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Pattern Power: Textiles and the Transmission of Knowledge

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Fig.1. Wall painting, Afrasiyab, ambassadors wearing tailored garments of silk patterned with pearl roundels and ogival forms bearing animal motifs. Central personage appears to be proffering a bolt of silk patterned with pearl roundels.

One of the most vexing problems in textile history generally, and in the history of early Islamic textiles in particular, is the lack of any reasonable explanation for the extraordinary breadth and geographic span of textiles with design motifs arranged within a lattice framework of tangentially placed circular borders often with pearl roundels. The group includes both figural silks and their representation in other media (fig. 1).[1] As for the pattern-woven textiles that comprise this group, they are found in a wide variety of contexts spanning a geographic arc from Japan to Europe across Asia, the Middle East and Egypt (figs. 2-9). The textiles, and their representations in other media, display a diverse body of figural and non-figural imagery, yet the images share a sufficient set of features that their consideration as a group seems justified.

[1] Michael Meister, The Pearl Roundel in Chinese Textile Design, *Ars Orientalis* 8 (1970), 255-67; Carol Bier, *Sasanian Textiles: A Critical Review*, MA Qualifying Paper, New York University, Institute of Fine Arts, 1977; Bier, Textiles, in P. O. Harper, *The Royal Hunter: Art of the Sasanian Empire* (New York: Asia Society 1978), pp. 119-40; Lorna Carmel, *An Exploration of a Textile Pattern: Pearl Roundels Joined by Smaller Pearl Discs*, MA Thesis, University of Maryland, 1990.

Another problem related to the transmission of arts and ideas along what later became known as the Silk Road is the origin of the drawloom and the spread of its technology.[2] The development and dissemination of this technology must antedate the distribution of these pattern-woven textiles. This latter problem pertains to issues of technology and its applications, which offered a recognized potential for commercial advantage.

Fig. 2 (left). Silk, compound weave, winged horse, excavated at Antinoë, Egypt. Musée du Louvre, Paris (Gu. 1138).
Fig. 3 (right). Silk, compound weave, boar's head, excavated at Astana, New Delhi Museum.

These two vexing problems may ultimately be related. But the former problem, that of the distribution of patterned silks in weft-faced compound weaves (figs. 2-9), often with a high degree of stylization of animal or figural motifs, may more readily be considered in terms of aesthetic preferences than technology. These textiles already indicate a firm and unqualified understanding of the potential for pattern-weaving, yielding an aesthetic of repetition that is enmeshed with mechanical means of pattern making. The visual aspects of these silks in which the pearl roundel is a common framing device for overall repeat patterns relate them to then contemporary mathematical ways of thinking. The silks represent to an unprecedented extent the doubling and quadrupling of design elements internal to the framing roundels (figs. 4, 5 and 9).[3]

Before we begin to address these two interrelated problems, a cursory glance at the imagery present may be useful. Within the framework of roundels, individual motifs of animals or animal heads include both the fantastic and the real, from single or paired horses, goats, lions, boars, ducks, and a variety of bird species to winged horses and the

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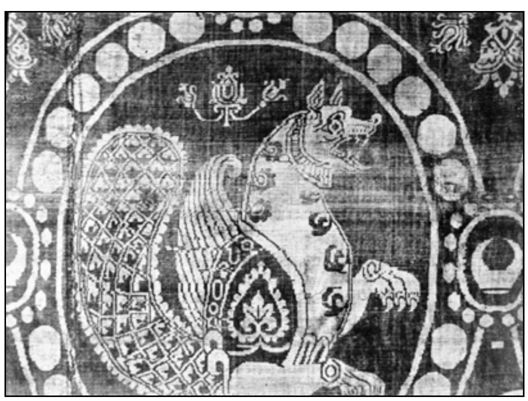
[2] John Becker, *Pattern and Loom: A Practical Study of the Development of Weaving Techniques in China, Western Asia and Europe* (Copenhagen: Rhodos International 1987); Rahul Jain, The Indian Drawloom and its Products, *The Textile Museum Journal* 32-33 (1993-94), 50-81; Anna Muthesius, *Byzantine Silk Weaving AD 400-AD122 (Vienna: Fassbaender 1997), 2, 19-26.*

