

Spiral patterns on the Neolithic pottery of East Asia and the Far East

Irina Zhushchikhovskaya¹, Olga Danilova²

¹ Institute of History, Archaeology and Ethnology of Peoples of the Far East,

Russian Academy of Sciences, Russia, irinazh@mail.primorye.ru

² Vladivostok State University of Economics and Services, Russia

ABSTRACT – *The paper focuses on the investigation of East Asian and Far East Neolithic spiral patterns, with the application of some mathematical principles. The basis of the research is published data on pottery assemblages from Japan, Eastern China, and the Amur River basin from the 6th to the beginning of the 1st mil. BC. We suggest a descriptive order of spiral patterns based on the typology of spiral figures used in geometry. This approach permits us to see the regional and cultural diversity of Neolithic spiral patterns within the research area.*

IZVLEČEK – *V članku se ukvarjamo z matematičnimi principi vzhodnoazijskih in daljnjevzhodnih spiralnih vzorcev. Raziskava temelji na objavljenih zbirih lončenine iz Japonske, vzhodne Kitajske in območja reke Amur od 6. do 1. tisočletja p.n.š. V članku predlagamo opis in razvrščanje spiralnih vzorcev na podlagi tipologije spiral v geometriji. Skozi ta pristop lahko opazujemo regionalno in kulturno raznovrstnost neolitskih spiralnih vzorcev na študijskem območju.*

KEY WORDS – *East Asia and Far East; the Neolithic; pottery; spiral patterns; spiral as geometric figure*

Introduction

In many regions, the Neolithic and Bronze Age saw the flourishing of curvilinear ornamentation in decorative art – in particular, in pottery decoration. One of most widespread motifs was the spiral, which in its various techniques, configurations and compositional derivations, appeared on ceramic vessels in Central and Mediterranean Europe (Bogucki 1995; Manson 1995), Northern Africa (Spenser 1997), East Asia and Far East (Chen Chunhe et al. 1995; Kobayashi 2004; Okladnikov 1981; 1984).

In publications considering prehistoric, ancient and traditional decorative arts, the description and systematization of spiral patterns are usually suggested in general and approximate terms. Usually, spiral figures are identified as certain visual images and symbols, such as 'S-shaped figure', 'C-shaped figure', '8-shaped figure', 'ε-shaped figure', 'running wave pattern', 'volute pattern', 'weather horns pattern', and

'scroll design' (Ivanov 1962.347, 349, 353; Kahsina 1977.138–140; Kyzlasov and Korol 1990.22, 49, 53; Kobayashi 2004.43, 48; Myl'nikova 1999.61; Shepard 1985.255–305; Simonov 1995.32–34). In terms of semantics, the spiral pattern is associated with ideas of movement, dynamics, change (Malyavin 2001.484; Rybakov 1994.51, 195; Shepard 1985.302–304). In some cases the spiral is interpreted as a solar symbol (Yablan 2006.56).

This paper continues the subject of spiral motifs in prehistoric decorative art, and considers ornamental patterns in terms of geometry. Mathematical approaches to the characteristics and study of ornamental forms – in particular, past and traditional ones – conducted since the 1920s and 30s are restricted mostly by the application of the laws of symmetry as one of the basic properties of organic and non-organic nature (Birkhoff 1933; Shepard 1948; 1985.259–305;

Sturrok 2003; Yablan 2006). In cases of curvilinear ornamentation, it seems to be productive to use some principles of the graphic construction, description and systematization of curvilinear figures used in geometry and algebra (*Pedoe 1979*). The paper presents the results of applying these principles to the study of the spiral as a particular case of a curvilinear figure, and spiral patterns on the Neolithic pottery of East Asia and the Russian Far East.

The archaeological framework of our research includes the Jomon culture of the Japanese archipelago, the Yangshao cultural community in East China, and the Neolithic cultures of the Lower Amur River basin in the Russian Far East (Fig. 1). The research database is comprised of publications consisting of drawings and photographs of ceramic vessels decorated with spiral patterns (*Aikens and Higuchi 1982; Catalogue... 1999; Chen Chunhe et al. 1995; Chzhang 1984; Fukuda 2007; Kashina 1977; Kobayashi 2004; Okladnikov 1981; 1984; Pearson 1992; Skarpari 2003; Yamanouchi 1964*). The instrumental supplement of computer graphic processing (Adobe Photoshop and CorelDraw programs) was applied for the correct processing of the published data and presentation of the images of spiral figures.

