior, Mausoleum of Abū l-Qāsim (Imām Yaḥyā), Mōṣul (in name Lu'lu' ibn 'Abd Allāh, mid-13th. c.) --Sarre and Herzfeld, Arch. Reise, III, pls. IX & CI, left; and Herzfeld's analytical drawing (which he identifies as T. des E. 123), II, Fig. 252.

T. des E. 124

1. Carved marble panels at ends of lintel in main entrance bay, Sabīl of Qāytbāy in Shāri' Ṣalība (1479) --My photo, Fig. 129.

2. Upper rear panel, minbar, Madrasa of Qāḍī Abū Bakr ibn Muzhir (1479-80) --My photo, Fig. 130; and Hautecoeur Wiet, pl. 202.

3. Upper rear panel, minbar, Madrasa of al-Ghūrī (1503-04) --My photo, Fig. 131.

T. des E. 125

1. Design of front door, minbar, Mosque of Qijmās al-Ishāqī (1480-81) --My photo, Fig. 132.

T. des E. 127

1. (One square unit with eight-pointed star drawn "2 en 2" -- not enough shown to be regarded as a true variant of 127 but is at least closely related) In each alternate square panel of wooden dikka, Mosque of Tātār al-Ḥegāzīya (1360) --My photo, Fig. 133.

2. Wood screen of sabil, main facade, Madrasa of Umm as-Sulṭān Sha'bān (1368-69) --Mosques of Egypt I, pl. 92.

3. Wood screens to mausoleum chambers, Khānqā of Farag ibn Barqūq (1398/9-1411) --Précis, "La Menuiserie", pl. 15.

T. des E. 130

(In the text, Bourgoin states that this design is a curvilinear version of 129, but this is not the case, as the 12-point star-tips in the two designs are not in the same axis. For this reason I feel that it is preferable to

speak, as I do below, of an "all straight-line 130", rather than explain that a given design is a variant of 129 in which the star tips are "revolved". All this is not to mention that this difference in axis causes the presence of five-pointed stars in 129 and their absence in 130).

1. (Structurally very similar to a straight-line 130, differing essentially only in the configuration of the eight-pointed star) Window to immediate right of that of N.E. corner, drum, Mausoleum of Sunqur Sa'di (1315-21) --My photo, Fig. 97.
2. (All straight-line version -- a bit more spaced apart between 16-points) Painted ceiling under balcony in south corner, N.W. Iwān, Madrasa of Amīr Mithqāl (1361-62) --My photo, Fig. 134.
3. (All straight-line version with very slightly more space between sixteen-pointed stars but not like Mithqāl occurrence) Lower back panel, minbar, Mosque of Mu'ayyad (1415-20) --My photo, Fig. 135.
4. (Like Mu'ayyad occurrence) Main side panel, minbar, Madrasa Ashrafīya (1424) --Ta'rīkh al-Masāgid, Fig. 157.
5. (Like Mu'ayyad occurrence) Main side panel, minbar, Mosque of al-Ashraf Barsbāy in Khānqa (1432) --Ta'rīkh al-Masāgid, Fig. 168; and Comité, Exercice 1895, pl. IX.
6. (Like Mu'ayyad occurrence) Upper rear panel, minbar, Mosque of Qādī Yahyā at al-Habbānīya (ca. 1449-53) --Ta'rīkh al-Masāgid, Fig. 181.
7. (Like Mu'ayyad occurrence) Upper 1/8-radius panels of front end, kursī, Madrasa of al-Ghūrī (1503-04) --My photo, Fig. 136.

T. des E. 131

(Bourgoin, p. 10, says that this design is a curvilinear version on No. 135 but this is far from being so; the most obvious difference being that 135 contains seven-pointed stars, while this does not).

1. (All straight-line version, with heptagons created in the manner of the Sirçali Madrasa occurrence of T. des E. 118) Windows of facade, Mosque of al-Māridānī (1338/9-40) --My slide.
2. Bronze-plated front door of stone minbar, Madrasa of Sulṭān Ḥasan (1356-63) --My photo (slide); see Mosques of Egypt, pl. 88.
3. (All straight-line version, though the proportions may vary a bit) Main side panel, minbar, from Mosque of Sulṭān Shāh (mosque before 1495 -- minbar now in Br. Mus.) --Ta'rīkh al-Masāgid, Fig. 202.

T. des E. 132

1. (Slight difference in proportions of interior of sixteen-pointed star; and slight difference in space between hepta-gons) Grand bronze-plated door of entrance to Mosque of Mu'ayyad, from Mosque of Sulṭān Ḥasan (1356-63) --Haute-coeur and Wiet, pl. 129 (r.); and Bourgoin, Les Arts Arabes, pl. 73 (which drawing is identical with the design of the actual door and is identified as of the door of the Mosque of Mu'ayyad).

2. Wood and ivory double door "du Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 40.

1. (Sixteen-pointed star drawn "13 on 13" with 32-part division of circumference, whereas in Bourgoin's drawing, it is drawn "7 on 7" with 16-part division) Square carved-stone panel, front of square base of minaret, Mosque of Mogholbāy Ṭāz (1466) --My photo, Fig. 137.

2. (Design like Mogholbāy Ṭāz occurrence) Main side panel, south side, stone minbar of Qāytbāy in Khānqāh Farag ibn Barqūq (1483) --My photo, Fig. 138.

T. des E. 134

1. Main side panel, north side, minbar of Qāytbāy in Khānqa of Farag ibn Barqūq (1483) --My photo, Fig. 139; and Hautecoeur and Wiet, pl. 157.

T. des E. 135

1. (With only the central, not all, 16-points curvilinearized) Main side panel, minbar, Mosque of Qijmās al-Ishāqī (1480-81) --My photo, Fig. 140; also Mosques of Egypt II, pl. 226 (bottom).

2. (Identical, including composition, with Qijmās minbar, except that here the central 16-point is not curvilinearized as is that of Qijmās) Main side panel, minbar, Madrasa of Ghūrī (1503-04) --Hautecoeur and Wiet, pl. 211.

(It should be pointed out that 134 and 135 are identical except that the 16-point star-tips differ in axis by 1/32

T. des E. 133

1. (Sixteen-pointed star drawn "13 en 13" with 32-part division of circumference, whereas in Bourgoin's drawing, it is drawn "7 en 7" with 16-part division) Square carved-stone panel, front of square base of minaret, Mosque of Mogholbāy Ṭāz (1466) --My photo, Fig. 137.
2. (Design like Mogholbāy Ṭāz occurrence) Main side panel, south side, stone minbar of Qāytbāy in Khānqā Farag ibn Barqūq (1483) --My photo, Fig. 138.

T. des E. 134

1. Main side panel, north side, minbar of Qāytbāy in Khānqa of Farag ibn Barqūq (1483) --My photo, Fig. 139; and Hautecoeur and Wiet, pl. 157.

T. des E. 135

1. (With only the central, not all, 16-points curvilinearized) Main side panel, minbar, Mosque of Qijmās al-Ishāqī (1480-81) --My photo, Fig. 140; also Mosques of Egypt II, pl. 226 (bottom).
2. (Identical, including composition, with Qijmās minbar, except that here the central 16-point is not curvilinearized as is that of Qijmās) Main side panel, minbar, Madrasa of Ghūrī (1503-04) --Hautecoeur and Wiet, pl. 211.

(It should be pointed out that 134 and 135 are identical except that the 16-point star-tips differ in axis by 1/32

of the circumference - and 135 has the large star curvilinearized, whereas 134 does not. So the Qijmās minbar design must be regarded as the precedent not only for that of Ghūrī, but also of Qāytbāy).

T. des E. 136

1. (Identical in every respect except that line of bases of eighteen-pointed star points are carried through, forming small secondary inner star points, unlike Bourgoin's drawing. This is interesting, implying as it does that the drawing was made after another occurrence, while this is the only pattern and, as is clear, the only historical occurrence known to me combining nine- and eighteen-pointed stars) In rectangular panels of rail, minbar, Mosque of Qijmās al-Isḥāqī (1480-81) --Mosques of Egypt, pl. 226b.

T. des E. 137

1. Bossed, bronze-plated door of entrance, Madrasa of Sulṭān Barqūq (1384-86) --Mosques of Egypt II, pl. 95 (Bourgoin in Les Arts Arabes, pl. 79, shows this door, which he calls "Porte de la Mosquée de Qalaoun, au Caire").

T. des E. 138

1. (With very slight difference in area between 20-points) In painted stucco above miḥrāb, Qubbat al-Fadāwīya (1479) --Bourgoin, Les Arts Arabes, pl. 60 ("d'une mosquée près l'Abbasieh...vers le XIVe siècle").

T. des E. 139

1. Carved stone panels beside window, S.W. entrance bay, Mosque of Qāḍī Yaḥyā at Būlāq (1448-49) --My photo, Fig. 141.

V^e SERIE

PLAN OCTOGONE ET CARRE ASSEMBLES

T. des E. 143

(See introductory comments to T. des E. 51 above)

1. (Or 51) Running border making rectangular frame around wooden miḥrāb of Nūr ad-Dīn in Maqām Ibrāhīm in Citadel of Aleppo (began 564 H.) --Herzfeld, "Damascus: Studies in Architecture", II, Fig. 81, in Ars Islamica X.
2. (Or 51) Framing band around niche panel, "minaret einer Hochchule" at Sinjār (dated 1201) --Sarre and Herzfeld, Arch. Reise III, pl. IV.
3. Carved on surfaces of lower tier of stalactites over door, Mama Hatun Türbe, Tercan (1192-1204) --Grabar and Hill, Fig. 348.
4. One unit in carved stone roundel beside portal, Gök Medresse, Amasya (1276) --Ögel, Anadolu Selçuk..., pl. XXX, Fig. 59.
5. (Or 51) Wood strapwork enclosing nicely carved polygons, ends of tābūt of Qalā'ūn (1284-85) --Direct observation.
6. Main side panel, Lāğīn's minbar in Mosque of ibn Ṭūlūn (1295) --M.A.E. II, pl. 109.
7. Carved in framing band around doorway, Khudavend Türbe, Niğde (1312) --Photo Shahīra Meḥrez.

8. Decoration of last page of a Qur'ān written at Cairo by Shaykh Muḥammad ibn Kamāl al-Anṣārī in 1333 (see T. des E. 94 above) --Précis, "Les Manuscrits", pl. 37.
9. Main side and vertical rear panels, minbar, Mosque of Sunqur Bey, Niğde (1326/7-35) --Oral in Vakiflar Dergisi V, Fig. 27 and Gabriel, Monuments I, pl. XLIII.
10. (Or 51--a horizontal half of section on Qalā'ūn tābūt) Upper panel of doors of cabinets, Madrasa Gawharīya at al-Azhar (before 1440) --My photo, Fig. 56.
11. (Or 51--mirror of section at Gawharīya) Small horizontal panel inside sitting place in kursī, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photos, Figs. 57 and 117.
12. (Or 51) On four sides of octagonal stage, between small balconies, minaret, Madrasa Qaqmaq near Sh. al-Azhar (1451) --My photo, Fig. 58.
13. (Or 51) At least two occurrences carved in voussoirs of great arches (to side īwāns) and at least two in voussoirs of lintels over doors to madrasas, Madrasa of Qāytbāy at Qal'at al-Kabsh (1475) --My photos, Figs. 59 and 142.
14. (Or 51) Carved with lines as raised strapwork, wood facing of cabinet door in sanctuary Īwān, Madrasa Azbak al-Yūsufī (1494-95) --My photo, Fig. 60.
15. (Or 51--composition exactly as in Qalā'ūn tābūt) "Balustrade de la tribune de la Mosquée el-Bordenyeh (XVIIe siècle)" --Précis, "La Menuiserie", pl. 32.

T. des E. 146

1. End of "pupitre pour la lecture du Coran, au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 96.

T. des E. 147

1. Front door, minbar, Madrasa Ashrafīya (1424) --Ta'rīkh al-Masāgid, Fig. 156.

T. des E. 148

1. (Same general structure but achieved with more regular "pentagonal adjustment"; without the curvilinear overlay and the small 5-point complexes inside pentagons) Stucco panels from the Palace at Tirmidh ("12th. c.") --Rempel, Architectural Ornament of Uzbekistan, Figs. 96, 1 and 3 (photos) and 86, 2 (analytical drawing).
2. (Identical to Tirmidh design except that here the small interstitial square is transformed into a small octagon) Horizontal band in marble mosaic miḥrāb of mausoleum in Aqbughāwīya Madrasa at al-Azhar (1333-39) --My photo, Fig. 111; see also Hautecoeur and Wiet, pl. 106.
(For an interesting coincidence involving these two monuments, see KT-11).

T. des E. 152

1. (Minimal section but unquestionably this design) Central carved stone panel in N.W. Īwān, Mosque of Qijmās al-Ishāqī (1480-81) --My photo, Fig. 143.
2. (Large monolithic octagon takes up space center to center of 8-points; and interior of 16-point has slightly different proportions--but it is this design) "Panneaux de lambrissage de la mosquée d'Achmed el-Bordeynyeh" (1616-29) --Précis, "Les Applications", pl. 21, Fig. 7.

T. des E. 153

1. In painted stucco work of interior, Qubbat al-Fadāwīya (1479) --Bourgoin, Les Arts Arabes, pl. 58 ("d'une mosquée au Caire...vers le XIVe siècle").
2. Carved stone panels flanking window above entrance, Mosque of Amīr Qurqumās (1506-07) --My photo, Fig. 22.

VIe SERIE

ETOILES ET ROSETTES GROUPEES PAR 3 ET PAR 4.

T. des E. 159

1. Wide vertical framing band of portal, Ağzikara Han (1242-43) --Ögel, Anadolu Selçuk, pl. XX, Fig. 34; and Grabar and Hill, Fig. 468.
2. Wide carved stone band framing doorway, Cifte Kümbet, Kayseri (ca. 1270) --Ögel, Anadolu Selçuk..., pl. XXVIII, Fig. 56; and Grabar and Hill, Fig. 481.

3. (With centers of stars bossed) Main side panel, minbar, Ulu Cami, Bursa (ordered by Bāyazīd I, 1399-1400) --Oral in Vakiflar Dergisi V, Fig. 36.
4. "Claire-voie de la Grande Mosquée de Damas" [central one of the large semicircular windows visible on the facade of the transept in old photographs taken before the fire of 1893) --Trait des Entrelacs C.P. V; photo reproduced in E.M.A. I, pl. 35b.