[3] For early hints of Sogdian (rather than Sasanian) attributions for the representation and doubling of highly stylized animals, see Dorothy Shepherd and W. B. Henning, Zandaniji Identified? In *Aus der Welt ker Islamischerkunst: Festschrift fur Ernst Kuhnel* (Berlin: Gebr. Mann 1959), 15-40 and Dorothy Shepherd, Zandaniji Revisited, *Documenta Textilia: Festschrift fur Sigrid Muller-Christensen*. Ed. Mechthild Flury-Lemberg and Karen Stolleris. (Munich: Deutscher 1981), 105-22; for the premonition of Central Asian attributions, see also, see E. H. Peck, The Representation of Costumes at Taq-i Bustan, *Artibus Asiae* (1969) 31/2-3, 101-25.

mythical *senmurv* (figs. 6 and 7).[4] In several textiles human figures are represented, depicted as hunters mounted on horseback. The representations are often stylized, exhibiting a predilection towards geometricization of shapes. Pearls, gems, cabochons, crescents, disks, and a few abstract stylized forms are also present.

Figs. 4, 5. Silk, compound weaves, paired lions,, Sens Cathedral (left), Musée Lorrain, Nancy (right).

This group is also distinguished by the particular technical features of compound weave structures. In particular, weft-faced compound structures utilize single or paired warp sets with plain weave or twill binding systems. The textiles have survived in an extraordinarily wide range of disparate places: some are preserved in European church treasuries, some find themselves today in museum collections in Europe and North America; others were excavated in Egypt (fig. 2), the northern Caucasus (fig. 7), India or western China (fig. 3). Representations of textiles similar in style and pattern were painted on the walls of palaces and caves in Central Asia (figs. 1 and 14). Still other pattern-woven textiles show strong stylistic and technical dependence on this group and are preserved in the Shosoin (fig. 7) and Horyuji (fig. 8) treasuries in Japan.[5]



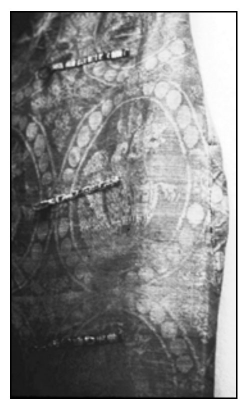


Fig. 6 (left). Silk, compound weave, senmurv, Victoria & Albert Museum, London (8579.1863).
Fig. 7 (right). Silk caftan, compound weave, senmurv, excavated at Moshchevaya Balka in the Caucasus.

[4] See Bier, *Sasanian Textiles: A Critical Review*, and Carmel, *Textile Pattern: Pearl Roundels*; see also P. O. Harper, The Senmurv, *The Metropolitan Museum of Art Bulletin* (November 1961), 95-101 and Krishna Riboud, A Newly Excavated Caftan from the Northern Caucasus, *Textile Museum Journal* 4/3 (1976), 21-41.

[5] See Bier, *Sasanian Textiles: A Critical Review*, and Bier, Textiles.

What factors may have led to this extraordinarily broad and early distribution of luxury silk textiles, which are visually related to one another, but which seem to resist standard categories of developmental relations?

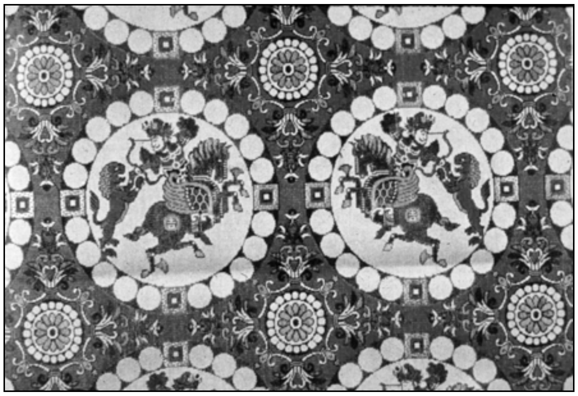



Fig. 8 (left). Silk, compound weave, mounted hunter on winged horse, Shosoin, Japan.
Fig. 9 (right). Silk, compound weave, mounted hunters on winged horses, Horyuchi, Japan.