The spiral as a geometrical figure

Spirals (from Lat. *spiro* – coil) are lines curved around a certain fixed point on a plane or a certain axis in space. Plane spirals are geometrical figures formed by rotating and moving any point. The direction of the movement is a basic characteristic of the spiral. Four mathematical, or algebraic, types of plane spiral figure are recognized. They are the Archimedes spiral, the logarithmic spiral, the clothoid spiral, and the spiral formed by the connection of semi-circular arcs (like the Chinese yin-yang symbol). Each type is bound by certain geometrical rules and has a distinctive appearance (Fig. 2).

The Archimedes spiral was described by Archimedes in the 3rd century BC. Its algebraic formula given in polar coordinates is:



Fig. 1. Map of the research area: 1 – Japanese archipelago; 2 – East China, Huanghe River basin; 3 – Lower Amur River basin.

$$p = a\varphi$$

A spiral of this type looks like a coiled line turning away from or towards a certain point on the plane. The distance between the spiral's coils is constant (Fig. 2.1).

The logarithmic spiral was described Decart and Bernulli in the 17th century. Its algebraic equation formula given in polar coordinates is:

$$p = ae^{k\varphi}$$

A spiral of this type is constructed by regularly increasing the distance between coils (Fig. 2.2).

Logarithmic and Archimedes spirals are similar to the structures of some animal and plant forms. For instance, the logarithmic spiral's configuration is characteristic of the shell structure of certain kinds of cephalopod and gastropod mollusks (*Hadorn and Wehner 1986*). The configuration of the Archimedes spiral looks very like the coiled pattern of the upper part of a fern shoot (*Atlas 1980.333*). The idea that certain natural forms might have been models for the construction of ornamental patterns in the Paleolithic and Neolithic has been advanced by some

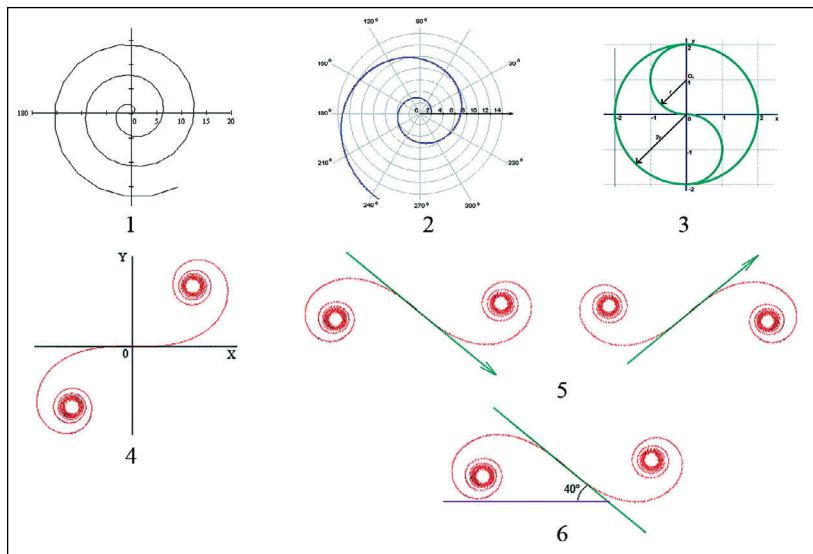


Fig. 2. Mathematical types of spiral figures: 1 – Archimedes spiral; 2 – logarithmic spiral; 3 – spiral formed by the connection of semi-circled arcs (yin-yang symbol); 4 – clothoid spiral; 5 – descending clothoid spiral (left); ascending clothoid spiral (right); 6 – determination of direction and inclination angle of tangent line in clothoid spiral.

researchers (Yablan 2006.52–179). In respect of direction, we distinguish right-oriented and left-oriented Archimedes and logarithmic spirals. After turning a spiral figure through 180° , the direction remains the same.

A clothoid spiral figure represents the plastic connection of two symmetrical branches directed opposed (Fig. 2.4). The configuration of branches corresponds to the Archimedes or logarithmic spiral. The term clothoid was introduced in 20th century by the Italian mathematician Chezzaro as an analogy to the Ancient Greek mythological character Clotho – the goddess of fate, winding the thread of human life around a spindle (information from www.liceotosi.va.it/matehelp/sportello). The clothoid spiral corresponds to the image of the well-known ornamental ‘running wave’ pattern. The parametric equations for a clothoid spiral are:

$$x = a \int_0^u \cos \frac{\pi u^2}{2} du \quad y = a \int_0^u \sin \frac{\pi u^2}{2} du$$

Considering the clothoid figure as an ornamental motif, we suggest establishing two descriptive characteristics. The first is the direction of movement indicated by the line which is tangential to both branches passing through the connecting stretch. The direction from left to right corresponds to the ascending clothoid; the opposite direction corresponds to a descending clothoid. Another characteristic is the angle of tangent inclination relative to the con-

ventional horizontal axis of the clothoid. The angle depends on the distance between the clothoid’s branches.