T. des E. 161

1. Large rectangular panel in niche, stone mosaic miḥrāb, Ṭaybarsīya Madrasa at al-Azhar (1309-10) --M.A.E. II, pls. 99b and 113b.

T. des E. 163

1. Window grilles, N.W. facade, Madrasa of Ṣarghatmish (1356) --My photo, Fig. 144.

VII^{e} SERIE

FAMILLE HEPTAGONALE.

This would seem to be a "Famille" in somewhat the same sense as is the "Pentagonale"; if one looks at such design as T. des E. 164, 166, 167 etc., one sees sets of parallel lines going in seven different directions. If one were to draw the fourteen-pointed stars "5 en 5" rather than "6 en 6", as all of these (excepting 168, which is done by pentagonal adjustment) are,

perhaps one would get a set of characteristic polygons with an interchangeability similar to that of the ten-points of the "3 en 3" group. I have not experimented with this "Famille".

On the appearance of the seven-pointed star, see Chapter IV, under the discussion of the Mosque of al-Ḥākim. Despite the presence of the fourteen-pointed star in a complex pattern in early 13th. century Anatolia (see Chapter IV, under Ayyūbid period for discussion of the Sivas Hospital portal design), the type of designs shown by Bourgoin here (excluding T. des E. 170) seem, at the present state of my knowledge, to be typically Cairene.

T. des E. 164

1. Upper panel on "lateral front", kursī in Madrasa Ashrafīya (1424) --My photo, Fig. 145.

T. des E. 166

(See end of this paragraph) This would be by far the earliest pattern in Egypt involving fourteen-pointed stars and/or the heptagonal grid system, if it were of the time of the founding of the Barqūqīya. For several reasons I doubt that it is of that date, even though three or four of the star centers have the name of Barqūq scratched in them. The first thing which made me suspicious is that there is a flurry of 14-point designs in the time of Mu'ayyad Shaykh and no others before. Another factor which has become increasingly clear is that while there is a great technical

similarity between this kursī and that in the Ashrafīya, the two are absolutely dissimilar in technique to any other extant Cairene mosque furniture, being made of solid planks, with the lines and polygons gouged out and filled with ivory. And finally, while, as stated above, the wooden centers of some stars (in no particular logic) have scratched in them the following cartouche:

1) in Fig. 87, bottom and top right full stars;
2) in Fig. 119, top left and bottom right but one.

(close-up of this "cartouche" in Fig. 146)

I seriously wonder whether these "cartouches" have not been added by the restorer or some other person who felt they should be there. First, they are very crudely done (perhaps an epigraphist could say whether the peculiarities of the letter-formation reveal a modern hand); and second, I tend to think that, like the kursī in the Ashrafīya (and like the lines and other polygons on this kursī) these stars centers would originally have been of ivory.

1. Kursī (panel on front end), Madrasa Barqūqīya (1384-85?) --My photo, Fig. 87.
2. Lower back panel, minbar, Madrasa of ʿAbd al-Ghanī (1418) --Hautecoeur and Wiet, pl. 162; see also my photo, Fig. 120.
3. (Identical in composition with immediately above) Lower back panel, minbar, Madrasa of ʿAbd al-Bāsiṭ (1420) --Taʾrīkh al-Masāgid, Fig. 136.

4. (Composition like above two) Upper rear panel, minbar, Madrasa Ashrafīya (1424) --My photo, Fig. 147.
5. (Composition like above three) Upper rear panel, minbar, Mosque of Gānī Bek (1426-27) --My photo, Fig. 100.
6. (Composition ditto) Upper rear panel, minbar, Mosque of Qāḍī Yaḥyā at Bayn an-Nahdayn (1444) --My photo, Fig. 101.
7. (Composition ditto) Upper rear panel, minbar; and (composition ditto) upper pair of carved stone panels over door, Mosque of al-Mar'a (1468-69) --My photos: former, Fig. 148; latter, Fig. 191.
8. (Composition ditto) Upper rear panel, minbar, Mosque of Qāḍī Yaḥyā at Būlāq (work of Fu'ād I) --My photo, Fig. 103.
9. Lower rear panel, minbar, Mosque of Salār and Sangar al-Gawlī (clearly recent) --Direct observation.

T. des E. 167

1. Front door, minbar, Madrasa of ʿAbd al-Ghanī (1418) --My photo, Fig. 149.
2. (Composition ditto) Front door, minbar, Mosque of Mu'ayyad (1415-20) --Mosques of Egypt II, pl. 110.
3. (Composition ditto) Front door, minbar, Madrasa of Qāḍī ʿAbd al-Bāsiṭ (1420) --My photo, Fig. 150.
4. End panel, kursī in Mausoleum of Qāytbāy in N. Cemetery (1472-74) --Hautecoeur and Wiet, pl. 198a.

T. des E. 168

1. Large panel of front end, kursī, Madrasa of al-Ghūrī (1503-04) --My photos, Figs. 21 and 151.

T. des E. 169

1. Upper rear panel, minbar, Mosque of al-Mu'ayyad (1415-20) --My photo, Fig. 152.

T. des E. 170

1. Lower part of terracotta and stucco blind niche panel to right of entrance Mausoleum of Abū l-Qāsim (Imām Yaḥyā), Mōṣul (founded by Lu'lu' ibn 'Abd Allāh, mid. 7th. c. H.) --Sarre and Herzfeld, Arch. Reise, III, pl. CI (see also pl. CII and Vol. II, Fig. 253 for photo and Herzfeld's analytical drawing of a quite similar design -- in tympanum of window in interior of same mausoleum -- which is on a hexagonal plan and includes six-pointed stars; and which occurs again in a panel over the entrance of the Madrasa Mirjānīya, Baghdād [758 H./1357 A.D.] --Arch. Reise III, pl. 10).
2. Carved stone panels at each end of N.E. and N.W. walls, N.W. Īwān, Mosque of Qijmās al-Isḥāqī (1479-89) --My photo, Fig. 143.

VIII^{e} SERIE

FAMILLE PENTAGONALE

The pentagonal grid system provides a set by characteristic polygons which are, in their own way, as self-consistent a system as are, for example, the triangles, lozenges and hexagons of the 60-degree family, although there is in the former no one shape which makes an allover pattern alone and which can be used as a building-block for "mega-grouping", as can the equilateral triangle and the square.[70]

Bourgoin analyzes 19 designs of the pentagonal group in the T. des E., several of which I have never found in a historical occurrence; on the other hand, one is constantly running into designs which are very like one or the other of his drawings, but which has the polygons in a slightly different arrangement. Because of the interchangeability of the system, this mutation would seem able to go on infinitely.[71] It is because of this

[70] See drawings K-1 and K-2 (square or 90° system); and K-14 and K-15 (triangle or 60° system); and Chapter III, bottom p. 40 and top p. 41.

[71] The polygons characteristic of the system can be used alone as a design, without any stars at all. This is already a usage in the supposedly 12th. c. palace at Tirmidh (see Rempel, Arch. Orn. of Uzbekistan, Fig. 106); the practice (and the identical pattern) is in Turkey by about 1200, in the band framing the portal of the Mama Hatun Türbe at Tercan (see Grabar and Hill, Fig. 346). The practice is very common in Seljūq Anatolia, but is rarely seen in Egypt, where the earliest usage I have found is from 1361-62 (panels on cupboard in Mosque of Amīr Mithqāl -- see this list, T. des E. 182, No. 1). Pentagonal "interstitial matter" is the only type of decoration in the panels on the portable cupboard of Barqūq which was in the 1969 Cairo Exhibition of Islamic Art (exhib. cat. No. 233, Islamic Museum invoice No. 23767).

interchangeability that one is very often able to use (trace) polygons from a given design, rearranging them, and come up with an analytical (if second-hand) drawing of the "variant".[72]

Particularly rich in polygons of the type found in Nos. 173, 175, 176 and 178 is the last design in the book, 190. I have used it in the manner described above to make "constructed tracing" KT-13; it could have been so used (rather than No. 173) for KT-11.

Another of Bourgoin's designs, No. 182, is only one of several designs of its type encountered in the late Mamlūk period, all of which use the same polygons and proportions, but with different arrangements.[73]

While the pentagram goes back into remote antiquity, and a type of ten-pointed star (as an isolated medallion) is found at Khirbet al-Mafjar,[74] it can be safely asserted that all the basic and some of the most sophisticated developments in infinite patterns of the pentagonal system are 11th.- and 12th.-century Persian. The earliest dated ten-point star pattern is T. des E. 175, in the North Dome Chamber of Iṣfahān's Great Mosque (1088); and before 1114, on the tower of Mas'ūd III at Ghazna, one finds amazing variety, complexity and mastery in the employment of the system.[75] It is almost certainly only an accident that the Aqṣā

[72] See above, Chap. III, pp. 39-40.

[73] For example, see upper rear panel, minbar, Madrasa of Qāytbāy at Qal'at al-Kabsh (my photo, Fig. 102), which is deceptively like T. des E. 182, but with extra space (arrangements of polygons) introduced between some stars.

[74] See Chap. IV, in connection with the Mosque of al-Ḥākim.

[75] Some discussion of developments on Mas'ud's tower in Chap. IV.

minbar furnishes the earliest dated occurrence of T. des E. 171 that I have been able to find. There is no question in my mind that it was invented long before this -- and in Persia (given 175 in 1088, I see no reason why 171 should not have come soon after -- especially considering the developments at Ghazna). While I list the Aqṣā occurrence first because of its solid dating, I believe the Bist occurrence may be earlier; I feel very strongly that the Iṣfahān one probably is. This is partly on the basis of technique and partly on the weight of the general evidence that up to the end of the 12th. century, the avant-garde developments in geometric art were made in the Īrānian school.[76]

If all the basic discoveries in the pentagonal system had been made by the end of the 12th. century in Īrān, one certainly finds a great expansion in variety and usage in Seljūq Anatolia and later in Mamlūk Egypt. It will be seen that the earliest ten-point star pattern in Egypt (T. des E. 171) is on the bronze-plated door from the Madrasa of Baybars I (1262-63) which is now at the French Embassy, Gīza. Although not quite as common as twelve-point patterns, the ten-point was very much a part of the Egyptian scene from Baybars' time onward.

[76]For all these considerations of historical developments see Chap. IV.

T. des E. 171

1. (Variant from Bourgoin's drawing in the same way that the design of Konya's Şircali Madrasa portal varies from T. des E. 118) Next-to-top rear panel of minbar of Nūr ad-Dīn in Aqṣā Mosque, Jerusalem (1168-69) --Mayer, Islamic Woodcarvers, pl. 1.
2. Naked-brick mosaic, tympanum of false-arch panel, "Iwān Est", Masjid-i Jāmi', Iṣfahān (on the basis of technique and general appearance, I consider this decoration to be of the first half of the 12th. century)--if not earlier--see introductory comments to the pentagonal system) --Gabriel in Ars Islamica II, pt. I, Fig. 24; better photo in Athār-é Īrān, 1936, Tome I, Fasc. I, Fig. 176.
3. Terracotta and carved stucco in arch soffit, Qal'at-i Bist (probably 12th. c.) --Grabar and Hill, Fig. 153.
4. Carved stone vertical framing band of miḥrāb, Ulu Cami, Dunaysir (1200) --Grabar and Hill, Figs. 510 and 511; and Ögel, Anadolu Selçuk..., pl. LXXIII, Fig. 150.
5. Carved and painted wood assemblage tābūt of the Seljūq princess Bakhtī Khātūn, from the Khātūnīya Mausoleum, now in the Damuscus Museum (dated 1250) --Direct observation.
6. Narrow framing band of niche inside portal, Cifte Minare, Erzerum (1253) --Bachmann, Kirchen und Moscheen, pl. 67.
7. Bronze-plated door from the Madrasa of Baybars I, now at the French Embassy, Gīza (1262-63) --M.A.E. II, pl. 44d.

8. Elaborately carved in stone, upper part of framing band around portal, Buruciye Madrasa, Sivas (1271-72) --Ögel, Anadolu Selçuk..., pl. LIV, Fig. 103.
9. (Variant as on Aqṣā minbar) Faience mosaic vertical framing band, interior archway, Gök Madrasa, Tokat (1295) --Grabar and Hill, Figs. 360 and 361.
10. Carved stone blind arch panel, tomb tower at Juga (probably 13th. c.) --Grabar and Hill, Fig. 231.
11. (Variant as on Aqṣā minbar) Painted in soffit of window opening into street (original?); and window of drum Mausoleum of Sunqur Sa'dī (1315-21) --Former, my photo, Fig. 153; latter, M.A.E. II, pl. 102c.
12. Decoration of first page of Qur'ān from Mosque of al-Khaṭīrī at Būlāq (mosque 1336) --Précis, "Les Manuscripts", pl. 36.
13. Openworked stone bannister panels on both balconies of minaret, Mosque of Mangak al-Yūsufī (1349) --My photo, Fig. 154.
14. Stucco framing band around doorway, Madrasa Mirjānīya, Baghdād (758 H.) --Sarre and Herzfeld, (Arch. Reise, vol. III, pl. X.
15. Bronze "Porte avoisinant la mosquée de l'Emir Cheykoun (aujourd'hui démolie) et construite par lui (milieu du XIVe siècle), Caire" --Précis, "L'Architecture", pl. 43. (But the inscription of which he himself gives 2 drawing indicates Qūqūn as the builder, so this should probably be placed before the Khaṭīrī Mosque occurrence. Here is the inscription given in his drawing:

أمر بإنشاء هذا الجامع المبارك بكرم الله تعالى العبد الفقير إلى الله
تعالى قوصون الساقي الملكي الناصري في ايام مولانا السلطان الملك
الناصر أعزّ الله أنصاره وذلك في سنة ثلاثة وسبع (ROBBED OUT)

One is left wondering whether he has drawn the inscription accurately, as what is left of the date doesn't seem to coincide with Qūṣūn's dates.

16. (Identification probable but photograph is too close a detail for certainty) Wood assemblage minbar, Great Mosque at Manisa (dated 1376) --Reifstahl, pl. 13.

17. At side of entrance, "first tomb...middle group", Shāh-i Zindeh, Samarqand (end 14th., beg. 15th. c?) --Cohn-Wiener, pl. XLII.