There are several ways to approach these two interrelated problems. In analyzing the silks, one may examine weave structures to isolate discrete groups.[6] Fabric names such as samite and lampas, although somewhat confusing, have been used to designate textile groups distinguished by sets of warps and warp functions.[7] Or one may attempt to define stylistic categories, interpreting or ascribing different centers of manufacture.[8] For each of these efforts, more work is needed and questions of dating and attribution remain unresolved.[9] Another approach is to examine the systems of repeat, which can be addressed either visually or in terms of drafting the weave for the loom set up. In using a drawloom in which the pattern harness is distinct from the structure harness, weaving is relatively easy; dressing the loom is the hard part.[10] The dressing of the loom includes not only tying the warps, but also preparing the *naqsh*, the moquette in which the pattern repeat is effectively programmed. The latter approach defines the system of repeats specifically in relation to technology.[11]

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[6] Nancy A. Reath and Eleanor B. Sachs, *Persian Textiles and their Techniques from the Sixth to the Eighth Centuries including a System for General Textile Classification* (New Haven: Yale University Press 1937); Milton Sonday, Pattern and Weaves: Satin Lampas and Velvet, in *Woven from the Soul, Spun from the Heart*, 57-83, ed. C. Bier (Washington: The Textile Museum 1987); M. M. El-Homossani, Double-Harness Techniques Employed in Egypt, *Ars Textrina* 3 (1985), 229-268.

[7] Sheila Blair and Jonathan Bloom, *Islamic Arts* (London: Phaidon 1997), 230-31; see also, Sonday; Pattern and Weaves.

[8] Phyllis Ackerman, Textiles through the Sasanian Period, *Survey of Persian Art* (London and New York: Oxford University Press 1938), 681-715.

[9] As acknowledged in the more recent work of James C. Y. Watt and Anne E. Wardwell, *When Silk was Gold: Central Asian and Chinese Textiles* (New York: The Metropolitan Museum of Art and the Cleveland Museum of Art 1997); Sheila Blair, Jonathan M. Bloom, and Anne E. Wardwell, "Re-Evaluating the Date of the 'Buyid Silks,'" *Ars Orientalis* 22 (1993), 1-42.

[10] Carol Bier, *Persian Velvets at Rosenborg* (Copenhagen: Rosenborg Palace 1995), 14-17.

[11] Louisa Bellinger, Repeats in Silk-Weaving in the Near East, *Textile Museum Workshop Notes*, 24 (1961), 1-4.

A related approach is visual rather than technical, observing differences in the manipulation of motifs or in treatment of the visual elements, which comprise a design that is repeated to form the pattern.[12] One may distinguish, for examples, motifs that are essentially asymmetrical and repeated (fig. 8), from motifs that are symmetrical and repeated (figs. 4, 5). Then, there are motifs that themselves are created by repetition within the whole, and motifs that are manipulated to create a new whole that is then repeated. Among the most complicated are patterns in which symmetry is implied, but when analyzed, the system of repeats is considerably more complicated than at first meets the eye (fig. 9). In an asymmetrical motif, there is no subdivision of the unit that is repeated. In the case of a symmetrical motif, however, the motif comprising the design unit can be broken down visually, if not technologically, into component parts that are equivalent to one another and treated symmetrically to produce the whole.[13] In contrast, an asymmetrical motif must be treated as a whole, but it can be manipulated and reproduced to create different patterns, depending upon how it is manipulated mechanically. The mechanical repetition that produces the pattern, of course, is what affects the visual results that we perceive.

The approach that I wish to take up here distinguishes textile patterns from the technology that has produced them.[14] This is conceptually quite simple when it is a question of surface design, a design applied using a technology that is entirely a separate set of processes from those used to produce the textile. Examples of such distinctions would include printed fabrics, embroidery (fig. 10), and appliqué. This is a more complicated proposition, however, even with simple structures such as tapestry (fig. 11), where design and pattern are effected during the process of weaving, with different colored yarns inserted as weaving progresses to create discontinuous wefts that are basic to the fabric structure. More complicated conceptually is the effort to segregate the pattern from the textile when the pattern itself is effected mechanically such that the pattern is integral with the textile.