A spiral formed by the connection of semi-circular arcs described by Albrecht Dürer in 16th century differs from other spiral figures types by its method of formation (Pedoe 1979.35–36). This spiral has to be constructed in an instrumental-mechanical, or circular way, but not by means of a mathematical formula. Certain variants of this spiral are determined by the length of semi-circular arcs (Fig. 2.3). This figure is an analogue of the well-known yin-yang symbol, in Chinese the *t'ai chi*, or ultimate

(Williams 2003.385). These mathematical types of plane spirals are applied to the systematization of the variety of spiral patterns on Neolithic pottery in East Asia and the Far East.

Spiral motifs on Neolithic pottery in Japan

The Neolithic Jomon culture existed in Japan from 13 600 to 900 BC, according to the most recent data. It is divided into six periods, which are defined in great measure in terms of changes in pottery decoration and patterns (Kobayashi 2004). Even quite archaic pots from the Incipient Jomon period (13 600–9200 BC) are in some cases designed with the simplest ornamental compositions, while the most intensive development of vessel decoration began in the Early Jomon (5300–3500 BC). The potteries of the Early, Middle, Late and Final periods are decorated by quite variegated compositions, including straight lines and curvilinear elements and motifs. Pottery decoration was done by cord-impression, incising, grooving, relief application, some kinds of stamping, and carving. Each period produced its specific combination of techniques, while cord-impressing remained the main technique from the beginning to the end of Jomon culture.

The spiral motif on Early Jomon pottery

It seems likely that the spiral motif first appeared in Jomon pottery decoration in the Early period. In some cases we can see only amorphous spiral-like

elements (Fig. 3.3). In other cases, the completed spiral figures are presented in a vessel's decoration (Fig. 3.1-2). The type of figure is usually like an Archimedes spiral. The technical means of spiral decoration are mainly cord-impression and sometimes incision. The flexibility of cords was appropriate for producing spiral patterns. According to published records, spiral figures form horizontal band compositions. Two kinds of Archimedes spiral type are distinguished – right-oriented and left-oriented. There are spirals formed by 1.5-2 coils and by 5-7 coils. An interesting case of multi-coiled spiral ornamentation is presented on a ceramic vessel of Moroiso style from Tenjin, in Yamanashi Prefecture (*Kobayashi 2004.38, Fig. 3.13*). The upper part of the vessel has a wide horizontal band as the dominant, which is formed by joining two left-oriented Archimedes spirals. The way the spiral combine produces the illusion of mirroring. The technique of ornamentation is cord-impression (Fig. 3.1). Another case is a horizontal band formed by alternating left-oriented and right-oriented Archimedes spirals – this pattern is on a vessel from a site near Fukuoka, Saitama Prefecture (*Yamanouchi 1964.Pl. 43*).

Certain Early Jomon pottery samples present two linked Archimedes spirals joined by a curved plastic line similar to a clothoid spiral figure (Fig. 3. 2). For instance, the horizontal band composition formed by these figures is found on a ceramic vessel from a site near Yudza, in Yamagata Prefecture (*Yamanouchi 1964.Pl.42*).

The spiral motif on Middle Jomon pottery

Spiral motifs developed further during the Middle Jomon period (3500-2500 BC) in local pottery styles called Kasory E, Kaen (Flame-like), Atamadai, Middle Daigi and others (*Aikens and Higuchi 1982.137-156; Kobayashi 2004.42-49; Yamanouchi 1964.Pl. 78, 79, 82-85*). In general, these styles demonstrate great variability in decorative composition and technique. The decoration or ornamentation, including spiral motifs, were mainly produced by appliqué relief over a background of cord impressions. There are spirals of several types: Archimedes, logarithmic, and clothoid (Figs. 4 and 5). Given the data from publications, we can suppose that the Archimedes spiral occurs in pottery more frequently than other types (Fig. 4. 3, 4). A logarithmic spiral is identified clearly in some cases only (Fig. 4. 1). The series of pottery samples shows a figure which appears to be intermediate between Archimedes and logarithmic spirals, especially when the spiral is formed by 1.5-



Fig. 3. Spiral patterns on Early Jomon pottery, Japanese archipelago (1 – Kobayashi 2004.38; 2, 3 – Yamanouchi 1964. Pl. 42, 43).

2 coils (Fig. 4. 5, 7). Combining different spiral types in the same composition is common (Fig. 4. 1, 2, 6).