18. Two small panels on "lateral front", kursī, Madrasa Ashrafīya (1424) --My photo, Fig. 145.

19. Front door and middle panel of rail, minbar, Mosque of ibn Bardbak ad-Dawādārī (ca. 1475) --My photo, Fig. 49.

20. Carved stone panel of rail, first balcony above roof, Madrasa of Azbak al-Yūsufī (1494-95) --My photo, Fig. 155.

21. Large horizontal panel of "lateral front", "pupitre pour la lecture du Coran, au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 97.

22. Central panel of rail, minbar, Madrasa of Qānībāy Amīr Akhūr (1503) --My photo, Fig. 52.

23. (Structurally 171 but with stars drawn "7 en 7" with 20-part division of circumference-- a phenomenon unique in my experience of this design) Rectangular carved-stone panel to right of entrance and just under inscription band, facade, Madrasa of al-Ghūrī (1503-04) --My photo, Fig. 156.

24. Vertical bands under arcade, small mosque of citadel, Akhlāt (1584) --Bachmann, Kirchen und Moscheen, pl. 57b.

25. Wood strapwork decoration under balcony, Manzil Waqf Muṣṭafā Ga'far as-Silaḥdār (1716) --Direct observation.
26. Wood strapwork ceiling of minbar, Mosque of Aḥmad al-Mihmandār (of time of restoration of mosque in 1722-23, recorded above door of minbar) --My photo, Fig. 157.

T. des E. 173

1. (Very similar design, but with positions of "double pentagon" and "angular hourglass" polygons reversed) Stone-carved design on courtyard facade, Şircali Madrasa, Konya (1243) --Ünsal, Turkish Islamic Architecture, Fig. 74.
2. Painted stucco gallery vault, Mausoleum of Öljeytü, Sulṭānīya (1305-13) --Pope, Pers. Arch., Fig. 171.
3. Large stone mosaic panel in niche, miḥrāb, Mosque of al-Māridānī (1338/9-40) --Mosques of Egypt I, pl. 67 (This is drawn and source is given by Bourgoin in T. des E., C.P. VII, top).

T. des E. 174

1. Framing band around door, Sahip Ata Cami, Konya (1279) --Ögel, Anadolu Selçuk..., Fig. 78.
2. Running band going around tomb above windows, smaller of the two tombs, Akhlāt (1281) --Bachmann, Kirchen und Moscheen, pl. 49b.
3. (Very similar but with more space between rows) Solid wood carved doors in "Maṭḥaf al-Āthār in Konya" (no date given) --Najī Zayn ad-Dīn, al-Khaṭṭ al-(Arabī, Fig. 183.

T. des E. 175

1. (This is the earliest occurrence I have encountered of a ten-point star-pattern) Brick mosaic in tympanum of blind-niche panel, North Dome Chamber, Great Mosque of Iṣfahān (1088) --Article by Pope in Creswell Festschrift, Fig. 7.
2. Panels on wall in main prayer īwān, Masjid-i Jāmi', Gulpayagān (1104-18) --Pope, Survey, pl. 308a; and Grabar and Hill, Fig. 282.
3. Stucco panel in palace at Tirmidh (12th. c.?) --Deniké, Architectural Ornament of Central Asia, Fig. 58; and (analysis) Rempel, Architectural Ornament of Uzbekistan, pl. 104, 1, 2 and 3.
4. Framing band of portal, Ağzikara Han (1242-43) --Ögel, Anadolu Selçuk..., pl. XXI, Fig. 36.
5. Framing band of portal, Karatay Cami, Antalya (1250) Riefstahl, pl. 92.
6. Two stucco roundels of inscription band (to left of miḥrāb, in small "room"), Madrasa of Zayn ad-Dīn Yūsuf (1298) --My photo, Fig. 158.
7. (With a Baybars-type lion (panther) in center, attacking a horse) "Door of a wooden book cupboard from Egypt in the 13th. century A.D. In the Coptic Museum in Cairo" --Zakī M. Ḥasan, Aṭlas, Fig. 399.
8. Stucco roundel to right end of inscription band, qibla wall, courtyard, Madrasa of Salār and Sangar al-Gawlī (1303-04) --M.A.E. II, pl. 94c.
9. Marble mosaic panel, N.E. wall, interior, Mausoleum of Baybars al-Gāshankīr (1306-10 --My photo, Fig. 159.

10. Stucco window to left of that of N.E. corner axis, drum, Mausoleum of Sunqur Sa'dī (1316-21) --My photo, Fig. 97.
11. Two pointed-arch stucco grilles (immediately flanking miḥrāb); two rectangular stucco grilles; and one pomegranate-shaped panel (N.E. end), qibla wall, Mosque of the Amīr Ḥusayn (1319) --M.A.E. II, pl. 104a (only first two grilles visible); and direct observation.
12. At least five stucco window grilles (some are surely new, being white), Mosque of an-Nāṣir Muhammad in the Citadel (1318 and 1335) --Mosques of Egypt II, pl. 239 (1); and direct observation.
13. Marble mosaic spandrels over lateral doors beside miḥrāb, mausoleum of Aqbughāwīya Madrasa at al-Azhar (1333-39) --Mosques of Egypt I, pl. 60; and Hautecoeur and Wiet, pl. 106.
14. False-arch panel (lower tier) in niche of miḥrāb, Mosque of Badr ad-Din al-'Agamī (1356-59) --Comité, Exercice 1912-14, pl. VIII.
15. Small panels at ends of inscription band above doors to mausoleum, Khānqā Farag ibn Barqūq (1399-1411) --Précis, "La Menuiserie", pl. 16.
16. Tile decoration of dome of minaret, Mosque of Gawhar Shād, Mashhad (1418) --Pope, Pers. Arch., Fig. 266.
17. V-cut panels on inside of rail, minbar, Madrasa of Qānībāy Amīr Akhūr (1503) --My photo, Fig. 14.
18. Tile panel on wall of Tash-Khaulī Palace, Khīva (19th. c.) --Deniké, Architectural Ornament of Central Asia, Fig. 193.

T. des E. 176

1. Framing band of portal, Akseray Sultan Han (1232-36) --Photo, Shahīra Maḥrez.
2. Second framing band in from 3/4-round salient, portal, Huand Hatun Türbe, Kayseri (1237-38) --Ögel, Anadolu Selçuk..., pl. XXIV, Fig. 45.
3. Central square depression, ceiling of ambulatory, S.E. sector, Mausoleum of Qalā'ūn (1284-85) --M.A.E. II, pl. 73b.
4. Stucco decoration in window arch, Mosque at Āshtārjān (ca. 1315) --Grabar and Hill, Fig. 279.
5. Lintel over entrance, tomb tower of the daughter of Arghūn Āghā, Salmās ("early 14th, century") --Pope Survey, pl. 344.
6. Wooden window grilles, N.E. facade, Mosque of Aydumur al-Bahlawān (before 1346) -- My photo, Fig. 160 (Bourgoin, in Précis, "L'Architecture", pl. 59, publishes a drawing of these windows which he confusedly states to be from the "Mosquée d'el-Gamâly...(XVe siècle)").

T. des E. 177

1. Square panels of rail, north side, minbar of Qāytbāy (stone) in Khānqā Farag ibn Barquq (1483) --Mosques of Egypt II, pl. 101; Hautecoeur and Wiet, pl. 157; and my photo, Fig. 139.

T. des E. 178

1. (Very slightly different, in that all "double pantagons" or ṭabl-shapes are bi-laterally symmetrical -- this in spite of the fact that Herzfeld publishes an analytical drawing of it [vol. II, Fig. 254] and says [vol. II, p. 257] that it is "identisch mit seiner [Bourgoin's] No. 178" -- the reason for the difference in proportion being that Bourgoin's drawing is on a square plan, while Herzfeld's [and the Mōṣul original] is slightly elongated vertically in plan. But we may be sure that Bourgoin's drawing is a precise copy of the original he was dealing with). Blind arch panel on facade to right of entrance, Mashhad Yaḥyā b. al-Qāsim, Mōṣul (mid. 13th. c.) --Sarre and Herzfeld, Arch. Reise, III, pl. CI.

T. des E. 179

1. Brickwork tympanum, Gunbad-i ʿAlaviyān, Hamadan (2nd. half, 12th. c.) --Pope, Survey, pl. 329.
2. Wide vertical framing band of west portal, Huand Hatun Cami, Kayseri (1237) --Gabriel, Les Monuments, I, pl. XII; and Ögel, Anadolu Selçuk..., Figs. 42 and 42a.
3. Stucco window above miḥrāb, Madrasa; and stucco window above and left of miḥrāb, Mausoleum of Qalā'ūn (1284-85) --M.A.E. II, pls. 75a and 70.
4. Two pomegranate-shaped panels, upper left, N.W. exterior, Mausoleum of Sunqur Sa'dī (1315-21) --M.A.E. II, pl. 102d; see also my photo, Fig. 98.

5. Carved stone band framing doorway, Mosque of Sunqur Bey at Niğde (1336) --Photo Shahīra Mehrez.
6. Marble mosaic framing panel around lintel, entrance, Qaṣr Qūṣūn (1337) --My photo, Fig. 161.
7. Iron grille over college door, S.W. corner, Madrasa Barqūqīya (1384-85) --My photo, Fig. 162.
8. Marble mosaic panels at each end of relieving lintel over entrance, Mosque of Gamāl ad-Din Yūsuf al-Ustādār (1408) --My photo, Fig. 163.
9. Upper rear panel, minbar, Madrasa Baqarīya (minbar given 1420) --My photo, Fig. 45.
10. Tilework on minarets of Ḥusayn Bayqarā, Herāt (1417-37) --Pope, Pers. Arch., Fig. 258a.
11. Wood mosaic panels at bottom, cabinet doors, Madrasa Gawhariya at al-Azhar (before 1440) --My photo, Fig. 56.
12. Upper rear panel, minbar, Mosque of Timrāz al-Aḥmadī (dated 1477) --My photo, Fig. 164.
13. Panels at each side of window above entrance, Ribāṭ Zawgat as-Sulṭān Īnāl (ca. 1456) Comité for 1900 (in Arabic), pls. 2, left and right (dating taken from Arabic Index).
14. Four marble mosaic panels at ends of lintels above large grilles for dispensing water, N.E. and N.W. facades, Sabīl of Qāytbāy, Shāri' Salība (1479) --My photo, Fig. 165.
15. Front end panel, "pupitre pour la lecture du Coran, au Caire (XVe siècle)" --Précis, "La Menuiserie", pl. 96.
16. Front door, minbar, Madrasa Qānībāy Amīr Akhūr (1503) --My photo, Fig. 52.
17. Upper rear panel, minbar in Madrasa of Salār and Sangar al-Gawlī (minbar is surely recent) --Direct observation.

T. des E. 180

1. Upper pair of stone-carved panels in entrance bay, Mosque of Timrāz al-Aḥmadī(1472) --My photo, Fig. 68.

T. des E. 182

1. (Interstitial matter, with slight alteration but entirely characteristic of this design) In narrow vertical panels to right of miḥrāb, Mosque of Amīr Mithqāl (1361-62) --My photo, Fig. 55
2. Marble mosaic panel in northern of two window sills, Mausoleum of Mu'ayyad Shaykh (1415-20) --My photo, Fig. 166.
3. Front door, minbar, Mosque of Qāḍī Yaḥyā, Bayn an-Nahdayn (1444) --My photo, Fig. 167.
4. (Same composition as Mu'ayyad window sill) Upper rear panel, minbar, Madrasa of Qānībāy Amīr Akhūr (1503) --My photos, Figs. 168 and 52.
5. Marble mosaic of niche of miḥrāb, Madrasa of al-Ghūrī (1503-04) --Hautecoeur and Wiet, pl. 210b.
6. Front door, minbar, Mosque of Qāḍī Yaḥyā at Būlāq (work of Fu'ad I) --My photo, Fig. 169.

T. des E. 186a

1. Large side panel, "Koursi de la mosquée de Kaitbai (Musée Arabe)" --Gayet, L'Art Arabe, Fig. 115.

T. des E. 187a

1. Metal-plated door of ʿAun ad-Dīn, Mōṣul (mid-13th. c.) --Sarre and Herzfeld, Arch. Reise, III, pl. VIII, and (Herzfeld's drawing) II, Fig. 264.
2. Pomegranate-shaped panel on N.E. corner of transition zone; and window to right of that of S.E. axis of drum, Mausoleum of Sunqur Saʿdī (1315-21) --Former, my photo, Fig. 97; latter, direct observation.
3. (Identical variants) Fragment of original carved wood mounted on wall of sanctuary; and wood mosaic window of facade, Mosque of Aḥmad al-Mihmandār (1324-25) --My photos; former, 171; latter 170.
4. (Mihmandār variant) Design of door on S.W. wall of sanctuary, Mosque of Aṣlam as-Silaḥdār (1344-45) --My photo, Fig. 172.
5. Interior windows "1" and "6" (my numbering) Mosque of Mangak al-Yūsufī (1349) --My photo, Fig. 173 (window "6").
6. Upper rear panel, minbar in Madrasa Barqūqīya (in name of Qaqmaq, reigned 1438-53) --My photo, Fig. 174.
7. Second and fourth panels of rail, minbar; and at least four occurrences in carved-stone voussoirs of great arches to side īwāns, Madrasa of Qāytbāy at Kabsh (1475 -- On minbar see this list, T. des E. 77, No. 23) --My photo, Fig. 102.
8. Panels of "porte du sahn", Madrasa of Abū Bakr ibn Muzhir (1480) --Précis, "La Menuiserie", pl. 54, Fig. 1; and my photo, Fig. 175.
9. Rail panels 2 and 4, minbar, Madrasa of Azbak al-Yūsufī (1494-95) --My photos, Figs. 107 and 126.

10. Rail panels 2 and 4, minbar from Mosque of Sulṭān Shāh (mosque before 1495 -- minbar now in Br. Mus.) --Ta'rikh al-Masāgid, Fig. 202.

T. des E. 187b

(All the below occurrences are an identical variant -- see drawing K-23).

1. Front door, minbar of Baktimur al-Ǧūkāndār in Mosque of Ṣāliḥ Ṭalā'i' (1300) --Hautecoeur and Wiet, pls. 46 (r.) and 83 (r.).
2. Small blind-niche panel closest to front, lower tier, stone mosaic miḥrāb, Ṭaybarsīya Madrasa at al-Azhar (1309-10) --My photo, Fig. 176.
3. Front door, minbar, Mosque of Timrāz al-Aḥmadī (1478) --My photo, Fig. 177.