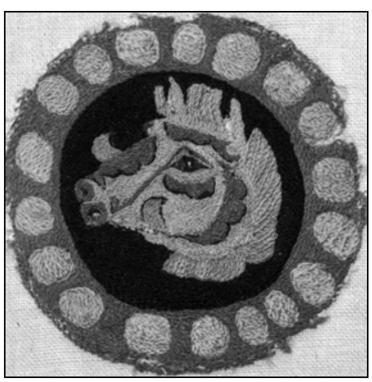
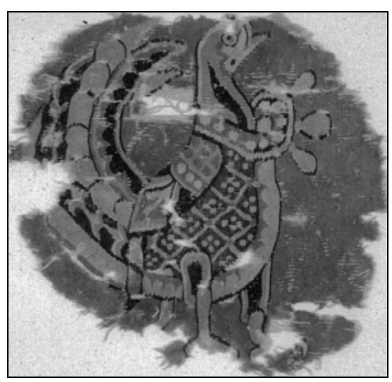

Fig. 10 (left). Embroidery, wool on linen, boar's head, The Textile Museum, Washington, DC (3.304).
Fig. 11 (right). Tapestry, wool, bird, The Textile Museum, Washington, DC (73.724).

[12] Bier, *Sasanian Textiles: A Critical Review*, and Bier, Textiles.
[13] Carol Bier, *Symmetry and Pattern: The Art of Oriental Carpets*, http://mathforum.org/geometry/rugs/ (1997), accessed 10 November 2004.
[14] An ontological distinction initially advanced in a paper I presented at the University of Michigan in 2003, Patterns in Time and Space: Technologies of Transfer and the Cultural Transmission of Mathematical Knowledge across the Indian Ocean, *Ars Orientalis* 34 (in press).

As we consider this group of textiles with a repeat pattern set within a lattice framework, there are certain curiosities or connections to which I wish to draw to your attention. Although the visual relationships are clear, the cultural contexts in which these textiles are found are diverse and perplexing as to their relationships. While the cultural origins of the fabrics remain uncertain, there are several points of comparison that may lead to general conclusions. A generic type of silver dirham (fig. 12) bears an unlikely similarity to several of these textile patterns.[15] Circular in form, many such coins of late Sasanian and early Islamic date, bear a ruler portrait on the obverse, with various symbolic forms on the reverse; surrounding both the ruler portrait and the symbolic imagery is often one or two or three annular rings and the representation of a star and a crescent, often repeated four times. The repetition of the star and crescent at four cardinal points on the coins visually relates to the common use of these symbols on the textiles in question. If one lays out a pattern of dirhams (fig. 13), side by side, simply by repetition, the resemblance is, indeed, quite extraordinary, but for the double sets of stars and crescents created by the lack of overlap in the coins, a doubling that seems to have been accommodated by adjustment in designing the textile patterns (figs. 1, 2 and 6).

The visual relationship to coins was not lost on contemporary observers: Gorgani, a poet of the mid-11th century, alluded to such effects when he wrote about the scattering of dinars and drachmas on a patterned textile "from the surface of the arched sky" ["glittering Canopus and Jupiter, have shed dinars and drachmas as on a *parand* from Shushtar"].[16] The relationship of coins and pearl roundels with stars and crescents is likely more than just a coincidence of visual similarity, more even than visual allusion or reference, but rather a visual reification of mathematical thinking.

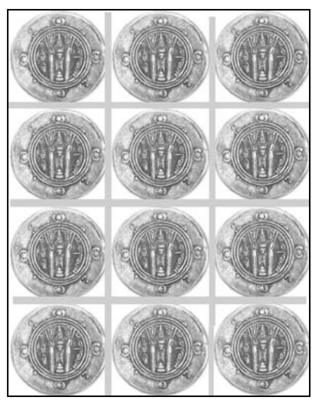

Fig. 12 (left). Arab-Sasanian silver dirham.
Fig. 13 (right). Pattern made with silver dirhams.

