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# Study on the Origins of Textile Materials on the Basis of Analysis of Related Hard Relics from Chinese Excavations

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## Abstract

*Textile materials are widely available in nature, and the original time when humans started to use them must have been very early. However, they also easily aged, and most of the ancient ones had decomposed and disappeared thoroughly before we could find them, resulting that the remaining textile relics cannot reflect entirely the origins of textile materials. Fortunately large numbers of indirect evidence related to ancient textile materials can be found in many unearthed culture relics belonging to the Stone Age. Starting from the basic survival needs of primitive man, in this article, we analysed related hard relics from Chinese excavations made of stone, wood, bone, and so on. And based on this, the time of origin of the textile materials was further speculated upon.*

**Key words:** *textile materials, origins, indirect evidence, hard relics, Chinese excavations.*

original objects is the most difficult part for engaging textile archaeological studies. If just using the traditional archaeological method based on the existence of original objects, the history of textile materials can now only be traced back to the early Neolithic Age. For example, the earliest surviving textiles in East Asia were found in the Chertovy Vorota Cave, Primorye Province, in the Russian Far East, which were made from untwisted or hand-twisted blades of sedge grass to form ropes, nets and woven mats, and can be dated back to about 8400~9400 years ago [6]. However, in fact, that might not be true. A carved bone figure of Venus wearing cloth in the form of a fringe of twisted strings of fiber proves that textiles had already existed in the late Paleolithic Age, about 22000 years ago [1]. Therefore by only depending on surviving textile relics, we cannot trace back to the very beginning of textiles.

Then, how to trace textile materials back to earlier origins? Fortunately, beyond textiles, there is a large amount of indirect evidence contained in other related relics, such as written and iconographic sources, the remains of animals and plants yielding fibers and dyes, tools used for product textiles, and so on. [7] Moreover they have been analysed by many European archeologists (e.g. Danish National Research Foundation's Centre for Textile Research at the University of Copenhagen) to prove the existence of textiles [8, 9], study the technologies and consumption of textile and dress production, and verify theories by experimental archeology [10-14], even visualising and reconstructing ancient textiles [15, 16].

Previously using the analogous method, direct and indirect evidence was analysed to study the origin of costume [17], and based on painted pottery the existence of textile materials as pens was investigated [18]. In this article, the origins of textile materials were proved and studied by analysing indirect evidence contained in remaining hard relics from Chinese excavations, which can provide new evidence and clues for studying the origins and history of textile materials.

Traditionally textile materials refer to fibers and fiber products, including fibers, yarns, fabrics and complexes of them [19]. However, for studying their origins, the scope covered should be enlarged to ancient textile materials. All of the materials humans acquired from nature, whose properties, forms and usages are in accordance with the traditional textile materials belonging to the category of ancient textile materials, including natural cellulose materials (e.g. rattan, grass, leaves, bark, etc.), protein materials (e.g. animal skins, fur, etc.), and other soft materials (e.g. animal intestines, sinew, etc.). They are even the very source which inspired humans to process textiles.

## Origins of textile materials

Actually the history of textile materials must be longer than we thought, and it can be even suggested that the origins of textile materials may synchronise with those of stone tools because of the following four reasons.

Firstly in the primitive period, the primary problems humans faced was surviv-

## Introduction

As organic polymer materials, natural textile materials easily decompose with age, and finally disappear. Compared with hard relics, such as stone tools, pottery, bone artifacts, and so on, the number of surviving ancient textiles is much smaller [1], thus exquisite pottery, noble jewelry, etc. rather than textiles spring to mind first at the mention of cultural relics.

By using many chemical and physical methods, archaeological textiles can be identified [2], and they can also be reconstructed as physical replicas by experimental archeology [3] or as virtual visualization by the 3D graphics method [4, 5]. However, the disappearance of the

al, hence any substance that served the needs of human life is likely to be used by them. Textile materials, existing widely in nature, are no exception, and they must have originated as tools which were simply processed and used by humans to satisfy their basic living needs at first.

Secondly as a kind of soft material with a certain extent of strength, textile materials possess excellent functions which are necessary for human life, while hard materials do not have, such as for binding, packaging, or carrying something, and defending bodies, etc.