K-7

Square plan. From apexes of squares, tangent circles are struck. Inside these circles, twelve-pointed stars are drawn "4 en 4"; and extension of lines past star tips create four-pointed stars of "interstice". To regularize these 4-points, guiding circles should be drawn once the radius has been established.

1. Panels of long sides of sloping top, tābūt of al-Imām ash-Shāfi'ī (1178) --Ta'rīkh al-Masagid, Fig. 53; and Hautecoeur and Wiet, pls. 51 (L) and 52 (L).

2. Stucco and terracotta panel of tympanum "über dem Innentor von der Brücke", Bāb al-Wasṭānī, Baghdād (work of Khalif an-Nāṣir, reigned 1180-1225) --Sarre and Herzfeld, Arch. Reise, II Fig. 191 (drawing of Herzfeld); and IV, pl. CXXXIII, 5.
3. Design in brick, tympanum, Great Mosque at Van (l. 12th. c. ?) --Bachmann, Kirchen und Moscheen, pl. 59.
4. Carved stone lintel (thin engraved lines) over entrance, Madrasa ʿĀdilīya, Damascus (finished 619 H.) --Herzfeld, "Damascus: Studies in Architecture, III", Fig. 90 (is a reproduction of Précis, "L'Architecture", pl. 19), in Ars Islamica, vol. XI-XII.
5. Carved in stone strapwork, lintel over window, N.W. facade, Mausoleum of Qarāsunqur (1300-01 --M.A.E. II, pl. 89d.
6. Third panels in from front (flanking central arabesque panel), lower tier of small panels between colonnettes, marble mosaic miḥrāb of Ṭaybarsīya Madrasa at al-Azhar (1309-10) --My photo, Fig. 176, see also M.A.E. II, pl. 113b.
7. Window to right of that of N.W. corner axis, drum, Mausoleum of Sunqur Sa'dī (1315-21) --My photo, Fig. 98.
8. New-looking stucco window, Mosque of Qūṣūn (1329-30) -- after original?) --Ta'rīkh al-Masāgid, Fig. 81
9. Stucco panel in Īwān, Madrasa-i Do Dar, Mashhad (1439 -- photo J.M. Rogers.
10. (Variant in that interstice is transformed into small octagon in place of small four-pointed star) Carved in third panel from bottom, rail on south side, minbar of Qāytbāy in Khānqā Farag (1483) --My photo, Fig. 178.

11. Mosaic panel "encastré dans les parois de la Grande Mosquée de Damas" (probably Mamlūk) --Précis, "L'Architecture", pl. 14. Fig. 3.

K-8

Square plan. From apexes of squares strike tangent circles, in which inscribe duodecagons with apexes in contact. Inside these, strike concentric circles whose radii equal 3/4 those of duodecagons and inscribe in them twelve-pointed stars "5 en 5". It will be readily seen how extension of sides of duodecagons and of points of stars create five-pointed stars and other interstial matter. A very natural variant of this design is one in which sides of duodecagon are extended even further, surrounding irregular octagon with four five-pointed stars.

1. Brick strapwork panel, Mausoleum of Mu'mina Khātūn (1186-87) --Jacobstahl, Fig. 13; also Ögel, Anadolu Selçuk..., Şek. 68 (apparently a tracing from Jacobstahl; though, characteristically, no credit is given).
2. One unit in each of 24 panels of bronze openwork, chandelier from Mosque of Sulṭān Ḥasan (but chandelier dated 1329) --Herz, La Mosquée..., Fig. 1.
3. (Variant with four 5-points around octagon) Marble mosaic spandrels of miḥrāb in Madrasa (itself) Aqbughāwīga (1333-39) --My photo, Fig. 179
4. Spandrels of marble mosaic miḥrāb, Mosque of al-Māridānī (1338/9-40) --Comité, 1905, pl. VII.

5. Main side panel, minbar; and spandrels of miḥrāb (marble mosaic), Mosque of Sitt Miska (1339-40) --My photos, Figs. 180 and 181.
6. (Variant like Aqbughāwīya) Wooden door of stone minbar, Mosque of Āqsunqur (1346-7) --My photo, Fig. 182; also Hautecoeur and Wiet, pl. 113.
7. Main side panel, minbar, Mosque of Arghūn Shāh al-Ismā'īlī (1347) --My photo, Fig. 183.
8. Main side panel, minbar, Mosque of Mangak al-Yūsufī (1349) --My photo, Fig. 184.
9. (Variant like Aqbughāwīya) Stucco panel surrounding upper part of tympanum above entrance, Madrasa Mirjānīya, Baghdād (1357) --Sarre and Herzfeld, Arch. Reise, vol. III, pl. X.
10. "Tabouret en marqueterie du Caire (XIVe siècle)" --Précis, "La Menuiserie", pl. 94.
11. Decorated page, Qur'ān of Mu'ayyad "écrit par Abdar Rahmân ibn as-Faïgh, daté du mois de ramadan de l'an 814 (1411)" --Précis, "Les Manuscrits", pl. 25.
12. (All-curvilinear version, with 5-point stars around octagon) Main side panel, minbar moved from Masgid al-Ghamrī to the Khānqā of al-Ashraf Barsbāy (ca. 1439) --Zakī Ḥasan, Atlas, Fig. 403.
13. Main side panel, minbar in Madrasa Barqūqīya (in name of Gaqmaq, reigned 1438-53) --My photo, Fig. 174.
14. Pomegranate-shaped bronze panel on door of main entrance, Mosque of Qijmās al-Isḥāqī (1480-81) --Ta'rīkh al-Masāgid, Fig. 198; see also my photo, Fig. 23.

K-10

Square plan. At apexes of square are twelve-pointed stars drawn "5 en 5" with circumference divided into 24 parts. Radius of 12-points is equal to 1/3 of the side of the réseau-square. Extension of lines crossing at star-tips results in all the rest, including the eight-pointed star; but for the latter, it is advisable to draw guiding circles for tips of eight-points, once a few have been established.

1. (With eight-point curvilinearized) Painted stucco gallery vault, Mausoleum of Öljeytü, Sulṭānīya (1307-13) --Grabar and Hill, Fig. 239.
2. First of three pomegranate-shaped stucco panels to left of miḥrāb, Mosque of the Amīr Ḥusayn (1319) --My photo, Fig. 185.
3. Lower pairs of stucco windows on at least three sides of transition zone (N.W., N.E., S.E.); and at least one window of drum, Mausoleum of Sunqur Sa'dī (1315-21) --Former, my photo, Figs. 78, 97 and 98; latter, M.A.E. II, pl. 102.
4. Interior stucco window "3" (my numbering), Madrasa Mangak al-Yūsufī (1349) --My photo, Fig. 186.
5. Carved and glazed terracotta panel inside entrance, Mausoleum 13 (Pugachenkova's numbering), Shāh-i Zindeh Complex, Samarqand (1360) --Hrbas and Knobloch, pl. 62; and Grabar and Hill, Fig. 88.
6. As framing bands in mosaic faience, portal to sanctuary, Masjid-i Jāmi', Yazd (1375?) --Pope, Survey, pl. 445; and Persian Architecture, Fig. 216.

7. Lower part of design on faience-covered dome, Masjid-i Jāmi', Sāveh (early 15th. c., according to Grabar --1518 according to Survey, pp. 1166-69) --Grabar and Hill, Fig. 213.

"Khānqā Bunduqdārī Design"

1. In trilobed terracotta panel to left of miḥrāb, Ulu Cami, Van (probably late 12th. c.) --Bachmann, Kirchen und Moscheen..., pl. 61.
2. Stucco panel in S.W. recess, interior of Second Mausoleum, Khānqā al-Bunduqdārī (1283-84) --M.A.E. II, pl. 61c.
3. Three stained-glass windows (above large window-casements --first and third from S.E. on S.W. wall and third from S.E. on N.E. wall), Mausoleum of Qalā'ūn (1284-85) --Direct observation.
4. Stucco roundel of inscription band to left of entrance to mausoleum, one window in drum of dome and large stucco roundel in center of interior of dome, Zāwiya Zayn ad-Dīn Yūsuf (1298) --Latter, M.A.E. II, pl. 84c; other two, direct observation.
5. Central lobed-arch panel (stucco) above miḥrāb at al-Azhar (1300) --Hautecoeur and Wiet, pl. 91.
6. Stucco panel in hood of miḥrāb in courtyard, Madrasa-Mausoleum Salār and Sangar al-Gawlī (1303-04) --M.A.E. II, pl. 112c.
7. At least two windows of tranzone, Mausoleum of Baybars al-Gāshankīr (1307-10) --Direct observation.
8. Blind arch panel to far right of miḥrāb, Mosque of Amīr Ḥusayn (1319) --Hautecoeur and Wiet, pl. 104.
9. In two pomegranate-shaped stucco panels on S.E. face of transition zone (flanking upper three-window set), Mausoleum of Sunqur Sa'dī (1315-21) My photo, Fig. 78.

10. Window from Mosque of Qūṣūn (1330? Looks new in photo) --Ta'rīkh al-Masāgid, Fig. 81.

11. Pair of windows on N.W. facade, Mosque of Mangak al-Yūsufī (1439) --Direct observation.

Special List:

Designs Containing 20-Pointed Stars

1. Terracotta strapwork panel, Tower of Mas'ūd III, Ghazna (before 1114). Design based on decagons in contact at the apexes, with 10-pointed stars (drawn "3 en 3") and 20-petalled rosettes inside the decagons; 8-pointed stars between the decagons. See Āthār-é Īrān, 1936, Tome I, Fasc. II, article by Godard, Fig. 236, central panel (for discussion, see Chapter IV, footnote 131).

2. Stucco window grille (immediately left of N.E. axis), drum of Mausoleum of Sunqur Sa'dī (1315-21). Design on square plan with, in interstice, octagon inside which is small 4-pointed star. See my photo, Fig. 97.

3. Stone carved strapwork roundel inside large marble mosaic roundel above S.W. entrance, Mosque of Aṣlam as-Silaḥdār (1344-45). Has large 20-pointed star (drawn "9 en 9") in center, surrounded by ten 8-pointed stars ("3 en 3") which latter are cut along their center axis by the edge of the roundel; this is a design composed for the space and cannot continue over a plane surface. See Précis, "Marqueterie", pl. 25; and Mosques of Egypt, I, pl. 70.

4. Painted, relief stucco decoration above miḥrāb, Qubbat al-Fadāwīya (1479). Design of 20-pointed stars on square plan with 12-pointed stars in center or interstice; but for very minor difference, this is T. des E. 138, which see in list. See (for illustration) Les Arts Arabes, pl. 60.

5. Bronze-plated door, "porte principale", Madrasa of Abū Bakr ibn Muzhir (1479-80). Design based on assemblage of decagons and pentagons; 20-pointed stars inside hexagons and 10-pointed stars inside pentagons. See Chapter IV under discussion of Egyptian "originals", footnote 131. For illustration see Comité, 1897, "Appendice", pl. IV.

6. Marble mosaic floor of Sabīl of al-Ghūrī (1504-05). Design of 20-pointed stars ("8 en 8") on square plan with 8-pointed stars in interstice. In Précis II, pl. 46, is a design which fits the above description and which is identified as being from the Sabīl in question; but the drawing does not correspond to the actual floor, as the points of the 20-point star are rotated ½ division. In C.P. VI of Le Trait des Entrelacs is a design identified as "tiré du pavement d'une fontaine au Caire (XV^{e} siècle)", which does correspond to the floor of the Ghūrī sabīl, but for very minor aspects of proportion. For photo of the floor, see Ta'rikh al-Masāgid, Fig. 225.

7. Ceramic tile panel, "Morocco". Design of 20-pointed stars on square plan with 8-pointed stars in interstice. Seen on a poster advertising "Indian Tea."

CHAPTER IV

A QUICK HISTORICAL SKETCH AND SOME FURTHER CONCLUSIONS

For the history of Islamic geometric design in Egypt, by far the richest period is the Mamlūk. As a general statement, this has perhaps long been recognized; at least, few people familiar with the Islamic art of Egypt would deny it. But perhaps we can go a bit farther toward showing just how rich it was, and how developments in Egypt relate to those in the Islamic world as a whole. To put things in a meaningful perspective, it will be necessary to make a selective survey of historical developments.

The Ṭūlūnid Period

The remarkably intact Mosque of Aḥmad ibn Ṭūlūn shows, particularly in the decoration of the soffits of the arches adjoining the S.W. corner of the ṣaḥn, that geometric art of a specifically Islamic type was present in Egypt in the ninth century. But these examples, as well as the three window-grilles considered by Creswell[77] to be original, show no advancement beyond Umayyad art. Indeed, both Khirbet

[77] *E.M.A.* II, p. 346. I have not found the time to make a systematic study of the problem of the dating of the various grilles at the Mosque of ibn Ṭūlūn (though I have photographed them all and have some idea of what designs are present), but such a study is needed. Now that a large list of occurrences of a large number of Egyptian designs has been made, it would seem that the next step would be to conjoin the general design-development evidence thus provided, with a study of the epigraphical and physical evidence as elucidated by Flury and Creswell to come up with some "educated guess" about the date of those grilles more than a 100 years old (i.e., not due to recent restoration).

al-Mafjar and Qaṣr al-Ḥayr al-Gharbī provide designs of considerably more sophistication.

One may remark here that it would seem that if there had been a taste for such, the supposed haste of the builders of Sāmarrā would have induced them to employ geometric-repeating design because of its natural applicability to mass-production. Instead we find the reduction of floral ornament to a few basic shapes which could be simply (rectangularly) repeated. Rare indeed are truly geometric patterns from Sāmarrā, and they are of the simplest.[78]

The Fāṭimid Period

Fāṭimid architecture shows little usage of geometric patterns more advanced than the Umayyad ones -- to judge from what we have left. The Mosque of al-Azhar contains nothing which can be reasonably asserted to be original (i.e., from the foundation) geometric decoration. Al-Azhar's cresting on the S.E. side of the ṣaḥn[79] takes the form of an openworked T. des E. 5, a design which occurs at least thirty years earlier (1093 Kharraqān Tomb Tower) in western Īrān. The other geometric ornament from the same period at al-Azhar (inside the small cupola of the "transept", etc.) is of the simplistic type common in such punched-plaster work.