The figure of an Archimedes or logarithmic spiral may be used as a basic motif in ornamental composition (Fig. 4. 1-6), or as additional, or accenting one, if the composition includes other more representational motifs (Fig. 4.7). In first case, the figures of Archimedes or logarithmic spirals form motifs of band type ornament. Ornamental bands usually have a horizontal orientation and are located in the upper part of the vessel. The composition may be organized by a simple parallel transition, or replication of a spiral figure along the horizontal axes (*Yamanouchi 1964.Pl. 82, 107*), or alternating left-oriented and right-oriented spirals similar to the principle of mirroring (*Yamanouchi 1964.Pl. 109, 144*). Spiral figures forming horizontal bands are sometimes linked together by a direct horizontal or slightly inclined line that gives the effect of a permanent pattern (*Yamanouchi 1964.Pl. 82, 84, 107, 109*). In some cases, ornamental band compositions consisting of Archimedes or logarithmic spirals are vertical (Fig. 4.1). It may be noted that the principle of the vertical dis-



Fig. 4. Spiral patterns on Middle Jomon pottery, Japanese archipelago (1, 2 - from Kobayashi 2004.44, 46; 3, 4, 5 - Catalogue 1999.11; 6, 7 - Yamanouchi 1964.Pl. 122, 112).

position of ornamental motifs and elements was known in the pottery-making tradition of the Early Jomon period. For instance, ceramic vessels of Ento type were designed with vertical zones filled in cord impressions of various kinds (Yamanouchi 1964.Pl. 32, 33). Obviously, the manner of orienting ornamental patterns vertically survived during the Middle Jomon period, but in another decorative context. Interesting cases are the compositions formed by combining large and small Archimedes or logarithmic spiral figures (Fig. 4. 1, 2).

The clothoid spiral type seems to be an infrequent motif on Jomon pottery of the Middle period. In particular, the pottery of Kasori E style shows some samples of clothoid spiral motif (Kobayashi 2004.43, Fig. 3.16). Spiral figures produced in relief appliqué technique have a horizontal orientation forming the band composition. The specific feature of the clothoid spiral is that its branches are separated

one from another by some interval or distance. The angle of tangent inclination is around 20–40°. This gives the impression of a ‘fluent’, long-drawn spiral (Fig. 5).

The spiral motif on Late and Final Jomon pottery

The late (2500–1200 BC) and Final (1200–900 BC) Jomon periods are characterized by significant changes in pottery-making standards. The pottery assemblages from Late and Final Jomon sites provide evidence of improving techniques and technology, increasing diversity of shapes, and new tendencies in ceramic vessel decoration. Ornamental motifs and compositions marked by esthetic perfection correlate finely with the vessel's shape. Ornamentation techniques include incising and grooving, low relief application, carving, and cord-impressing (Aikens and Higuchi 1982.

164–182; Kobayashi 2004.40, 42–49; Pearson 1992. 73–75).



Fig. 5. Spiral patterns on Middle Jomon pottery, Japanese archipelago (1, 3 - from Kobayashi 2004.43; 2 - Yamanouchi 1964.Pl. 139).

Curvilinear ornamentation appears on the pottery of local types: Horinouchi, Final Angyo, Kamegaoka, and others (Aikens and Higuchi 1982.164–179; Fukuda 2007.25–71; Kobayashi 2004.40; Yamanouchi 1964.Pl. 15–264). Published records show a series of curvilinear figures which are associated with Archimedes and logarithmic spirals or their intermediate forms. The configuration and compositional pattern of spiral motifs share characteristics with the same spiral types of the Middle Jomon (Fig. 6). The 2–2.5-coiled spiral figure predominates, while in certain cases the spiral may be formed of 5 to 6 coils (Catalogue...1999.47, Fig. 1; Yamanouchi 1964.Pl. 164, 178, 181, 191). Archimedes and logarithmic spiral figures form horizontal or, more rarely, vertical band compositions by parallel transition or mirroring (Catalogue...1999.29, Fig. 3, 31, Fig. 1; Yamanouchi 1964.Pl. 178, 181) (Fig. 6. 1–3). Sometimes the spirals may be combined with other elements and motifs to forming an ornamental composition (Pearson 1992.97, Fig. 47, 99; Yamanouchi 1964.Pl. 164) or in some cases may be used as an additional accenting motif (Aikens and Higuchi 1982.144, Fig. 3.26; Yamanouchi 1964.Pl. 112) (Fig. 6. 4).