Thirdly the main function of hard tools (stone tools) is dividing, while that of soft tools (textile materials) is combining. When humans learned to divide or smash things using stone tools, they also learned inevitably to combine and carry things using textile materials, both of which are indispensable because of the functional opposite-complementation.

Finally the earliest textile materials may originate from the application of natural plant fibers, animal fibers, or other natural soft slender objects, such as grass, rattan, animal hides, etc. [20], from the reason that these materials were very easy to be acquired, prepared and utilised by humans. There must have been a long development history for textile materials, from being obtained from nature to being processed into mats, fabric or rope.

Therefore textile materials are closely related to human basic survival needs. It is reasonable and inevitable that textile materials originated as tools with a history as long as stone tools. And they might have originated when humans tore off a vine for binding, or cut off a piece of animal skin for packaging. As for fabrics which need to be woven by specialised tools (e.g. looms), they must have been products which came into being long after textile materials were utilised by humans.

### Indirect evidence analysis from hard relics

Although most ancient textile materials have already disappeared into far history, many unearthed hard relics (e.g. stone tools, pottery, bone artifacts, etc.) contained a large number of indirect evidence, suggesting the existence of textile materials which were used as various tools.

### Binding and stringing tools

#### Binding tools

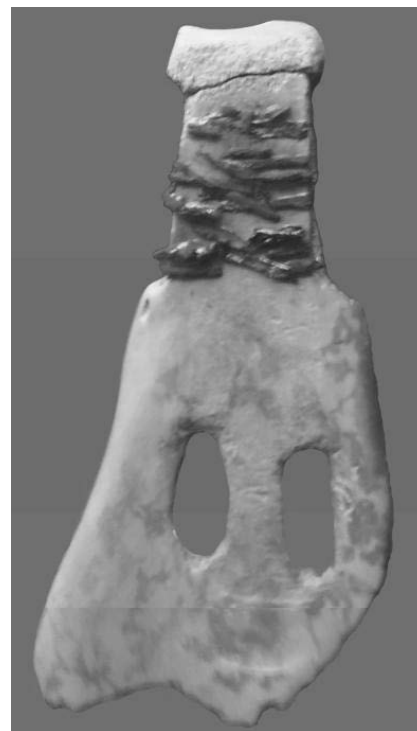
It is inevitable for binding tools to come up, because the binding operation is simple and effective, and the raw materials for binding are abundant and can be obtained easily in nature, such as a bunch of grass, a stick of rattan, and so on. And when these soft materials were used to bind foods or prey for convenient transporting, or to tie other hard tools together for easy carrying, they became tools. During use, grass might be twisted or braided to increase the strength, and rattan or stalks might be struck, smashed and split to get finer ones.

Many hard relics, belonging to the Anthropolithic Age, were parts of complex tools, such as axes, arrowheads, shovels, adzes, and so on. They usually had slots or bulged parts which might have used to be bound together with handles for convenient use.

For example, a kind of representative agriculture hand tools: bone spades, were unearthed at the Hemudu site, Zhejiang of China, which can be dated back to 7000 years ago [21]. On the surface of the bulged part of one bone spade, there were remains of rattan used for binding the handle (*Figure 1*).

Another example was at the site of Linru, Henan, China, where a ceramic urn with a coloured drawing on the surface was excavated, which has a history of 5000~7000 years [22]. And in the drawing, there is a zax with several holes, through which something like ropes were used to bind it with a handle (*Figure 2*).

Moreover, the zax unearthed at the Zhiyu site (about 29000 years ago) [23] and the ceramic axe at the Qingdun site (about 5000 years ago) [24] also suggested that textile materials were used as binding tools to combine hard tools with handles in the Anthropolithic Age.



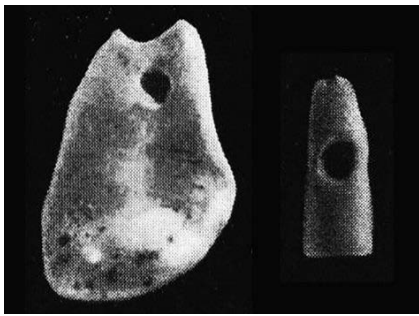
*Figure 1. Bone spade with rattan from the Hemudu Site Museum (unearthed at Hemudu, Yuyao, Zhejiang Province, China).*