Under Abbasid patronage, centered in Baghdad, the period from the 8th into the 11th century was extremely fertile for the development of mathematical thought. This was the age of al-Khwarezmi, al-Kindi, al-Farabi, Omar Khayyam, Al-Buzjani and al-Biruni, key figures in an age of extraordinary patronage that supported scholarship.[17] Major works from the Greek corpus of mathematical, scientific and philosophical writings were

[15] R. Göbl, Die Numismatik als Quelle zur Kunst der Sasaniden, der Kushan und der Iranischen Hunnen, *Bulletin of the Asia Institute*, NS 1 (1987), 65-79.
[16] A. S. Melikian Chirvani, *Parand* and *Parniyan* Identified, *Bulletin of the Asia Institute* 5 (1991), 175.
[17] J. L. Berggren, *Episodes in the Mathematics of Medieval Islam* (New York: Springer-Verlag 1986).

translated into Arabic.[18] And for the first time, there was a synthesis of the heritage of Greek geometry and Indian arithmetic, including the acknowledged introduction of the base 10 system and the use of zero, explorations of arithmetic by new means of calculation and computation, advanced developments in trigonometry, and the introduction of algorithms and algebra.[19] This was a period when geometric solutions were sought to solve algebraic problems, and algebraic solutions were sought to solve geometric problems.

While this may not sound particularly relevant to textiles, or these textiles in particular, let me explain two factors that I think are especially significant. The first is that many computations could be demonstrated visually by means of textiles as a planar surface on which systems of linear repeats exemplify the arithmetic functions, squaring and extracting square roots, as well as halving and doubling. Secondly, the seminal work of al-Khwarezmi, called *Al Jabr wa'l Muqabala*, was later translated into Latin, but no equivalent for the word *al jabr* could be found – hence, algebra! The concept was not yet known. Al-Khwarezmi wrote his book on algebra in the manner of a sequence of problems.[20] Many of the problems use dirhams, silver coins of the Islamic realm, for the unit of calculation. He suggests laying them out and counting them. The dirhem itself is his exemplary unit of measure. Curiously, the Latin translation[21] uses the word dragma, rather than "unit." The prospective relationship of coins and textiles thus potentially becomes clearer.

To strengthen such a connection, the geographic and temporal span of the use of the star and crescent as imagery on late Sasanian and early Islamic coins coincides approximately with the localized appearance of such textiles. Such coins, with star and crescent at each of three cardinal points (the fourth point reserved for the ruler's crown), first appear in the regular issues of the Sasanian king Kavad I (488-497 and 499-531).[22] This feature continues to be used by successive Sasanian kings, sometimes with the use of a fourth star and crescent at the top of the coin.[23] The feature persists in Arab-Sasanian coinage, which still utilizes Sasanian imagery (fig. 12). This includes the coins struck under the suzerainty of Umayyad governors in Iran, and extends into the Abbasid period.[24]

Typically, the motif of star and crescent is positioned at four cardinal points on the reverse of the coin – top and bottom, right and left such that when a batch of coins are tight-packed in a square grid arrangement, these images occur at the tangential points of the circular coins (fig. 13). Such a layout, perhaps coincidentally, is, of course, visually

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[18] Dimitri Gutas, *Greek Thought, Arabic Culture: The Graeco-Arabic Translation Movement in Baghdad and Early 'Abbasid Society (2nd-4th/8th-10th centuries)* (London: Routledge 1998).

[19] Roshdi Rashed, *The Development of Arabic Mathematics: Between Arithmetic and Algebra* (Dordrecht, Boston, London: Kluwer Academic Publishers 1994).

[20] F. Rosen, ed. and tr., *The Algebra of Mohammed ben Musa* (London: Oriental Translation Fund 1831).

[21] Barnabas B. Hughes, *Robert of Chester's Latin Translation of al-Khwarizmi's* al-Jabr (Stuttgart: Franz Steiner Verlag 1989).

[22] R. Göbl, *Sasanian Numismatics* (Braunschweig: Klinkhardt & Biermann, 1971), Table X.

[23] Göbl, *Sasanian Numismatics*, Tables XI-XIII.