The clothoid spiral as an ornamental motif saw significant development during the Late to Final Jomon (Fig. 7). In most of cases, the configuration of clothoid figures is close to the clothoid of the Middle Jomon in its fluent, long-drawn line. The angle of tangent inclination to the horizontal axes of clothoid figures varies from 15° to 35°. In a few cases a compact, or ‘expressive’ clothoid, where the small distance between the branches may be noted. According to published records, there are several compositional variants of the clothoid spiral pattern. The first is a band of running wave type spirals combined to produce an effect of permanent movement. Usually the ornamental band is oriented horizon-

tally (Fig. 7.2 ,3, 4). For instance, ceramic bowl from the site at Kainohana, Final Jomon period, is decorated with a wide band of incised, descending clothoid spirals (Catalogue... 1999.33, Fig.4). An ornamental band composition formed of incised ascending clothoid figures is located in the mouth of a footed bowl from the Korekawa site, Final Jomon (Pearson 1992. 107). There are some similar cases (Yamanouchi 1964.Pl. 209, 250, 252). One kind of ornamental composition has a horizontal band of separate clothoid spiral figures located at an angle to band’s axes. This decoration was produced by incision, or incision in combination with carving (Fig. 7.5, 6). In rare cases, one can fix the vertical disposition of the clothoid spiral pattern on the vessel body (Fig. 7. 1).

The clothoid spiral was sometimes an accentuating element in an ornamental composition. Thus, the teapot-shaped vessel from Final Jomon site near Edosaki, in Ibaraki Prefecture, is decorated with a wide zone of incised meanders. The finest incised clothoid spiral figures are included in a total composition as ‘enlivening’ details. (Yamanouchi 1964. Pl. 185).

Spiral motifs on Neolithic pottery in eastern China

The Yangshao culture was discovered in the Huanghe River basin in the 1920s. The investigation of archaeological sites abundant in various cultural remains provided information of great value for understanding the Neolithic of East and Central China. The pottery was recognized as the most remarkable feature of Yangshao culture. A developed technology, significant morphological diversity and surprisingly colorful and complicated decoration are distinctive features of Yangshao ceramic vessels (Chen Chunhe et al. 1995.25–35; Kashina 1977).



Fig. 6. Spiral patterns on Late and Final Jomon pottery, Japanese archipelago (1, 2, 3 – from Catalogue 1999.29, 31, 47; 4 – Yamanouchi 1964. Pl. 202).

After the discovery of Yangshao culture, a series of closely related Neolithic cultures in a general chronological framework from the end of the 5th to the end of 3rd mil. BC was recognized within the vast area of the Huanghe basin. These are the Machayao and Daven'kou cultures, and some others (Chzhang 1984; Kuchera 1977; Scarpari 2005.154, 155, 215). Neolithic pottery was decorated with polychrome and monochrome painting on polished walls. Black, brown, white, and green colors were produced from mineral pigments. Ornamental traditions are characterized by a great diversity of elements, motifs, and compositional schemes. Curvilinear motifs – spirals, in particular – were widespread.

According to the data of published illustrations, the spiral configurations generally correspond to the clothoid type (Figs. 8 and 9). Probably among the earliest evidence of clothoid spiral patterns are the compositions on ceramic vessels from the Myaodigou site of the Yangshao culture, 3280 ± 100 BC. In some cases, ornamental horizontal band compositions are formed of clothoid-like elements (Kuchera 1977.Pl. 2, 3) (Fig. 8.1, 2). In other cases the compositions represent completed clothoid spirals. For instance, rows of ascending clothoids are combined to form a wide horizontal band surrounding the vessel body. The decoration is produced by multiple repetitions of a spiral figure in paint of various colors (Kashina 1977.114, Fig. 51–3). Similar ornamental compositions are characteristic of the pottery from the Yangshao culture site at Bangshan, while here the spiral figures correspond to descending clothoids (Fig. 8 – 3, 4). It is interesting to note that the ceramic vessels designed with this ornamentation are interpreted as funerary urns (Kashina 1977.124–140). The decoration of pottery from the site at Machang demonstrates cases of ascending and descending clothoid spiral figures composing horizontal bands. Sometimes the spiral pattern serves as the structural frame for stylized zoomorphic images of frogs and others (Kashina 1977.132, Fig. 64 – 1, 5).

The ceramic vessels of the Machayao culture are decorated with wide polychromic horizontal bands constructed of combined clothoid spirals of ascending and descending type (Fig. 9.1–4). An interesting case is the ornamental band formed by four descending clothoid figures combined with stylized frog images (Kashina 1977.117, Fig. 53 – 9a, 9b). In some cases, one can note a net-structured pattern of circles and ascending clothoid spirals (Fig. 9. 5) (Kashina 1977.113, Fig. 50–1). A specific feature of clothoid spiral patterns on Machayao and Yangshao pot-



Fig. 7. Spiral patterns on Late and Final Jomon pottery, Japanese archipelago (1, 2, 3, 5, 7 – from Yamanouchi 1964.Pl. 181, 209, 235, 244, 250; 4 – Catalogue 1999.33; 6 – Kobayashi 2004.40).

tery is that in certain cases the concentric circles or round figures enter inside the clothoid's branches (Fig. 9. 1, 5). In the pottery of Daven'kou culture there are cases of spiral patterns close to Yangshao ornamentation – a wide horizontal band of ascending and descending clothoid spirals (Fig. 9. 6) (Kuchera 1977.Pl. 11; Chzhang 1984.94, Fig. 26).