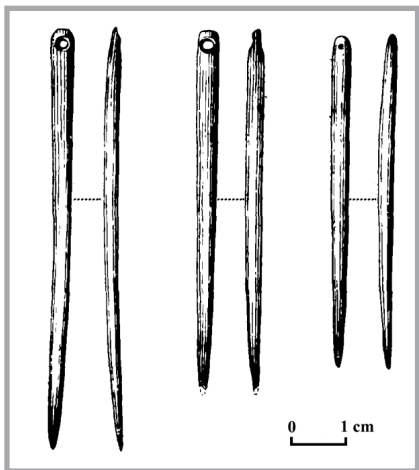
*Figure 2. Pottery jar with stork, fish and stone axe from National Museum of China (unearthed at Yancun, Linru, Henan Province, China).*



*Figure 3. Perforated animal teeth from National Museum of China (replicas: originals unearthed at Shandingdong, Zhoukoudian, Beijing, China).*



**Figure 4.** Perforated animal teeth (unearthed at Xianrendong, Haicheng, Liaoning Province, China). Photo from Yucai G. [26]



**Figure 5.** Bone needles (unearthed at Xiaogushan, Haicheng, Liaoning Province, China). Photo from Weiwèn H. [27]



**Figure 6.** Usage of spheroids. Picture from Shanxi Museum.



**Figure 7.** Netting shuttle from Hemudu Site Museum (unearthed at the fourth cultural layer of the Hemudu Site, Yuyao, Zhejiang, China).

## Hunting tools

### Slings

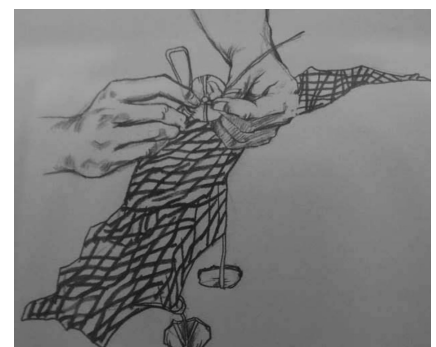
Using slings to capture prey for gauchos in South America was described by Darwin in his around-the-world travel diary in this way: they bound and connected two stone balls using ropes, with a ring-handle tied between, and for capturing big animals, they gripped the ring-handle and twirled the two stone balls in the air, and then threw them to entangle the legs of the animals.

In China, thousands of stone balls were unearthed at the Hsuchiayao site in Shanxi Province, which can be dated back to 100000 years ago [28], among which, the biggest stone balls weigh more than 1.5 kg, with a diameter of over 100 mm. And a large number of animal fossils were also excavated together with the stone balls. It can be inferred that humans in Hsuchiayao were likely to capture these animals by using slings in the way shown in *Figure 6*.

Therefore the weight and sizes of the stone balls and the usage of slings suggested that humans in Hsuchiayao had learned to make ropes with textile materials, even plant fibers, because the sling should be so long and so strong that it can bind and bear the large stone balls. But as for the problems as to which kind of textile materials (fibers or just animal intestines) or what textile technology were used to make the slings, this need to be further explored.

### Fishing nets

Many civilization in the world originated where there was water, which can supply humans with food, such as fish. Fishing nets were important tools for humans to catch fish. Although no original fishing nets have been unearthed up to now, many related relics can suggest the



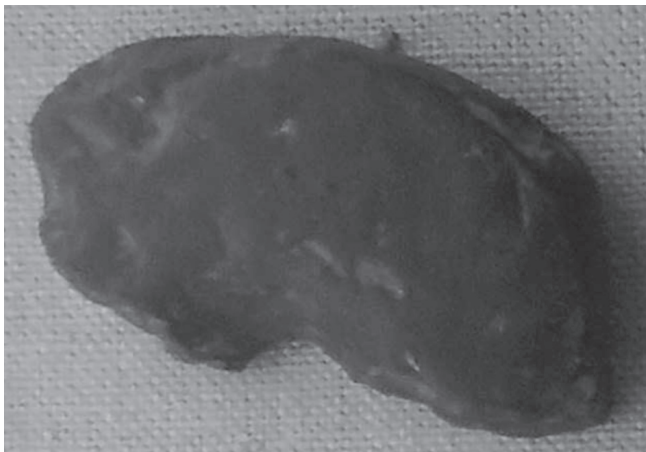
**Figure 8.** Usage of net sinkers. Picture from Xi'an Banpo Museum.