[78] For example, the familiar "8-pointed star and cross" pattern (K-4) which is already present at Qaṣr al-Ḥayr al-Gharbī (see Herzfeld, Der Wandschmuck der Bauten von Samarra und seine Ornamentik, Tafel LXXIX).

[79] Considered by Creswell to date 1130-49 (see M.A.E. I, pp. 254-57).

The Mosque of al-Ḥākim (1003) is interesting despite its deplorable state. There may have been a wealth of geometric ornament in its windows, but I know of no reason to suppose that any of the original windows have survived. Al-Ḥākim's interest in sorcery, astronomy and mathematics is legendary and an interest in the stranger geometric figures is attested by the presence of medallions of seven- and five-pointed stars on the northern minaret of his mosque.[80] The "pentagram" is asserted by Creswell to appear here "in Muslim art for the first time" (p. 104). This is not the case, as it appears at Khirbet al-Mafjar, elaborately inter-laced;[81] and Creswell goes on to assert that its "traditional Jewish origin is confirmed by the fact that the earliest existing example of it (Fig. 46, facing p. 112) occurs on the fallen lintel of a second-century Jewish synagogue at Tabgha (Capernaum)" (loc. cit.). While the Tabgha lintel may be the earliest existing example of the pentagram (even this statement should be qualified by a "known to me"), it is far from confirming any Jewish origin. While one suspects it may ultimately be of Eastern derivation,[82] the Pythagoreans (who had taken so much from the Ancient East, by way of knowledge as well as occult practices) used the "star-shaped pentagram . . . as a symbol of recognition and

[80] See M.A.E. I, pl. 26.

[81] Hamilton, fig. 206.

[82] Like the 60° system -- see introductory comments to "Famille Hexagonale."

it was called by them Health."[83] This usage predates the lintel by some 700 years!

Most interesting is the fact that here is the earliest example I have seen of a seven-pointed star (and it is regular).[84] But both the pentagram and the heptagram are only isolated unites on al-Ḥākim's mosque, and, indeed, no allover patterns of interest confront us here.

The Mosque of al-Aqmar (1125) has on its façade, in the same niche with the famous lamp, a simple six-point star pattern on a triangular plan.[85] But this same pattern, in an even more advanced form (more widely spaced, more

[83] Cajori, A History of Mathematics, 2nd ed., p. 18.

[84] The next example I can cite is from the tomb-tower of Mas'ūd III at Ghazna (before 1114) where it is part of a complex pattern involving 10-pointed stars and based on the decagon/pentagon/ assemblage (for the panel with the design, see Athār-é-Irān, 1936, Tome I, Fasc. II, fig. 236, right panel). The seven-pointed star in general is relatively rare in geometric design. There is no systematically precise way of dividing the circle into seven equal parts, as is the case with any odd number. And more significant (since the circle can be divided into any number of equal parts by adjustment), the seven-pointed star, again like other uneven numbers, is difficult to combine in a pattern making allover sense, combining with the other elements so as to leave no loose ends or visually awkward areas; all Islamic geometric designs fulfill this requirement. This Ghazna design is perhaps the most ingenious usage of the seven-pointed star I have seen. Patterns of the pentagonal as well as the heptagonal groups only appear in Egypt in the Mamlūk period (which see below, as well as the "List".

[85] See M.A.E. I, pl. 83a; and drawing K-17.

elaborately treated), occurs in window "P7" from Khirbet al-Mafjar (2nd qtr. 8th c.).[86]

No patterns of interest are to be found on the Mashhad of Sayyida Ruqayya, but the wooden miḥrāb (1154-60) from there, which is now in the Islamic Museum, is justly famous as an early Egyptian monument exhibiting complex geometric designs. In connection with it, I should drop back a few years to that other famous geometrically-decorated wooden miḥrāb, that from the Mashhad of Sayyida Nafīsa (1138-46). Both these miḥrābs show totally new designs for Egypt; and between them the number of such new designs is impressive. More remarkable still is the fact that of eight or so "new" designs, all but two I have found in earlier occurrences outside Egypt; four of them are present on the two tomb-towers at Kharraqān in western Persia alone (dating from 1067-8 and 1093 respectively).[87] Of the designs for which I can show foreign precedents, only T. des E. 25 (see "List") has not its earliest recorded occurrence in Persia; and that

[86] Hamilton, fig. 250 (analytical drawing). The design (with greater or less space between the stars) has many occurrences, including the 1093 Kharraqān Tower ("frieze from side 7" -- Stronach and Young, pl. XXIIe) and the upper and lower side panels and the lower rear panel of the miḥrāb of Sayyida Ruqayya (1154-60) (--see Pauty, Les bois sculptés, pls. LXXXI and LXXXIII).

[87] The designs precedented at Kharraqān are: T. des E. 18, 20, 89 (all on the 1067-68 tower) and K-17, mentioned above (from the 1093 tower). One will find from looking at my list that: T. des E. 20 was at least one hundred years old in Persia when it appeared at Kharraqān; and that T. des E. 12 (present in the niche of the Ruqayya miḥrāb) had two immediately preceeding occurrences in Persia.

Is in Syria, where the influence of Seljūqid Persia must have been strong at the time.

What about the two designs for which my earliest recorded occurrence is in one of these miḥrāb? One of them is the design in the niche of the Nafīsa miḥrāb; it is composed of "octogones étoilés", (i.e., 8-pointed stars drawn "deux en deux"), and regular octagons, on a square plan.[88]

This same design occurs two more times in Egypt (both in the Mamlūk period) and once in the Great Mosque of Damascus (probably under Mamlūk dominion); but otherwise, designs involving this star are extremely rare in Egypt, whereas they are quite common in Persia in all periods.[89]

One design remains for consideration, that from the top panel on the left side of the Ruqayya miḥrāb;[90] it is (with

[88] See drawing K-6-A and Pauty, Les bois sculptés, pls. LXXV and LXXVI.

[89] See: T. des E. 67, the only design containing this star to be found in the Trait, for which I have found any historical occurrences (12 so far), none of them in Egypt (Bourgoin did his collecting mainly in Cairo, but also in Damascus and perhaps the Islamic West); K-6 (showing what an early date at which Persians were working with the same basic scheme of the Nafīsa niche design; and K-12, which in Persia at least as early as the Mausoleum of Öljeytü (with an elaborate overlay -- see Grabar and Hill, Figs. 242 & 248). One suspects for this latter a much earlier origin. Other examples to further substantiate this line of argument can be found. In all this, as well as with other design types, one must remember that Egypt is where I've collected my material first-hand, so my coverage is most thorough there.

[90] See Pauty, Les bois sculptés, pl. LXXXIV.

some superficial difference -- it has none of the surrounding elongated hexagons) T. des E. 69 -- probably the most advanced or sophisticated design on the two miḥrābs. But again, it is, by comparison with contemporary developments in Persia, hardly impressive. Let us attempt to document this assertion.

The designs in the niche of the miḥrāb of the mosque at Barsiyān, near Iṣfahān ([11] 34) provide perhaps the most telling comparison.[91] In the "lower tier of stalactites" of this miḥrāb is a series of slightly concave blind-arch panels of unglazed brick mosaic designs altogether out of the class of anything appearing in Egypt before the Mamlūk period. They are: (central panel) design combining regular or near-regular stars of 8, 7, 6, and 5 points, and calling to mind the design (T. des E. 163) in the window-grilles on the facade of the Madrasa of Ṣarghatmish (1356), as well as one from the Tomb-Tower of Mu'mina Khātūn at Nakhichevan (1186-87);[92] (next outward) design combining 11- and 12-pointed stars;[93] (outer panel) T. des E. 48.[94] Smith's Fig. 21 (also of the Barsiyān miḥrāb) shows a design with stars of 9, 6, and 5 points. The 9-pointed star enjoys a great vogue in various combinations (with other stars of

[91] See M.B. Smith in Ars Islamica IV, esp. Fig. 27.

[92] See my photo taken from Jacobstahl -- Fig. 195.

[93] See above, chapter I, p. 24.

[94] This is my earliest occurrence of this, the most popular of Islamic designs (with the possible exception of T. des E. 1), which makes its first appearance in Egypt in 1250 and is unavoidable after that.

12, 11, 10, 6 points, etc.) in Seljūq Anatolia and makes its first appearance in Egypt in 1262-63.[95] To anyone prone to be skeptical either about the dating of the sanctuary at Barsiyān[96] or about the fact that these niche designs are from designs capable of infinite extension on a flat surface, I merely point to Mu'mina Khātūn of fifty years later.

T. des E. 89 and 69 are, of course, both 12-point star patterns, which with the Ruqayya miḥrāb is an entirely new phenomenon in Egypt; since one and perhaps both of these designs very likely were borrowed from outside, it is particularly interesting to note that the section shown from each of them for the panels of the Ruqayya miḥrāb are curiously illogical,[97] giving the impression that the carver had the pattern beforehand in this size and either was unable or unwilling to reconstruct it for the specific panel he had to fill.

No more innovations in Egyptian geometric art greet us until the very end of the Fāṭimid period, with the Mosque of Ṣāliḥ Ṭalā'i' (1160). Here the great door provides two designs we have not met before. Of them one is that of the second panel from top and bottom of the wood (back) side (both leaves). It is a combination of octagons and their ramifications and it is copied in Cairo only in modern times,

[95] See T. des E. 120, no. 2, and discussion below of early Baḥrī period.

[96] Is [6]28/[12]34 or [7]28/[13]34 rather than [5]28/[11]34 plausible?

[97] That is, not falling along the structural lines of the design; and with less than 1/4 star in the corners.

as far as I know.[98] Much more interesting is the design on the bronze (front) side of this door. This is a combination of 8- and 6-pointed stars drawn by Bourgoin as T. des E. 106. This is the only occurrence of this design I have recorded; but it relates in visual effect and constructional basis to the design on the ends of the tābūt of Umm al-Malik Kāmil in the Mausoleum of al-Imām ash-Shāfi'ī (see my drawing K-9). Perhaps Creswell's comments about the latter could apply to our door also (if we transpose the number of points in the stars, of course).[99]

Creswell seems to speak only of the larger aspects of architectural form when he argues against Persian influence in Fāṭimid architecture.[100] And on our subject, he sums up the Fāṭimid period thus: "Geometrical ornament at this time played quite a subordinate part, the familiar interlacing star pattern, which in later times had ten, twelve, or even sixteen points, is only found in its simplest form, the eight-pointed star."[101] The first ten words of the above, taken in

[98] See M.A.E. I, pl. 102. A similar but more developed design (containing also "deux en deux" eight-pointed stars) is to be seen in the upper vertical panel beside the portal of the Maghak-i Attari ("early twelfth century") at Bukhārā (see Grabar and Hill, 2nd. ed., Fig. 3).

[99] "...interlacing twelve-pointed stars form the basis of the network, but they are elongated in the direction of their width, which makes a very unsatisfactory impression; this is presumably why this experiment, so far as I know, was never repeated." (M.A.E. II, p. 74.). More discussion of this later design will follow under the Ayyūbid period.

[100] For summary, see M.A.E. I, pp. 289-90. For example, in his extended discussion on stucco miḥrābs, he makes no systematic comparison of the motifs and speaks mostly of the larger composition of the miḥrābs.

[101] M.A.E. I, p. 289.

the sense meant, we can agree with; the rest gets progressively word by word more ridiculous and I shall not waste our time and space to criticize it further.

As we have seen, geometric design in Egypt becomes more complex and richer in repertory during the Fāṭimid period. It seems to me that the evidence would suggest a rather strong Persian influence, at least in the later Fāṭimid period, specifically in the two beautiful wooden miḥrābs discussed above (which contain numerous geometric motifs which are used subsequently in Egypt). When one conjuncts the date of these two miḥrābs with the strikingly advanced nature of their designs, when compared to other datable Egyptian monuments, and with the fact that so many of the motifs show earlier Persian occurrences, one is more or less forced to conclude there was Persian influence in late Fāṭimid times, whether that influence was direct or indirect (by way, most likely, of Syria).

At the very minimum we are well prepared to say that Persia was in this period considerably more developed with respect to geometric art than Egypt.

The Ayyūbid period

Ayyūbid architecture in Egypt, like the Fāṭimid, shows relatively little usage of geometric art on the buildings themselves. The most notable geometric decoration of an actual part of a building is the beautiful entrance to the Mausoleum of Abū Manṣūr Ismā'īl (1216), where the lintel over the door is framed by a series of 37 small squares, which are

carved alternately with floral and geometric motifs (with the exception that squares 18 and 19 -- numbering clockwise -- contain a beautiful floriated الملك لله). Of the "geometric" squares, only no. 30 is not a section from an infinite pattern, it being more of a knot-motif than a truly geometric one. It would be interesting and worth-while to analyze and construct larger areas of all these patterns (for which I have not felt I had the time), but they are all of very simple type; and it seems to me that only three squares demand our attention here. The lower left and upper left squares (nos. 4 and 10 respectively) both have the pattern numbered 42 in the T. des E.; this is chronologically my second recorded instance of this design. The other design to which I would like to call attention is that in square 32 -- a pattern involving the simple six-pointed star, its constituent equilateral triangle and its complementary hexagon, but on a rectangular plan (see my drawing K-14h).

In the Ayyūbid, as in the Fāṭimid period, the more complex patterns are to be found only in woodwork. Five designs for which I have found no earlier occurrence appear in the tābūts either in or from the Imām ash-Shāfi'ī.

The earliest of these, the tābūt of the Imām himself (1178), has two such designs; but one, that on the long lower sides[102] and the ends of the sloping top, is basically the pattern of K-15, III (with smaller 6-pointed star and elongated

[102] See Hautecoeur and Wiet, pl. 51. (1).

hexagons inside the original 6-pointed star, and a regular hexagon overlaid on the junction of each three tips of the original stars). The basic pattern (i.e., K-15, III) goes back to the first century A.D.[103] The second pattern of the tābūt of the Imām (K-7), on the sides of the sloping top,[104] one might call the square-plan counterpart of T. des E. 89, being the natural product of tangent "4 en 4" 12-pointed stars. The occurrences I have listed as nos. 2 and 3 show that it was very much in the air in Mesopotamia at the time.

The tābūt of the mother of al-Kāmil (who constructed the present mausoleum and buried his mother there in 1211)[105] has on its long sides[106] the same pattern discussed above as being on the long lower sides of the tābūt of the Imām. The extraordinary design on the ends of the tābūt of Umm Kāmil is that concerning which Creswell is quoted above (foot-note 99).[107] The basic scheme of this design is tangent duodecagons on a square plan inside which are "5 en 5" 12-pointed stars with radii equaling 3/4 of the duodecagon.