Sometimes curvilinear patterns were constructed using the Archimedes spiral. For instance, in Bangshan pottery there are cases of horizontal ornamental bands formed by the parallel transportation of a right Archimedes spiral figure (Kashina 1977.134, Fig. 66–5). The same principle of ornamentals band



Fig. 8. Spiral patterns on Yangshao pottery, East China (1, 2 – from Kuchera 1977.Pl. 2, 3; 3, 4 – from (<http://www.bibliotekar.ru/china1/3.htm>)).

formed with left-oriented Archimedes spirals is found on the pottery of Machayao culture (Skarpari 2003. 155).

Spiral decoration on Neolithic pottery from the Lower Amur River region

The Neolithic of the Lower Amur River region in the southern region of the Russian Far East is presented in archaeological assemblages of the Malyshevo, Kondon, Voznesenovka cultures. These cultures, probably connected by close relationships, form a chronological sequence within the limits of the 6th–mid-2nd mil. BC. Pottery is the most representative category of artifacts at these Neolithic sites. Ceramic vessel decoration is very diverse as to motifs, compositions, and techniques (Derevyanko and Medvedev 2006; Medvedev 2003; Okladnikov 1981; 1984).

Pottery assemblages of Malyshevo culture and Voznesenovka culture give the series of spiral pattern samples. Malyshevo culture pottery dated to the 6th–mid-4th millennium. BC has examples of Archimedes and clothoid spirals used as the basic motifs of horizontal band compositions. Spiral decoration was produced by imprinting with a toothed roller tool (Fig. 10). The Archimedes spiral is formed of 4–6 coils. In certain instance there

are right and left oriented Archimedes spirals within same composition (Derevyanko and Medvedev 2006.136, Fig. 7.10 – 3). In the cases of clothoid spiral patterns, the opposing branches of the curvilinear figure are formed with multi-coiled Archimedes spirals (Fig. 10. 1). Sometimes, horizontal band composition is formed with curvilinear

figures looking like uncompleted, or ‘broken’, clothoid spirals (Derevyanko and Medvedev 2006.136, Fig. 7.10 – 4).

The pure flourishing of spiral patterns is connected with the pottery-making tradition of the late Neolithic Voznesenovka culture in the mid-3rd–mid-2nd mil BC. Ceramic vessels excavated at the sites at Voznesenovka, Kondon, Takhta, Suchu have horizontal band-like compositions formed with motifs of Archimedes and logarithmic spirals, clothoid spirals, and the yin-yang type, or a type of ‘T’ai Chi figure’ (Fig.



Fig. 9. Spiral patterns on Machayao (1–5) and Davenkou (6) pottery, East China (1, 3 – from Kuchera 1977.Pl. 4, 7; 2, 4, 5 – from <http://www.bibliotekar.ru/china1/3.htm>; 6 – from Kuchera 1977.Pl. 11).

11). The decorative technique was standard – incised or grooved spiral patterns over a vertical zigzag pattern impressed by a small-toothed comb and covering most of the vessel’s walls. So, the spiral pattern played the main role in a vessel’s decoration. In many cases the composition represents the combining of different spiral types – for instance, Archimedes or logarithmic spirals and clothoid spirals (Fig. 11.4, 8), or clothoid and yin-yang spirals (Fig. 11.2). The spiral figure formed by the connection of semi-circular arcs and looking like a yin-yang symbol occurs in ornamental compositions in several cases – this motif is specific to the Late Neolithic pottery of Lower Amur, as against Jomon culture and Yangshao pottery (Fig. 11.1–3).

The pottery of Voznesenovka culture is quite interesting in some samples decorated with curvilinear anthropomorphic images. Fragments of such vessels were discovered at Voznesenovka (Fig. 12). An important element of this decoration is a spiral figure of yin-yang type. The decoration is produced by gro-



Fig. 10. Spiral patterns on Malyshevo culture pottery, Lower Amur region (from Okladnikov 1981.Pl. 62, 85, 89).

oving and fine comb-impressing on a red painted and polished background. Researchers interpret these splendid vessels as containers for non-utilitarian, probably festive, purposes (*Derevyanko and Medvedev 2006.148*).

Conclusion

The materials considered here provide a basis for some conclusions concerning spiral patterns on the Neolithic pottery of East Asia and the Russian Far East.