## Stringing tools

Among those artifacts unearthed at various prehistoric culture sites, there were a large number of stone and bone objects which were perforated. For example, many perforated animal teeth were unearthed at the Caveman site (*Figure 3*, see page 109) in the Beijing Zhoukoudian area (about 20000 years ago) [25], and at the Xianren cave site (*Figure 4*) in Haicheng, Liaoning, China (about 20000~40000 years ago) [26]. Obviously these perforated artifacts must have been stringed by ancient textile materials so that they can be worn or carried by humans.

Particularly in a cave of the Xiaogushan site, Liaoning, China, three bone needles (*Figure 5*) were found which can be dated back to 20000~40000 years ago [27]. One of them, 77.4 millimeters long, was intact with a smooth needle stem, and at one end of it, there was a perforated pinhole with the diameter of 1.6mm, and the other end was the needle tip. Another bone needle was 65.8mm long with a perforated pinhole which had a diameter of 2.1mm, and the needle tip was damaged slightly. The third one must have been a semi-finished bone needle, because at the end, where there should be a pinhole, the needle stem was not perforated entirely and hence there was just a shallow slot with the largest diameter of about 3.4mm.

The findings of bone needles with perforated pinholes suggested that humans in Xiaogushan of that period had likely learned to sew soft materials (e.g. animal skins, leaves, etc.) using needles with fibrous materials, because the diameters of pinholes was so small that common natural materials could not go through it. Hence humans in that period had also learned some ways to make textile materials with small diameters.



**Figure 9.** Graphite net sinkers from Shanxi Museum (unearthed at Zhiyu, Shuozhou, Shanxi Province, China).



**Figure 10.** Boat-shaped painted pottery jar from the National Museum of China (unearthed at the Beishouling Site, Baoji, Shaanxi Province, China).

existence of them. For example, various netting shuttles, a kind of tool used to make nets, were found at the Cishan site (7600~8000 years ago) [29], Hemudu site (**Figure 7**), and Xinkailiu site (6100 years ago) [30].

The primitive humans in Banpo (6000~6700 years ago) are famous for eating fish as the main food, and a large number of stone net sinkers, which were bound at the edges of the net to weigh it down, as shown in **Figure 8**, were unearthed at the Banpo site. The oldest net sinker unearthed up to now was the graphite one (**Figure 9**) found at the Zhiyu site, which can be dated back to 30000 years ago [23]. Thus humans in that period had already learned to make fishing nets using textile materials.

In addition, on the surface of many unearthed ancient painted pottery, there are net-like designs. For instance, a boat-shaped painted pottery jar (**Figure 10**) was found at the Beishouling site (5600~7100 years ago), Shaanxi, China. And on the surface of the jar, there is a design of net with net sinkers at the edges. It can be suggested that this jar boat with a fishing net on the surface mirrors a fishing scene using nets with primitive humans.

### Protecting and disguising tools

For hunting their target or prey successfully, primitive humans sometimes disguised themselves as prey-like animals. Then ancient textile materials played important roles, which were used as protecting or disguising tools, which can be

inferred from some ancient drawings on the surfaces of walls, rocks or painted pottery.

A hunting scene was depicted by a group of drawings (1.12 meters high and 0.91 meters wide) on the rocks of Yin Mountains in Inner Mongolia, China. In the upper right corner of the drawings, there is a hunter disguised with an artificial tail, near whom several animals were running away. And at the bottom, a goat was shot in the body by an arrow fired by another hunter, also with an artificial tail [31].

Moreover in the Palaeolithic Age of France, hunters disguised with animal skins were drawn in the frescoes of a cave which can be dated back to 15000~17000 years ago. And in a rock drawing with a history of 11000 years, hunters disguised themselves as ostriches using their skins.

These ancient drawings suggested that humans in those periods had already learned to disguise themselves using ancient natural textile materials, such as animal feathers, skins and fur, or plant

materials. Hence the original purpose for humans to wear animal-related materials must have been disguising themselves for easy hunting.