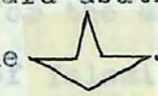
[103] See E.M.A. I, Fig. 79, for Creswell's analysis of this design from the "Domus Augustana on the Palatine".

[104] See Hautecoeur and Wiet, pl. 52, 1.

[105] See M.A.E. II, p. 74; summary of dating of various parts of the Mausoleum, p. 73.

[106] See Hautecoeur and Wiet, pls. 51, r. and 52, r.

[107] Drawn and with the section present on the tābūt outlined in my drawing K-9. For photo of this panel, see Ḥasan 'Abd al-Wahhāb, Ta'rīkh al-Masāgid, pl. 56; detail, Pauty, "Le minbar de Qous", pl. IVa.

In the interstitial areas in which the extensions of the sides of the duodecagons are allowed to create the irregular octagons each surrounded by four 5-pointed stars, the design is identical to K-8, a design which is very popular indeed. But here, in alternate interstitial areas, the designer has created for himself a dilemma by introducing an eight-pointed star of which four tips are tangent to those of the twelve-pointed stars.[108] The presence of this eight-pointed star has forced the abandonment of the outline of the duodecagons, causing 1) the surround of the twelve-point star to be elongated diagonally and 2) the awkward abutment of four tips of the eight-pointes star with the  -shapes. As far as I know, Creswell is right: it was never repeated.

Two beautiful and famous tābūt panels ffom the Mausoleum of the Imām,[109] supposedly also made around 1211, both have identical designs; "4 en 4" twelve-points on an equilateral triangle plan with six-pointed stars in the interstice. This design involves awkward tangents to three of the tips of the six-point stars; and in this precise form I have found it in only one other occurrence -- in the miḥrāb of the Mausoleum

[108] These four points of the eight-pointed star actually result from the extension of the lines of the tips of the twelve-points, circles then being struck and the other four points being constructed on the model of the original four.

[109] Islamic Museum invoice nos. 408 and 409 -- see Weill, Les bois à épigraphes I, pl. XXIII.

of Qarāsunqur (1300-01).[110]

Finally, two more tābūt panels, also from the Mausoleum of the Imām, and also presumed to be from about 1211,[111] present us with identical "first" of T. des E. 66, which in different variants I have recorded ten times.

So far as I am aware, only one of the above-discussed Ayyūbid tābūts is signed; but it is interesting that the earliest of them, that of the Imām himself, was made by an Aleppan master from a famous family of najjārīn. "Ubyad an-Najjār, known as Ibn Ma'ālī, in 574 (1178/9) made (ṣan'at and 'amilahu) a cenotaph for the mausoleum of the Imām Shāfi'ī, Cairo, now in the museum of Islamic Art, Cairo."[112] Hautecoeur and Wiet (p. 88) say of the maker of this cenotaph: "son nom permet de croire qu'il était un parent d'un des artistes alépins qui signerent la fameuse chaire de Nour el-Din à la mosquée Aksa de Jérusalem." But in fact, 'Ubayd must have

[110] See my drawing K-19-A. I have listed these two occurrences under T. des E. 92; their visual appearance causes one to think them only minor variants on 92, whereas the basis of construction is entirely different. The design only works, we might note, when the radii of the 12- and 6-pointed stars are in this precise relationship to each other, which has to be found by adjustment, as the radii have no reasonable fractional relationship either to the height or the side of the triangle of repetition, or to each other.

[111] Islamic Museum invoice nos. 2130 and 2131; see Weill, Les bois à épigraphes, I, pl. XXII. For the exact form of the design, see drawing KT-C.

[112] Mayer, Islamic Woodcarvers, p. 65--the latter part of this must be mistaken as the cenotaph in question is actually in the Mausoleum of the Imām.

been a brother of the signer of the Aqṣā minbar, Salmān ibn Ma'ālī (three other Ḥalabīs signed this minbar, which dates from 1168-69.[113] Herzfeld[114] has an extended discussion on the Aleppo school of wood and marble workers centered around the two masters, Yaḥyā al-Akhtirīnī (or al-Jibrīnī) and Ma'ālī ibn Salam (it was the latter who signed the wood miḥrāb of Nūr ad-Dīn in the Maqām Ibrāhīm in the Citadel of Aleppo). Herzfeld also cites ibn Jubayr to the effect "that Aleppo was famous for the art of its cabinet-makers, nadjdjār, and ebony workers ...".

Considering the resemblance (both in type of geometric strapwork and in the type of floral and geometric carving within the polygons) of the tābūt of the Imām to other, "Egyptian" pieces of woodwork, it would seem that close comparison of the Egyptian with the Aleppan material is in order.

While the 12th c. Persian designs discussed above could be reiterated here to show the relatively retarded state of geometric design in Egypt in the Ayyūbid period, this would seem much less à propos than a comparison with more contemporary monuments. There was apparently very little building in 13th century Persia, and what one finds when following the development of geometric design is in fact consistent with general historical opinion: Seljūqid Anatolia fell heir to the tradition of Seljūqid Persia in the sense that in the first half of the

[113] See Mayer, op. cit., pp. 48 and 63.

[114] Ars Islamica X, pp. 57 - 58.

13th century it was Anatolia that was the great center of the use (and apparently of creation) of geometric art. The mosques, madrasas, hospitals, turbes and perhaps above all, the great hans of Seljūq Anatolian architecture exhibit probably the most complex patterns ever used as actual parts of buildings. These patterns are deeply cut in the stone, they are large and prominent, and the number of different patterns is bewilderingly profuse. A certain number of the designs encountered are among those drawn by Bourgoin for his Trait; and when this is the case, we are, more often than not, thus provided with an earlier occurrence of a design later to be found in Egypt.[115]

Here I should like to discuss some early Anatolian Seljūq designs not in the T. des E. but which show something of the high development of geometric art at the time.

Almost exactly contemporary with the Mausoleum of Abū Manṣūr Ismā'īl is the hospital of Kaykāvūs at Sivas (614 to 617 H.). Framing the entrance to this hospital are two bands of geometric decoration remarkable for their complexity.[116] The outer band's pattern is one of 9-point star complexes (i.e. with surrounds of elongated hexagons, five-pointed stars, octagons, etc.) arranged on a hexagonal plan and having

[115] An extended discussion of this phenomenon will be found below in the section on the early Baḥrī period, as it is precisely at this time that these previously Anatolian designs turn up in Egypt.

[116] See Ögal, Anadolu Selçuk . . . Figs. 6 & 7.

between each six 9-point complexes a six pointed star surrounded by hexagons.[117] The inner band of the Sivas Daruşşifa portal is even more complex: here we find a combination (square plan?) of star-complexes of 14, 10, and 7 points. Two designs from Cairo one can cite as slightly analogous are T. des E. 132 (16 and 12 points, with heptagons in the interstice) and T. des E. 133 (16, 12, and 7 points); it will be seen that the former has its earliest recorded occurrence in the 1360's and the latter in the 1460's. And I must say that these two are structurally not very close to the Sivas example and that the combination of 16- and 12-point complexes on a square plan is a far easier problem than the combination of 14- and 10-pointed complexes, which latter have no numerical common denominators larger than two and therefore no common angles.[118] Perhaps closer among Egyptian examples to our Sivas design is the main side panel of the minbar of the Mosque of Abū l-ʿAlā (ca. 1485), in which 16-point stars are at the apexes of the square réseau, with 10-point stars along the sides of the square and 12-points in the center.

[117] See my comments below, under early Baḥrī Mamlūk period, about the 9-pointed star and its appearance in Cairo.

[118] In design concept this combination of 14- and 10-pointed stars rather reminds one of the 7- and 10-point combination on the tower of Masʿūd III at Ghazna (before 1114, see above, p. 155) and also of the 11-point combinations in general (although these latter are a special problem as they have an uneven number of points). Finally one might mention T. des E. 159, which combines stars of 12, 10, and 9 points, on a square plan.

One last Anatolian design we may mention here as corresponding in time with the Ayyūbid period in Egypt (although about ten years later than the Mausoleum of Abū Manṣūr Ismā'īl and the Sivas Hospital) is that framing the portal of the Konya-Aksaray Sultan Han (1229).[119] This pattern combines regular stars of 16, 12, 10 and 8 points and has incidental irregular 6-pointed stars. The only analogous design I have seen is T. des E. 61 (stars of 12, 10, 9 and [irregular] 6 points);[120] The Konya-Akseray design is on the square plan and therefore the combination of 16- and 12-pointed stars (sharing the common denominator four), whereas the Ṭaybarsīya design is "plan du trigone", with stars of 12 and 9 points (sharing the denominator three). In both designs the 8- and 10-point stars play secondary roles. Despite the difference between the two designs in plan and in star-point numbers, they are quite similar in their general structural method. And they are even more similar in their visual appearance, with their flashing, undulating, continuous-line effect in which the stars seem to be the result of the crossing of the lines; in fact, however, only the 6-point stars are resulting from lines already present. The network of apparently curving

[119] This is the design mentioned above, chapter I, pp. 6 (Sarre, Raise in Kleinasien, Fig. on p. 81) and 8 (footnote 8, concerning Ögel's inclusion of a tracing of the design).

[120] The only occurrence I have found is in the large panel in the niche of the miḥrāb of the Ṭaybarsīya Madrasa at al-Azhar (1309-10).

lines are actually the secondary factor, resulting from the extension of tips of stars struck regularly in circles.

The Mamlūk Period

As stated in the beginning of this chapter, the Mamlūk period is the most prolific for Egypt in usage of geometric design. And as we suggested there also a superficial awareness of this fact will come to anyone who has a good general familiarity with Islamic art in Egypt and who reflects on the matter. A systematic approach involves avid long-term collection and repetitive analysis and comparison and reveals startling and unsuspected facts, as well as giving the documentation for the more obvious ones. Among the latter, we may mention the quantitative preponderance of geometric design in the Mamlūk period when compared with any other. This is not at all surprising in relation to any period previous to the Mamlūk, if for no other reason than the sheer quantity and magnificence of the Mamlūk architecture left to us.[121] It is also relatively obvious to the interested eye that the percentage of the decoration on architecture (or, for that matter,

[121] Although my observations on Ottoman-period Cairene architecture will be seen as largely undocumented, it is safe to add that it also is less rich than the Mamlūk. Again, it is clear that in general the Mamlūk buildings are grander and richer than the later ones; and it is also clear that there is a decline in the number and complexity of motifs used. Very commonly the execution is markedly degenerate also, even relatively simple patterns sometimes being almost unrecognizable due to distortion in execution. This phenomenon is even to be noticed in certain late Mamlūk examples such as over the doors of the ṣaḥn of the Madrasa of Qānībāy Amīr Akhūr (1503, see my photo, Fig. 51) and on the facade of the Madrasa of al-Ghūrī (1504-05 - - see my photo, Fig. 54).

we may say also on "minor arts") of earlier periods, which is of a geometric type, is less.

What is perhaps more interesting than quantity or percentage of geometric decoration is the introduction of basically new type of designs and design-systems which characterizes the Mamlūk period. It is only natural to expect (against a backdrop of progressive development in geometric art over the millenia and centuries) that the Mamlūk period should include the appearance of new types of designs; furthermore, as the Mamlūk period marked the first time since the early eleventh century that Cairo was truly the capital and seat of a great empire, it is only natural to expect its arts to flourish.

But what close study reveals which is quite astonishing and somewhat difficult, perhaps, to explain is that this influx begins dramatically with the first major monument of the Mamlūk period, the Madrasa of aẓ-Ẓāhir Baybars.[122] The two bronze-plated doors from this madrasa which have been preserved are of the greatest historical importance. The one drawn by Bourgoin in Les Arts Arabes (pl. LXXIV) is the first occurrence of a design in Egypt containing a 9-pointed star (T. des E. 120 -- see entry 2). And the door which is now

[122] Of the five designs I have managed to find on or from the monument, none had previous Egyptian occurrences (see T. des E. 10, 120 and 171; and K-14-d and k/1). The monument provides such important evidence despite its deplorable destruction in the nineteenth century. If it were still intact (or, for that matter, his Friday Mosque, which has suffered an almost equally disastrous history) I am convinced that many more "firsts" for Egypt would be present.

at the French Embassy in Gîza is the first geometric repeating design of the pentagonal system to appear in Egypt (T. des E. 171, entry no. 7). This is obviously of tremendous significance, this introduction of a completely new system, and it demands some extended discussion.

Besides the pentagram on the northern minaret of the Mosque of al-Ḥākim (see above, under "The Fāṭimid Period"), there exists in Egypt to my knowledge only one other extant piece of art exhibiting the knowledge of five-part division, before this door. In a roundel in the center of a lobed-arch panel on the N.W. side of the interior of the Mausoleum of the ʿAbbāsid Khalifa (before 1242), is a solitary 10-pointed star.[123] It is drawn "4 en 4" and the limits of the panel extend a bit beyond the star tips, the lines of which cross and continue; but the star extensions are not delimited by a decagon as is customary in repeating patterns with 10-points drawn "4 en 4", nor is there any suggestion that this is part of a pattern. There is, in fact, absolutely no doubt about this being a solitary star;[124] nor is this similar to the Anatolian type of roundel discussed in the "List" in relation to the Mosque of aẓ-Ẓāhir Baybars.[125]

Considering the antiquity of the pentagram and that we

[123] See M.A.E. II, pl. 32a.

[124] Just as are the 5-, 7-, and 10-points from Khirbet al-Mafjar and the Mosque of al-Ḥākim (see above under discussion on al-Ḥākim).

[125] See T. des E. 68, entry 1.

have a type of 10-point star from the Umayyad period,[126] it is somewhat surprising to find that the earliest repeating pattern in this pentagonal system occurs in the eleventh century.[127] Similarly it is somehow ironic that, while it took two hundred years for the first of these pentagonal system (or ten-point) designs[128] to reach Egypt, there was an Egyptian geometer named Abū Shujā' ibn Aslam who flourished about 900 A.D. and who wrote a work entitled "On the Pentagon and the Decagon", involving the application of algebra to geometry.[129] The great espanses of time between the scientific possibility of working in a given system (theoretical discoveries) and the appearance thereof in a geometric pattern tends to support Bourgoin's contention that geometric art follows its own development independently of theoretical

[126] For both see above, under Mosque of al-Ḥākim. I do not know what method the Pythagoreans used to divide the circle into five parts, but there has been an excellent, systematic and relatively simple method since Ptolemy, who flourished in Alexandria, 139 A.D. (Almagest, Book I, Chapter 9 -- see Cajori, p. 47).