- ❶ The current mathematical typology of the plane spiral as a geometric figure may be applied to the description and systematization of curvilinear de-



Fig. 11. Spiral patterns on Voznesenovka culture pottery, Lower Amur region (1–6, 8, 9 – from Okladnikov 1984.Tabl. XV, XIX, XX, XXI, XXII, XLV, XLVI, LVII; 7 – from Okladnikov 1981.Pl. 91)

coration on prehistoric pottery. This approach helps to make our research more correct and logical, and provides new possibilities and perspectives in the study of archaeological records.

- ② The pottery decoration of Neolithic cultures of Eastern Asia and the Russian Far East presents cases of spiral motif configurations corresponding to all the basic types of plane spiral figure. These are the Archimedes, logarithmic, clothoid spirals, and the spiral of yin-yang type, or t'ai chi figure. It may be considered as evidence that the spiral was one of the main and most developed geometrical concepts of the Neolithic population in this part of the world.

- ③ The spiral decoration of Neolithic East Asian and Far Eastern pottery demonstrates certain regional and cultural variability. The pottery-making tradition of Jomon culture from the Early to the Final period shows a gradual development of spiral motifs and compositions including them. Spiral motifs are formed with Archimedes, logarithmic, and clothoid spirals. Archimedes and logarithmic spiral types reaches the peak of development in the Middle Jomon period, while the clothoid type flourished during the Late-Final periods. The clothoid spirals on Jomon pottery are characterized mostly by fluent, long-drawn configurations. In general, they show great compositional diversity.

A distinctive feature of spiral decoration on eastern Chinese pottery is the predominance of spiral motifs corresponding to clothoid figures. The compositional structure of the ornamental pattern is standard in most cases – clothoid spiral figures are combined to form a horizontal band around the vessel's belly.



Fig. 12. Spiral patterns on pottery with anthropomorphic images from the Voznesenovka site, Voznesenovka culture, Lower Amur region (from Okladnikov 1981.Pl. 18, 19).

It is a classic type of running wave pattern. The clothoid figure is characterized by the short distance between its branches, creating the effect of an expressive, compact spiral. This style differs obviously from the clothoid spirals on Jomon pottery. Archimedes spiral figures were used in Neolithic Chinese pottery spiral decoration more rarely than clothoids.

Curve-lined decoration on the pottery of Lower Amur region became most developed in the late Neolithic stage, the mid 3rd–mid 2nd millennium. BC, which was close to the Late Jomon of the Japanese archipelago and some assemblages of the Yangshao cultural circle in East China. Ornamental compositions tend to be combinations of various spiral types, rather than patterns of single spirals. The most interesting feature of spiral ornamentation on Lower Amur pottery is the presence of a motif corresponding to a curvilinear figure formed by the connection of semi-circular arcs, or the yin-yang symbol.

In general, it seems likely that regional variability in spiral decoration reflects cultural differences in prehistoric esthetic conceptions and traditions. The common idea of spiral figures was adopted in different forms in various Neolithic entities of East Asia and the Far East.