[24] E-mail from Michael Bates, Curator of Islamic Coins, American Numismatic Society, Sept. 28, 2004.

parallel to that of a bolt of cloth patterned with pearl roundels, with smaller roundels at tangential points (fig. 1, center). A further parallel is suggested by the framing device of the annular ring of the coins and the pearl roundel in the textiles. As to the question of coincidence, if one plots the location of mint towns where these coins were struck, the geographic span is comparable to the locations where textiles with pearl roundels are represented in wall paintings at Afrasiyab (a suburb of Bukhara), Varakhsha, and Panjikent.[25]

The temporal span of the coins is also relevant to the textiles; the star and crescent first appear singly in the coins of Sasanian royalty. Later kings replicated the image, placing it in three locations, the fourth in association with the king's headgear, which penetrates visually beyond the annular ring. After the fall of the Sasanian empire, Arab-Sasanian coins perpetuate the quadripartite placement of this image, as do coins of the shorter-lived dynasties of the Ispahbads of Tabaristan who began minting such coins in 711, the Saffarids, Tahirids, and Samanids.[26] Thus, the temporal range extends from the 6th century at least through the 8th century. In addition to the geographic and temporal synchronicity of the coins and the textiles, one may also recognize that both these coins and silk textiles with pearl roundels bear images that draw upon images associated with Sasanian royalty.[27]

In relation to these patterns, let us consider the concept of algorithm, which was also introduced by al-Khwarezmi. The very word *algorithm* is itself a Latin-based corruption of his name. A process that is repeated again and again is known as an iterative, or reiterative, process. This is an algorithm. Broadly defined, an algorithm is "an interpretable, finite, set of instructions for dealing with contingencies and accomplishing some task which can be anything that has a recognizable end state, end point, or results for all inputs."[28] Basically, the *naqsh* that is prepared for pattern-weaving at the loom defines an algorithm for the repeat of a unit, the unit being the design that is to be repeated to form the pattern. Reflecting back on a group of theological philosophers in Baghdad and Basra, the Ikhwan al-Safa, "The whole scheme of creation and generation resembled the generation of numbers from one,"[29] just as a pattern is created by the manipulation and repetition of a design unit.

Finally, let me return to the notions of geometry and algebra, and their relationship during this period of intensive mathematical development. In his *Ihsa al-'Ulum* (*Enumeration of the Sciences*), the philosopher, al-Farabi, who studied both mathematics and music, describes two sciences of arithmetic, practial arithmetic and theoretical arithmetic, addressing the abstract concept of "number" itself. He says that practical arithmetic inquires into numbers insofar as numbers are fixed to things numbered, such as

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[25] For representations in paintings, in the Hermitage, Petersburg, see Aleksander Belenitsky, *Central Asia*, tr. James Hogarth (London: Barrie & Rockliffe, The Cresset Press 1969), pls. 136-38, 142, and 154-89 (Pendzhikent); pls. 139-41 and 142-54 (Varakhsha).

[26] C. E. Bosworth, *The Islamic Dynasties: A Chronological and Genealogical Handbook* (Edinburgh: University Press, 1967).

[27] Bier, Textiles.

[28] http://encyclopedia.thefreedictionary.com/algorithm, accessed 7/13/04.

[29] Ian Richard Netton, *Muslim Neoplatonists: An Introduction to the Thought of the Brethren of Purity (Ikhwan at-Safa')* (London: George Allen & Unwin 1982), p. 34.

men, horses, dinars, or dirhams. He says that this is the arithmetic that people use in the commercial transactions of the market and the city. In contrast, he describes theoretical arithmetic as inquiring into numbers in the abstract, insofar as they are separated in the mind from bodies. In this way, one may study everything that happens to numbers in their simple essences without mutually comparing them, for example being even or odd, and "everything which happens to them when they are mutually compared, for example: their being equal; or one being more than another (i.e., their being unequal); or one number being a part or parts of another number, or double it, or equal to it with the addition of a part or parts; or like numbers being proportional or not being proportional, similar or dissimilar, commensurable or incommensurable. Furthermore, theoretical arithmetic inquires into what happens to numbers upon addition and their resulting sum, their subtraction and resulting difference, their multiplication, and their division. This is like numbers being squared or representing surfaces or solids, or being perfect or imperfect. Thus theoretical arithmetic investigates all of these things and whatever happens to numbers when they are mutually compared. It teaches how to find [unknown] numbers from known ones, and, in short, every way of finding numbers."[30]

Now, all of this is visually evident in the patterns of these textiles in which the system of repeats comprise a square lattice composed of units that are repeated. The notion of one, plus one, plus one is now known as the successor function.[31] This represents the essential nature of a pattern that exhibits symmetry. The unit is spatial; thus, geometry (i.e. relationships among shapes) is emergent in the process of pattern-making. Most of us certainly take the successor function for granted in our daily lives, if we haven't lost it to memory entirely, but the conscious awareness of these aspects of pattern were new in mathematical thinking at the time of al-Khwarezmi. They would have led to habits of mind that eventually led to the understanding of number theory and pattern theory, and an appreciation of visual mathematics as it is understood today.[32]