[127] See "List", introductory comments to "Famille pentagonale".

[128] The terms are in practice interchangeable. I know only one pentagonal system repeating pattern in which the only star is a "pentagram"; it is in the tympanum of the Divriğ Hospital (1228-29 -- see Ögel, Anadolu Selçuk , . ., Fig. 28) and it is quite untypical of Islamic designs in its manner of construction. For designs made up solely of interstitial matter derived from ten-pointed stars, see introduction to "Famille Pentagonale".

[129] Encyclopédie de l'Islam, (1927), Tome II (B-K), article "Handasa", p. 273.

geometry.[130]

One is able to be more assured that one has found at least one of the earlier occurrences of a pattern or a system, if one can find none earlier, if they become common thereafter and especially if correlative later developments which seem a natural result of the time elapsed can be found. These conditions are present in support of Īrān as the cradle of patterns of the pentagonal system; and the first two of them support our assertion that the system only appeared in Egypt in the early Mamlūk period.

I have just spoken of the absence of pentagonal-system patterns in Egypt before the beginning of the Mamlūk period. As for the prevalence of designs in the system immediately after Baybars' time, one can cite occurrences in the Qalā'ūn complex (T. des E. 176 and 179); Zāwiya Zayn ad-Dīn Yūsuf (T. des E. 175): Madrasa Salār and Sangar al-Gawlī (T. des E. 175); Baybars al-Gāshankīr (175); Madrasa Ṭaybarsīya at al-Azhar (187b "variant" -- which is closely related to 171); Mausoleum of Sunqur as-Sa'dī (171, 179, 187a); etc. In general, the usage of 10-point patterns is continued throughout the Mamlūk period, and while I have found some designs in this system (as in others) only, or first, in Egypt, it is premature to state that they are actually Egyptian developments, especially until a survey is done on Anatolian Seljūq designs, so many of

[130] See above, Chapter I, under discussion of Gayet's contention that the patterns came about as problems posed by Arab geometers.

which came over into Egypt, particularly in the early Baḥrī period.[131]

As mentioned above (Chapter II, p. 36), Bourgoin states that "les entrelacs tracés sur le type pentagonal sont relativement récents et se rencontrent plus particulièrement en Turquie."[132] Perhaps such casual statements should not occupy us overly; yet these few comments in this part of the Trait are the only ones even of the general type I know of in any book. As for the pentagonal system being recent, it is simply not the case, as the late eleventh and early twelfth centuries saw the birth and some of the greatest steps in the system. Patterns of the pentagonal type are indeed common and various in Turkey, particularly in the Seljūq period; but I see no evidence that any basically new developments in the system took place there.[133] Iṣfahān's North Dome Chamber (1088),

[131] See below for designs of early Baḥrī Egypt which have earlier Anatolian occurrences. Especially interesting as a possible local development is the design on the bronze "porte principale" (now unused) of the Madrasa of Abū Bakr ibn Muzhir (1479-80 -- see Comité, 1897, "Appendice" pl. IV), which is the only one of its type I have seen. It was a pentagonal system assemblage plan and combines star-complexes of 10 (drawn "4 en 4") and 20 (drawn "8 en 8") points. Except for a design in the pentagonal system which includes a kind of 20-petalled "rosette" or curvilinear star in one of the panels on the Tower of Mas'ūd III at Ghazna (see Athār-é Irān, 1936, Tome I, Fasc. II, article by Godard, Fig. 236), all other infinite patterns I have seen which include twenty pointed stars are on a square plan (see special list of twenty-pointed stars). It is provoking to reflect that it is practically simultaneous that one gets the only known example of what is also a beautiful and natural combination; I allude to the combination of stars of 9 and 18 points (T. des E. 136) in the panel of the minbar of Qijmās al-Isḥaqī; parallel thinking is evident.

[132] Trait des Entrelacs, p. 11.

[133] For rundown of earliest 10-point pattern and of the use of the polygons characteristic of the pentagonal system, see introductory comments to "Famille Pentagonale".

[134] See introductory comments to "Famille Pentagonale".

the Tower of Mas'ūd III at Ghazna (before 1114) and the palace at Tirmidh (12th c.) seem to me to constitute in their designs not only the great milestones in the pentagonal system, but the second of the three is perhaps the epitome of known usages. The only two panels from this tower which I have been able to see at all well in photographs both have designs which are based on polygonal assemblages of the system presently under consideration. One has the decagon-pentagon assemblage most basic to the system, but instead of putting simply a 10-point star in the decagon and a 5-point star in the pentagon (as does, for example, T. des E. 171, the most popular of 10-point designs), this design has tangent 7-pointed stars struck from each apex of the decagons and pentagons; the extensions of the tips of the 7-points naturally create in the pentagons 5-pointed stars and mesh with the extensions of a 10-point star struck from the center of the decagon. The other design from Mas'ūd's Tower is based on decagons in contact each at four apexes with 10- and 20-pointed stars inside the decagons and 8-pointed stars between the parallel sides of the decagons. What strikes one most about these Ghazna designs is their grand (not to say awesomely vast) scale, with great distances full of complex polygonal adjustment between star-centers.

Tirmidh provides not only the earliest example of the usage of pentagonal system polygons without stars,[134] but also provides the earliest known examples of pentagonal

[134] See introductory comments to "Famille Pentagonale".

adjustment[135] (at least of its application to designs with structural bases outside the pentagonal system -- in this discussion I will leave out designs like T. des E. 179, as it is pentagonally structured entirely).

It is clear that the usage and application of pentagonal adjustment was extended to new types of designs in Seljūq Anatolia, if only on the basis of a design of 12-pointed stars on a triangular plan with 9-points in the interstice, which is framing the portal of the Susuz Han.[136] But the pentagonally-adjusted type of design which is most typical of Egypt (more common in the 15th c. but occurring already in the end of the 13th)[137] is represented by designs like

[135] See Deniké, Arch. Orn. Cntrl. Asia, Fig. 60, and Rempel, Arch. Orn. of Uzbekistan, pl. 103, 1-4 for a design using pentagonal adjustment to create the visual effect of 6-pointed stars on two levels (empel has analysis); Rempel, pl. 96 for photo and analysis of 8-point pattern on square plan with pentagonal adjustment (but for latter device very similar to T. des E. 148) which later occurs in the miḥrāb of the Mausoleum of the Aqbughāwīya Madrasa at al-Azhar; and Deniké, Fig. 58, for yet another Tirmidh design (sq. plan, no stars as such) using pentagonal adjustment. All the examples cited here are the type of pentagonal adjustment which was so much used later, having lines extend off the sides of regular pentagons. Already in the North Dome Chamber at Iṣfahān there is a design employing octagonal adjustment (see T. des E. 31), and one with heptagonal adjustment (see T. des E. 32); and the door of the hospital of Nūr ad-Dīn at Damascus (1154) has a design in which regular five-pointed stars give a kind of pentagonal adjustment.

[136] See Ogel, Anadolu Selçuk..., pl. XXX, Fig. 57. Though this design never made it to Egypt, what is probably its ancestor did and was quite popular in the early Mamlūk period. See list of occurrences under "Khānqā al-Bunduqdārī Design".

[137] A pentagonally-adjusted design which in general layout resembles T. des E. 82 (which latter is not pentagonally adjusted) exists in the large panels flanking the miḥrāb in the Mausoleum of Aḥmad ibn Sulīmān ar-Rifā'ī (1299 --see my photo, Fig. 108).

T. des E. 22, 53, 71, 72, 107, 116, 117, 123, 124, 125, 134, 135, 148 "variant", 152 and 158. The only pre-Mamlūk precedent for this type of design known to me is that on the Mausoleum of Abū l-Qāsim at Mōṣul (mid 13th c.); this is T. des E. 123, and since it is drawn by Bourgoin, one must assume that it appeared in Egypt, though I have recorded no Egyptian occurrence.

One should perhaps emphasize that this type of design (which can be recognized visually, without understanding its method of construction) does appear so early as the mid-13th century and in Egypt by the end of that same century, for it seems sometimes taken to be typical of the late 15th century in Egypt. One can only say that designs embodying the practice are much more common in the 15th century, and that a certain subspecies in which the shapes seem even more isolated (T. des E. 117, 124, 125, 134, 152 and 168) does not seem to appear until the time of Qāytbāy. A kind of exception to this latter statement is the "148 variant" in the Aqbughāwīya Mausoleum miḥrāb.

As I have said before, the great majority of Bourgoin's material was collected in Cairo, so in one sense, the Trait des Entrelacs might be taken as a crossection of Egyptian designs; if we want to get a more specific idea of what designs are especially typical of Egypt, we may be fruitfully led if we again see Bourgoin's comments in the brief introductory text to the Trait. Immediately after his statement about the pentagonal group being relatively recent and especially typical

of Turkey, he says: "les grands et beaux entrelacs à rosettes, comme ceux des épures 68, 76, 77, 78, 110, 128, 129, 132, 137, 138, 140, etc., dont le style est si remarquable, ont pour pays d'élection l'Egypte, particulièrement, et aussi la Syrie." Anyone may check this statements reliability most obviously and literally by consulting the "List" contained in this thesis, and, of course, by looking for occurrences which would give contrary indications to what that list would indicate. But since the list is somewhat extensive and has been compiled in Egypt, perhaps a small summary of the motifs listed by Bourgoin as particularly Egyptian would be in order here.

While I have included the Baybars roundel under T. des E. 68 (which makes it no. 1) I have included there a long explanation of the similarity of this roundel to the Anatolian type; like them, it cannot be regarded as a section from an infinite pattern and thus is not 68, however much the star-complex units may resemble each other. T. des E. 68 is, however, relatively common in 14th century Egypt.

It seems quite curious that such a design as T. des E. 76 I have found in no Egyptian occurrence before one-fourth of the 15th century was gone. This is particularly puzzling as T. des E. 77 (which is identical with 76 except for being on square plan rather than "trigone") is extremely much in evidence throughout the Mamlūk period, with a design of similar structure appearing as early as 1296 (see entry no. 3).

While T. des E. 77 is one of the most popular of designs

in Mamlūk Egypt[138] (being surpassed, apparently, only by 48), and probably has more occurrences in Egypt than anywhere else, it is misleading to leave Bourgoin's statement regarding it as it stands; for it has Anatolian Seljūq (if not earlier) occurrences.

While T. des E. 78 resembles (in plan and larger aspects of shapes incorporated) 68 and 76, I have found it relatively rarely; and again, it had been around for some time before appearing in Egypt.

It is a curious fact of Mamlūk Egyptian geometric design history that some designs appear in one or several occurrences relatively close together in time, and then cannot be found again for a quite long time, or vice-versa.[139] While to some extent this may be explained by the disappearnce of monuments (including, of course, objects) and the incompleteness of the survey, the profusion of monuments in Cairo and the relative inclusiveness of the survey leave one wondering whether craftsmen or designers did not visit older monuments to pick up motifs. T. des E. 110 has a particularly spotty history, especially in light of the fact that it has three extent usages

[138] It has a close competitor in T. des E. 118, which like 77, was most common in Egypt in wood, although appearing several times in other materials; and also like 77, & 118 is clearly an importation from abroad. T. des E. 118 would seem to qualify as a "grand et beau entrelac" (Bourgoin does say "etc.") of the type under discussion; and it is interesting that the first occurrence (with reasonably solid dating) of it which I have found is on the same monument as my earliest occurrence of T. des E. 78.

[139] See for example, T. des E. 78 and K-23.

in the Ghūrī complex alone, while I have only recorded four earlier occurrences, all in Cairo, the earliest of them being one-and-three-quarter centuries before.

T. des E. 128[140] is the only design I have seen incorporating 15-pointed stars (though they are natural enough on equilateral triangle plan), and I have found no historical occurrence of it. But since it is included in the Trait, and especially since it was mentioned in this group as pertaining to Egypt, it presumably exists (or existed) there.

For the closeness and differences in structure between T. des E. 129 and 130, see the "list" under the latter, for which, with minor variations, I have found seven occurrences, all in Cairo. Among these "straight-line variants" of 130, it is curious that the earliest (that of the drum of the Mausoleum of Sunqur as-Sa'dī) by so much precedes the others; indeed it exists here at a time when 16-pointed stars are otherwise unknown in Egypt.[141] But around the door of the "edicule"

[140] Redrawn twice by Hankin, who also provides no historical information, though he does say it is taken from Bourgoin. See "The Drawing of Geometric Patterns in Saracenic Art", Fig. 39 and p. 21; and "Some Difficult Saracenic Designs. III", Figs. 1 and 2 (whole article devoted to it).

[141] Not to mention the window beside it, which has 20-pointed stars (see special list of designs with 20-pointed stars). Both these windows look old and unlike any others I have seen, except having in the centers of the stars the common small trefoil; I therefore see no reason why they should not be considered original. The next occurrence of a design with 16-pointed stars which I have noted from Cairo is in the windows on the façade of the Mosque of al-Māridānī; but for minor variation, it is T. des E. 131.

in the courtyard of the Kayseri Sultan Han is a variant of T. des E. 57, which is also very close in structure to our T. des E. 130 variants, differing in that its interstice contains an octagon and four hexagons (of the same configuration as in T. des E. 77) rather than an 8-point star complex. I am sure that had Bourgoin found this Kayseri design in Cairo, he would have considered it also as among these "beaux entrelacs à rosettes" (but for number of points, it is identical with T. des E. 77).

We must consider this enumeration of designs of large and beautiful "rosettes" on Bourgoin's part to be only suggestive, and in no sense meant to be even approximately inclusive. For it strikes one as strange that he should mention, for example, 129, 133, 137 and 138 and not mention, among others, 133 and 136, both of which have Cairene occurrences, and are particularly beautiful examples of the large star-burst type of design.

Likewise, our consideration of developments in the Mamlūk period must remain only tentative and suggestive. There is a vast amount of physical material which must be processed and digested; and this should then be coupled with intensive study of texts, which would hopefully strengthen the suggestions arising from a consideration of the basic material. My work here presented consists almost entirely of a collection and consideration of the physical evidence and the design-systems embodied in them. This unquestionably is the first step and should be continued, not only for Egypt but for the other parts

of the Islamic world. And while the collection is quite revealing by itself, its suggestions are somewhat like a house without a roof; without being capped by textual historical relation, their potentialities remain unrealized.