Gradually humans were so accustomed to this behavior that they started to wear them not only for hunting. For example, a painted pottery basin, which can be dated back to 5000 years ago, was found at Sunjiazai, Qinghai, China [32]. On the inner surface of the basin, there were five dancers with tail decorations (**Figure 11**). And another example, in a rock drawing in Dengkou County, Inner Mongolia, China, four persons with tail decorations dance by imitating the flying movements of birds [31]. These drawing scenes related to human dancing suggested that tail decorations likely originated from disguising for hunting.

Obviously for wearing animal-related decorations (a kind of ancient textile materials) conveniently in various ways, human must have processed the materials. And it is suggested that this process may have enlightened humans about some other usages of textile materials.



**Figure 11.** Painted basin with dancing design from the National Museum of China (unearthed at Sunjiazhai, Datong, Qinghai Province, China).

## ■ Conclusion

Textile materials are an indispensable part of the course of human evolution. Because of the characteristic functions of combining or connecting, textile materials can facilitate the activities of human life and production. Thus textile materials must have originated as tools, which have a longer history than any textiles unearthed.

Textile materials were widely available, easily processed, and were not inferior, even superior, to stone tools. Hence the time when textile materials were utilised by humans must have been at least no later than the origins stone tools, which can be suggested by the related indirect evidence contained in larg numbers of hard relics.

For human production and life, the combining function of textile materials was as important as the dividing function of stone tools. Many hard tools (e.g. stone tools, bone tools, wooden tools, etc.) of the Neolithic Age were made up of two or more parts which needed to be connected or combined together by pliable and slender textile materials. And the bone needles with a millimeter-sized pinhole dating back to 20000~40000 years ago suggested even more that fibers or threads with millimeter-sized diameters had already been utilised by humans in the Palaeolithic Age. As for the original time when the original textile materials within easy reach (e.g. weeds, rattan, etc.) were used directly by humans for binding and carrying, this must have been earlier.