REFERENCES

- AIKENS M., HIGUCHI T. 1982. *Prehistory of Japan*. Academic Press. New York – London – Toronto.
- ATLAS 1980. *Atlas arealov i resursov lekarstvennyh rastenii SSSR [Atlas of the areas and resources of medicinal plants of the USSR]*. Botanical Institute of the Academy of Sciences, Moscow (in Russian).
- BIRKHOFF G. D. 1933. *Aesthetic Measure*. Cambridge.
- BOGUCKI P. 1995. The Linear Pottery Culture of Central Europe: Conservative Colonists? In W. K. Barnett and J. W. Hoopes (eds.), *The Emergence of Pottery: Technology and Innovation in Ancient Societies*. Smithsonian Institution Press. Washington – London: 89–98.
- CATALOGUE 1999 *Catalogue of Special Exhibition-Studying of Shellmound*. Matsudo Museum Press. Matsudo (in Japanese and English).
- CHEN CHUNHE, TIANG YUSHAN et al. 1995. *Zhongguo Lidai Yishu [Chinese Art in the Dynasties]*. Taiwan, E. B. Books Co., Ltd. Taipei (in Chinese).
- CHZHANG YATZIN 1984. *Keramika neoliticheskikh kultur Vostochnogo Kitaya [The Pottery of East China Neolithic Cultures]*. Nauka. Novosibirsk (in Russian).
- DEREVYANKO A. P., MEDVEDEV V. E. 2006. Neolithic of the Nizhnee Priamurye (Lower Amur River Basin). In S. M. Nelson, A. P. Derevyanko, Y. V. Kuzmin, R. L. Bland (eds.), *Archaeology of the Russian Far East: Essays in Stone Age Prehistory*. BAR International Series 1540. Archaeopress. Oxford.
- FUKUDA M. 2007. *Hokkaido and the Prehistoric Cultures of Russian Far East: Archaeology of the 1st millennium B.C.*
- HADORN E., WEHNER R. 1986. *Allgemeine Zoologie*. Georg Thieme Verlag. Stuttgart.
- IVANOV S. V. 1962. *Ornament narodov Sibiri kak istoricheskii istochnik [The Ornamental Art of Siberian Peoples as a Historical Source]*. Nauka. Moscow – Leningrad (in Russian).
- KASHINA T. 1977. *Keramika kul'tury Yangshao [Yangshao Culture Pottery]*. Nauka. Novosibirsk (in Russian).
- KOBAYASHI T. 2004. *Jomon Reflections*. Oxbow Books. Oxford.
- KUCHERA S. 1977. *Kitaiskaya arkheologiya [Chinese Archaeology]*. Nauka. Moscow (in Russian).
- KYZLASOV L. R., KOROL G. G. 1990. *Dekorativnoe iskusstvo srednevekovykh hakasov kak istoricheskii istochnik [Decorative Art of Medieval Hakas Peoples]*. Nauka. Moscow (in Russian).
- MANSON J. L. 1995. Starčevo Pottery and Neolithic Development in the Central Balkans. In W. K. Barnett and J. W. Hoopes (eds.), *The Emergence of Pottery: Technology and Innovation in Ancient Societies*. Smithsonian Institution Press. Washington – London: 65–78.
- MALYAVIN V. V. 2001. *Kitaiskaya tsivilizatsiya [Chinese Civilization]*. Moscow (in Russian).
- MEDVEDEV V. E. 2003. Akademik A. P. Okladnikov i neolit Nizhnego Amura: razvitie idei [The Academician A. P. Okladnikov and the Neolithic of the Lower Amur Region: the Evolution of Concepts]. In *Problemy arkheologii i paleoecologii Severnoi, Vostochnoi i Tsentral'noi Azii*. Institute of Archaeology and Ethnology, Siberian Division of the Russian Academy of Sciences. Novosibirsk: 164–171 (in Russian).
- MYL'NIKOVA L. N. 1999. *Goncharstvo neoliticheskikh plemen nizhnego Amura [The Pottery-Making of the Lower Amur Region]*. Institute of Archaeology and Ethnology, Siberian Division of the Russian Academy of Sciences. Novosibirsk (in Russian).
- OKLADNIKOV A. P. 1981. *Ancient Art of the Amur Region*. Aurora Art Publishers. Leningrad (in English and Russian).
1984. *Keramika drevnego poseleniya Kondon (Priamurie) [The Pottery of the Prehistoric Site at Kondon (Priamurye)]*. Nauka. Novosibirsk (in Russian).
- PEARSON R. (ed.) 1992. *Ancient Japan*. Smithsonian Institution Press. Washington, D.C.
- PEDOE D. 1979. *Geometriya i iskusstvo [Geometry and Art]*. Translated from English. Mir-press. Moscow (in Russian).
- RYBAKOV B. A. 1994. *Yazychestvo drevnikh slavyan [The Paganism of Ancient Slavic Peoples]*. Nauka. Moscow (in Russian).
- SHEPARD A. O. 1948. *The Symmetry of Abstract Design, with Special Reference to Ceramic Decoration*. Carnegie Institute Press. Contribution 47. Washington, D.C.
1985. *Ceramics for the Archaeologist*. Carnegie Institute Press. Washington, D.C.

SIMONOV M. D. 1995. Osnovnye elementy udaegeiskogo ornamenta [Basic Elements of Udaege Ornamental Art]. In *Ornamental'noe iskusstvo narodov Dal'nego Vostoka*. Komsomolsk - na-Amure: 32-34 (in Russian).

SKARPARI M. 2003. *Drevnii Kitai. Kitaiskaya tsivilizatsiya ot neolita do epohi Tan [Ancient China. Chinese Civilization from the Neolithic to the Tang Dynasty]*. Astrel Press. Moscow (in Russian).

SPENSER A. J. 1997. Pottery in Pre-dynastic Egypt. In I. Freestone, D. Gaimster (eds.), *Pottery in the Making: World Ceramic Traditions*. British Museum Press. London: 44-49.

STURROK S. 2003. *Celtic Spirals Handbook*. Guild of Master Craftsman Publications Ltd. Lewes.

WILLIAMS C. A. S. 2003. *Chinese Symbolism and Art Motifs*. Tuttle Publishing. Boston.

YABLAN S. 2006. *Simmetriya, ornamenty i modulyarnost [Symmetry, Ornamental Forms and Modality]*. Institute of Computer Technologies. Moscow (in Russian).

YAMANOCHI S. (ed.) 1964. *Primitive Arts of Japan. Vol. 1. Jomon Pottery*. Kodansha Press. Tokyo.