One suggestion that I have found in the material and repeatedly have alluded to is that of Anatolian influence on Mamlūk Egypt, at least in the early Baḥrī period.[142] This is most strongly suggested when one considers the number of designs of the Anatolian repertory which are entirely absent from Egypt up until the Mamlūk period and which suddenly appear. These designs include the following fourteen: T. des E. 6, 16a, 48,[143] 51/143, 77, 90, 118, 120, 171, 175, 176, 179; as well as KT-11 and K-14, k/1. This is not to mention K-8 and the "Khānqā Bunduqdārī Design", both of which have Armenian, not strictly Anatolian, precedents. Also, certain other less spectacular decorative motifs (such as the vertical zig-zag meander which is found in early Baḥrī miḥrābs) are of Anatolian origin.[144] One is tempted to

[142] See the first part of the section on the Mamlūk period in this chapter. By "early" Baḥrī, I would include up to about 1320, or about half the Baḥrī period.

[143] Ṣālih Nagm ad-Dīn's Mausoleum was built by Shagarat ad-Durr, so it can be considered Mamlūk.

[144] Baḥrī occurrences include the marble miḥrāb niches of: the Mausoleum of Salār (1303-04 -- see M.A.E. II, pl. 112a); the Mausoleum of Baybars al-Gāshankīr (1306-10 -- see M.A.E. II, pl. 113a); and the Mausoleum of the Madrasa of Zayn ad-Dīn Yūsuf (1325 -- see M.A.E. II, pl. 114d). For Anatolian precedents, see: carving on colonnete beside doorway, Hatun Han, Pazar (1238-39 -- see Grabar and Hill, Fig. 351); carving on torus of outside wall of Karatay Han (1320-40 -- See Grabar and Hill, Fig. 493); etc.

connect the remarkable influx of Anatolian motifs with Baybars' famous campaign; especially provocative is the fact that after defeating the Mongols near Albistan, Baybars entered Kayseri and had himself placed on the throne, during which episode "the Egyptians admired the town's public buildings ...".[145] But who knows what kind of contact results in transmission? In any case this campaign was in 1277, and both Baybars' Madrasa and Mosque were finished before this time. One expects rather a more general and repeated type of contact; at least the documentation I have managed to assemble for four more designs which are precedented in Anatolia seems to indicate such. The first Egyptian occurrences I have found for T. des E. 38, 57 (variant), 61 (variant), and 173 all fall between 1340 and 1363. Two of these (57 variant and 61 variant) are from the Mosque of Sulṭān Ḥasan, whose portal as well as its fluted stalactites (and the stalactites on the minaret of the contemporary Madrasa of Ṣarghatmish) are so remarkably Anatolian in type.

Of course, the fourteen motifs cited above as having Anatolian precedents are far from constituting all the new motifs I have noticed as appearing first in Egypt in the earlier part of the Baḥrī period. By my count (made from my "List" and drawings), I have recorded a total of forty such motifs before about 1350,[146] of which count sixteen for which I record earlier

[145] See Cahen, Pre-Ottoman Turkey, p. 288 (citing Ibn 'Abd aẓ-Ẓāhir).

[146] T. des E. 2, 6, 10, 16a, 38, 43 variant, 48, 51/143, 54, 68, 77, 78, 82, 90, 92, 93, 94, 97, 99, 100, 110, 118, 120, 130 variant, 148 variant, 161, 171, 173, 175, 176, 179, 187a; and K-8, K-10, K-14 -d & k/1, K-20 - III, K-23, KT-11 and the "Khanqa Bunduqdarī Design."

Anatolian occurrences[147] (for four of which latter I have recorded even earlier Persian occurrences). From among the above-mentioned forty, I number twelve as having earlier occurrences in various places other than Anatolia.[148] So this leaves only twelve designs from this period which, on the basis of my material, seem to stand a chance of being considered local early Mamlūk developments.[149]

On the other hand, for designs having their first Egyptian occurrence (according, again, to my list) in the entire remainder of the Mamlūk period (1350-1517), I am able to find only nine motifs for which I have recorded an occurrence earlier in another Islamic country.[150] But lest anyone think that there are fewer designs which make their first Egyptian appearance

[147] To the fourteen enumerated above as pre-1320, the extension to the year 1350 adds T. des E. 38 and 173.

[148] These are: T. des E. 2, 10, 43 variant, 54, 68, 78, 84, 148 variant and 187a; and K-10, K-14-d and the "Khānqāh Bunduqdārī Design."

[149] They are: T. des E. 82, 93, 93, 94, 97, 99, 100, 110, 130 and 161; and K-20-III and K-23. I have pointed out (under "The Ayyūbid Period") that 161 bears very close relation to the band framing the portal of the Konya-Akseray Sultan Han; and (under discussion of Bourgoin's list of "Beaux Entrelacs") the closeness of the 57 variant of the Kayseri Sultan Han to our 130 variants in Cairo. One can certainly expect to find earlier occurrences of some others of our twelve, very likely in Anatolia.

[150] T. des E: 14, 23, 33, 43, 56, 57, 61, 159 and 170. It will be seen that from these: 14 and 43 are very old (and thus likely to have had previous Egyptian occurrences); and that 33 was in Egypt in the pre-1350 period, at least in the form of the Oljeyt"u Qur'ān, as well as, possibly, the "tabouret" cited.

in the 1350-1517 period than that of 1250-1350, we must observe the following facts. By my count (again based on the "List" and any additional drawings or tracings I have made which represent distinctly different designs), I have recorded a total of one-hundred-fifteen designs which are used in Egypt in the Mamlūk period at all, whatever their place or date of first occurrence. Of these, one-hundred-two appear in Egypt for the first time in the Mamlūk period. Of this one-hundred-two, forty have their first Egyptian occurrence between 1250 and 1350, and the remaining sixty-two first appear in Egypt between 1350 and 1517. So, it is from this sixty-two that I can show only nine to have previous occurrences outside Egypt.

Thus it is clear that relatively few designs were used in Mamlūk Egypt which had also been present in Egypt in earlier periods;[151] and that in the period 1250-1350 the majority of new designs show prior occurrences outside Egypt, while after 1350, the vast majority of motifs (in a fertile period) which are making their first Egyptian appearance have not been recorded elsewhere in an earlier

[151] They are: T. des E. 1, 5, 12, 18, 25, 42, 66, 69, 89, K-6-A, K-7 and K-17 (bottom). Again, it must be reiterated that this list is not absolutely inclusive, so there will surely be a few more designs fitting into this class; but the list is most thorough for the earlier (i.e., pre-Mamlūk periods and the small number of designs from earlier times which were used in Mamlūk times is almost entirely a factor of the few designs present at all previous to 1250, and of the efflorescence thereof thereafter. And it will be seen that, but for 42, 66, 69, 89 and the variations of K-17 (see, for an example of these, KT-8), the above twelve designs count very few Mamlūk occurrences between them. Finally, it is quite curious that I have found no Circassian occurrences of so popular a design as 89.

occurrence. As I have said previously, it is highly likely that earlier non-Egyptian occurrences for a number of them will be ultimately found, if for no other reason than that my survey is by far most thorough for Egypt. But for now (and the general picture may not change with more thorough documentation in other countries) it certainly seems that beginning in the mid-fourteenth century, and reaching a climax in the reign of Qāytbāy, Egypt was the Islamic world's (it is hardly necessary to say "world" only) most fertile, creative center of geometric art. It is simply beyond the scope of this present study to adequately chart and interpret the ebbs and flows of development that the Mamlūk periods show; hopefully, however, this job will be done.

Appendix to Chapter IV: "Les Treillis"

Concerning the "treillis" which constitute a type of design which Bourgoin states to be the speciality of Persia, I can only say that (while I do not doubt Persia's providing numerous examples) I have seen from there few examples. If we discard T. des E. 16a, which would seem to belong to the type although Bourgoin does not include it as such, it would seem that Cairo is the seat of the majority and most interesting of them.

In addition to T. des E. 41, 98, 149,[152] 105 and 127, one finds two more designs of the type in Les Arts Arabes, pl. 31. In Fig. 3 is a panel in which duodecagons are tangent each along four sides, leaving a 4-pointed star in-between; besides the usual short connecting lines, a hexagon is found in the center of each duodecagon. The panel is identified as "Au Caire." Figure 4 shows a large panel (which I have not seen) identified "Mosquée Sultan Hassan", in which 12-pointed stars ("3 en 3") are disposed on an equilateral triangle plan, with 6-pointed stars between. Its underlying structure is that to be seen in K-15-III.

Another "treillis" is to be seen above a door of the ṣaḥn of the Madrasa of Ināl al-Yūsufī. It has 8-pointed stars on a square plan with octagons between (see KT-7 and my photo. Fig. 189).

[152] For none of which I have found occurrences, but presumably they were also "recueillié" in Cairo or Damascus.

Yet different from all these are the wooden windows of the façade of the Madrasa of Barqūq in the Sūq an-Naḥḥāsīn, which have 12-pointed stars on square plan with 8-points between.

Appendix to Chapter IV:
A Word on Geographical Distribution and Technical Usage

Bourgoin, in his introductory comments to the Trait, makes the statement that the same design can be transposed and worked in the most widely different manners and techniques, and that most of the designs are found thus worked throughout the whole Orient.[153] I doubt that he meant that most of the individual designs he shows are to be found in all parts of the Muslim East, but rather that in a general sense, throughout any design's geographical spread, it may be found in a diversity of materials. Our "List" gives a striking confirmation of this observation; of designs for which several occurrences are given, none is limited to a given technique. It is true that certain designs are especially popular for certain kinds of application. For example, in Anatolia a tremendous majority of minbars have as their main side panel T. des E. 48. This design is also (if rarely) used on Cairene minbars; but for the latter, it is T. des E. 77 that is the most popular. Now the reason for the popularity of these two designs for minbar sides (in addition to their beauty and relative simplicity) is that they are on a square plan, which allows the convenient and eye-pleasing forty-five degree angle of the minbar side to cut the stars exactly in the center. Of all minbars

[153] p. 12; see Chapter II, p. 36.

I have seen, only three have hon-square-plan designs; they are all three in Anatolia.[154] The general principle of the suitability of the design to the area to be covered is one which is almost invariably respected and implemented in Islamic art.

[154] The minbar of the Ulu Cami at Divrig (dated 1240/1 -- see Mayer, Islamic Woodcarvers, p. 29; for photo see Oral in Vakiflar Dergisi V. Figs. 14 and 15) maintains the usual angle of a minbar's side, but has an equilateral-triangle-plan design, which means that the stars are terminated in odd and arbitrary places; the minbar of the Ivez Pasha Cami in Manisa (893 H., it seems -- see Oral. op.cit., Fig. 40) maintains also the usual angle, even though it has a pentagonal system design! This design relates to T. des E. 171; and while the craftsman has managed to frame it symmetrically, the effect is also poor. On the other hand, the maker of the Çorum Ulu Cami minbar (687 H. -- see Oral, op.cit., Fig. 24), using a triangle-plan design, has chosen to have his stars cut in the center, so the rail is at an angle of thirty degrees to the floor, also not a happy solution.

GLOSSARY

A few terms which I have been forced to use in the discussion of the structure of the designs should perhaps be explained here. A more full explanation of these borrowed from Bourgoin as well as fuller understanding of the technical discussion, can best be had by close study of the first part of Bourgoin's Les Arts Arabes.

1. Basic Structure. This term is largely self-explanatory. In my usage, it means that a design has the same réseau (see entry below) and general proportions but somewhat more important difference than "variation" (see below).

2. Complex (star complex, 12-point complex, etc.). This term has generally been applied to the type of star which has elongated points and is surrounded by a complete "corona" of elongated hexagons (see drawing ii-6).

3. "Drawn 'cinq en cinq' with twelve-part division," etc. Phrase taken over from Bourgoin as more economical than any I could come up with in English. For best explanation, see drawing ii.

4. Interstice. In the most general sense, the area between the major stars. This is usually the central area of the polygon forming the réseau, and is itself often composed of a star or star-complex (see, for example, the nine-point complexes in T. des E. 120).

5. Pentagonal adjustment. Translation of Bourgoin's "ajustement pentagonale". He says in the introduction to Le Trait des Entrelacs (p. 10): "Un entrelacs rectiligne

déterminé peut être modifié par ajustement, c'est-à-dire par l'introduction d'une figure qui, toute secondaire qu'elle est, n'en change pas moins profondément l'inclinaison des lignes du thème principal...".

The most usual method of pentagonal adjustment is to establish the réseau, divide the space surrounding the star center in the required number of equal parts, and once the desired size of the star is determined, strike pentagons on the radii at the proper distance from the center and extend the lines of the sides of the pentagons. These extended lines often meet lines extended from inside the star or star complex. As implied by Bourgoin in our quotation, the adjusting polygon need not be a pentagon, and the earliest examples I have found are octagonally and heptagonally adjusted (T. des E. 31 and 32 -- see discussion of pentagonal adjustment in relation to early Baḥrī Mamlūk period, Chapter IV).

6. Réseau. Another term taken from Bourgoin for economy's sake. As implied by the term, this is the basic network of polygons at the apexes of which the circle for inscribing the stars are struck. This réseau-structure can be "semblable", i.e., regular polygons such as equilateral triangles or squares or rectangles of which a single shape makes an infinite pattern; or it may be an assemblage of different polygons, such as octagon/square, hexagon/square/triangle, etc. There are also designs in which no calculable basis is practicable as a réseau, and the structural relationship, the angles of the polygon(s) of the réseau are developed by extension of the radii of one or more initial stars or regular polygons (see

designs of "Familles" "Pentagonale", "Heptagonale" and my drawing K-21).

7. Variant. Term employed to show that a given design is visually or structurally similar to another. As this is a rather imprecise bit of terminology, there is customarily reference to an analytical drawing, mine or otherwise, of the variant (see "148 variant", "187b variant" etc.).

8. Variation. Contrary to "variant", "variation" I have used only to show that a minor difference exists between the design of the art object and the precise form of the analytical drawing. This usually involves the presence or absence of optional lines which do not change the structure at all. As "variation" or "minor variation" I have often designated change in the interiors of stars, while in other cases I have omitted mention of such changes.

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