## References

1. Cybulska M, Maik J. Archaeological textiles – A need for new methods of analysis and reconstruction. *Fibres and Textiles in Eastern Europe* 2007; 15(5-6): 185-189.
2. Cybulska M, Jedraszek-Bomba A, Kuberski S and Wrzosek H. Methods of Chemical and Physicochemical Analysis in the Identification of Archaeological and Historical Textiles. *Fibres and Textiles in Eastern Europe* 2008; 16(5): 67-73.
3. Schlabow K. Textilfunde der Eisenzeit in Norddeutschland. Göttinger Schriften zur Vor- und Frühgeschichte (Band 15). Neumünster: Karl Wachholtz Verlag; 1976.
4. Cybulska M. Reconstruction of Archaeological Textiles. *Fibres and Textiles in Eastern Europe* 2010; 18(3): 100-105.
5. Cybulska M. To See the Unseen. Computer Graphics in Visualisation and Reconstruction of Archaeological and Historical Textiles. In: Mukai N, editor. *Computer Graphics: InTech*; 2012. p. 213-228.
6. Kuzmin YV, Keally CT, Jull AJT, Burr GS and Klyuev NA. The earliest surviving textiles in East Asia from Chertovy Votora Cave, Primorye Province, Russian Far East. *Antiquity* 2012; 86(332): 325-337.
7. Strand EA, Frei KM, Gleba M, Mannering U, Nosch M-L and Skals I. Old Textiles — New Possibilities. *European Journal of Archaeology* 2010; 13(2): 149-173.
8. Brøns C. Textiles and Temple Inventories: Detecting an Invisible Votive Tradition in Greek Sanctuaries in the Second Half of the First Millennium BC. In: Fejfer J, Moltesen M, Rathje A, editors. *Tradition: Transmission of Culture in the Ancient World*. Danish Studies in Classical Archaeology. Acta Hyperborea. 14. University of Copenhagen: Museum Tusulanum Press; 2015. p. 43-83.
9. Good I. Archaeological Textiles: A Review of Current Research. *Annual Review of Anthropology* 2001; 30: 209-226.
10. Harlow M, Michel C, Nosch MLB, editors. *Prehistoric, Ancient Near Eastern and Aegean Textiles and Dress: An Interdisciplinary Anthology*. Ancient Textiles (Book 18). Oxford, UK: Oxbow Books; 2014.
11. Harlow M, Nosch M-L, editors. *Greek and Roman Textiles and Dress: An Interdisciplinary Anthology*. Ancient Textiles (Book 19). Oxford, UK: Oxbow Books; 2014.
12. Gleba M and Mannering U, editors. *Textiles and textile production in Europe from prehistory to AD 400*. Ancient Textiles (Book 11). Oxford, UK: Oxbow Books; 2012.
13. Strand EA, Nosch M-L, editors. *Tools, Textiles and Contexts: Textile Production in the Aegean and Eastern Mediterranean Bronze Age*. Ancient Textiles (Book 21). Oxford, UK: Oxbow Books; 2015.
14. Nosch M-L, Koefoed H, Strand EA, editors. *Textile Production and Consumption in the Ancient Near East: archaeology, epigraphy, iconography*. Ancient Textiles (Book 12). Oxford, UK: Oxbow Books; 2013.
15. Strand EA, Cybulska M. Visualising Ancient Textiles – how to make a Textile Visible on the Basis of an Interpretation of an Ur III Text. In: Nosch M-L, Koefoed H, Strand EA, editors. *Textile Production and Consumption in the Ancient Near East Archaeology, Epigraphy, Iconography*. Ancient Textiles Series (Book 12). Oxford, England: Oxbow Books; 2013. p. 113-127.
16. Cybulska M, Kuberski S, Maik J and Orlińska-Mianowska E. Figural Embroidery from Tum Collegiate Church – Analysis, Reconstruction and Identification. In: Banck-Burgess J, Nübold C, editors. *The North European Symposium for Archaeological Textiles (NESAT XI)*; Esslingen am Neckar: Verlag Marie Leidorf; 2013. p. 185-191.
17. Yuan T and Weidong Y. Study on Origin of Costume Based on Functions of Carrying Tools. *Journal of Silk* 2015; 52(05): 71-75.
18. Yuan T and Weidong Y. Investigation of the Existence of Textile Materials as Pens from Painted Pottery. *Applied Mechanics and Materials* 2015; 703: 64-67.
19. Weidong Y, editor. *Textile Materials*. Beijing: China textile press; 2006.
20. Kovacevic S and Car G. Analysis of the Oldest Wool Fabric Found in Europe. *Fibres and Textiles in Eastern Europe* 2014; 22(5): 49-53.
21. Archaeological Team of Humudu Site. Main discoveries in the second phase of excavation of Hemudu site, Zhejiang Province. *Cultural Relics* 1980; (5): 1-15.
22. Cultural Centre of Linru County. Investigation of the Neolithic site at Yan Village in Linru County. *Cultural Relics of Central China* 1981(1): 5-8.
23. Lanpo C, Pei G and Yugui Y. Report on the excavation of Zhiyu paleolithic site, Shanxi province. *Acta Archaeologica Sinica* 1972; (1): 39-58.
24. Nanjing Museum. A Neolithic site at Qingdun, in Haiyan County, Jiangsu Province. *Acta Archaeologica Sinica* 1983; (2): 147-190.
25. Pei WC. A preliminary report on the Late-Palaeolithic cave of Choukoudien. *Bulletin of the Geological Society of China* 1934; (13): 327-358.
26. Yucai G. The boring technique of the ornaments at Xianren Cave Site, Haicheng and related questions. *Acta Anthropologica Sinica* 1996; (4): 294-301.
27. Weiwen H, Zhenhong Z, Renyi F, Baofeng C, Jingyu L, Mingye Z, et al. Bone artifacts and ornaments from Xiaogushan site of Haicheng, Liaoning province. *Acta anthropologica Sinica* 1986; (3): 259-266.
28. Lanpo C, Qi W and Chaorong L. Report on the excavation of Hsuchiyayao Man Site in 1976. *Vertebrata Palasiatica* 1979; (4): 276-293.
29. Yan K. Research on Cishan Culture. Master Thesis, Shandong University, China, 2012.
30. Archaeological Team of Heilongjiang Province. Excavations at the site of Xinkailiu in Mishan county. *Acta Archaeologica Sinica* 1979; (4): 491-518.
31. Shichi W. Chinese Primitive Art. Beijing: Zijincheng Press; 1996.
32. Archaeological Team of Qinghai Province. Painted basin with the design of dancing unearthed from Sunjiazhai, Datong, Qinghai province. *Cultural Relics* 1978; (3): 48-49.

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