In conclusion, what is it that we are dealing with when we consider these several groups of patterned textiles, found in disparate locations, but likely related geographically and temporally in cultural origin? They share a visual layout of images set within a square lattice of tightly packed circles. They share the use of a means of mechanical repetition, which links the images to a textile technology. We are also dealing with ideas, expressed both at the artistic level and at the technological level. And we are dealing with the transmission of these ideas across time and space from the Sasanian period well into early Islamic periods – broadly speaking from at least the 6th century into the 10th

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30 Kushyar ibn Labban, *Principles of Hindu Reckoning*, translation with introduction and notes by Martin Levey and Marvin Petruck (Madison: University of Wisconsin 1965), p.x.

31 Victor J. Katz, *A History of Mathematics: An Introduction*, 2nd ed. (Reading, Massachusetts and Menlo Park, California: Addison-Wesley 1998), 736-37. I am indebted to Akeel Bilgrami for drawing my attention to the relationship between Peano's successor function and patterns.

32 The relationship between mathematics and modularity in Islamic arts of Iran based on the work of a mathematician, al-Buzjani, has been recently addressed by Reza Sarhangi, Slavik Jablan, and Radmila Sazdanovic, Modularity in Medieval Persian Mosaics: Textual, Empirical, Analytical, and Theoretical Considerations, in *Bridges: Mathematical Connections in Art, Music, and Science*, ed. R. Sarhangi and C.Séquin (Bridges Conference Proceedings, 2004), 281-92, and earlier by Alpay Özdural, On Interlocking Similar or Corresponding Figures and Ornamental Patterns of Cubic Equations, *Muqarnas* 13 (Leiden, 1996), 191-211.

century. Within the relationships of arts and ideas, we may observe appropriation and acculturation, as evinced in coins, textiles, rock reliefs, and wall paintings (fig. 14).

Fig. 14. Wall painting, Qizil, with courtiers wearing tailored garments with patterns in pearl roundel framework, Berlin.

These textiles and their representations manifest the transmission of arts and ideas along the northern route of the Silk Road, even if we do not yet know exactly how to interpret this. We can only speculate from the primacy of the cloth. But what is clear to me as one who studies pattern, there is a power here, not just in the visual aspects of repetition, and the repeat of a unit or motif that is repeated, but in the very nature of its repetition, the placement of one plus one plus one of whatever the unit, and its additive qualities within the cloth. This additive function is mechanically achieved once the loom is dressed and the *naqsh* tied up. As weaving progresses, materials and process combine to form a spatial dimension within which geometry is emergent. The spatial relationships of the shapes woven provide graphically the means for mathematical calculation, possibilities for understanding all of the arithmetic functions – addition, subtraction, multiplication and division – as well as more advanced computational mathematics including halving and doubling, squaring and extracting square roots. One may also count odd numbers, recognize series, and engage in other forms of combinatorics. Even in folding the textile, one exercises mathematical processes and experiences, if not fully consciously, geometric qualities of the cloth.

In short, within each of these textiles lies the heart of what was then contemporary mathematical thinking visually expressed. Could it be that such patterns, once knowingly recognized as such, profoundly affected the processes of their reception as luxury objects? To judge by the quality of materials and their lustrous appearance, these were expensive textiles reflective of the highest wealth and status; to judge by their compound weave structures and the complexity of the figural patterns integral with the weave, these textiles represent the epitome of technical proficiency in their time. The breadth of their distribution and their presence in European church and Japanese temple treasuries suggest even more than rarefied appreciation. One might suppose that these patterned textiles carried not only visual impact but also an intellectual fascination for several reasons. The complexity of their designs was no doubt appreciated; perhaps they were even admired for their technological prowess. Visually they bear imperial allusions to Sasanian royalty, wealth, and empire. The underlying reason for their global impact, however, might well have been the centrality of pattern, with its newly recognized potential to convey arithmetic, algebraic, algorithmic, and geometric functions.