

Archaeological/historical/heritage research: The plate has been examined and described in detail on several occasions since its discovery.

Main threats or potential threats to the site: The object is well and safely preserved.

Management: The original plate is only shown to the public in very rare cases. Replicas of it are displayed at several museums around the world.

Additional bibliography

Hahn, J. (1988). *Die Geißenklösterle-Höhle im Achtal bei Blaubeuren*. Stuttgart: Karl Theiss Verlag.

Holdermann, C.-S., Müller-Beck, H. and Simon, U. (2001). *Eiszeitkunst im süddeutsch-schweizerischen Jura: Anfänge der Kunst*. Stuttgart: Karl Theiss Verlag.

Case Study 1.3: The Ishango Bone, Democratic Republic of the Congo

Presentation and analysis of the object and its place of discovery

Geographical position: The object was found at an open-air site within Virunga National Park, near the town of Goma, Democratic Republic of the Congo.

Location: Latitude 0° 7′ 37″ S, longitude 29° 36′ 2″ E. Elevation 912m above mean sea level.

General description: The terrace named Ishango (or alternatively Isango-Isoro/Isanga-Isoro) is located on the north-western shore of Lake Rutanzige (Lake Edward) close to the outflow of the Semliki River. Fishermen and gatherers settled here during the Upper Palaeolithic, and excavations have revealed small ivory points, barbed bone points, fish bones, bones of different species of mammals, quartzite tools, and a decorated haft made of a baboon bone, as well as human remains.

Inventory of the remains: The ‘Ishango bone’ is a slightly curved fibula of a baboon, about 10 cm long and dark brown in colour, which was discovered on the terrace in 1950. A short piece of quartz is fixed to one head of the bone, protruding by only 2 mm, and served as a blade. The tool was engraved with groups of notches arranged in three columns running the length of the bone. The first column (*G*) consists of 60 notches divided into four groups, containing 11, 13, 17, and 19 respectively; the second column (*M*) consists of 48 notches divided into eight groups containing 3, 6, 4, 8, 10 (9+1), 5 (1+4), 5, and 7 respectively; and the third column (*D*) consists of 60 notches divided into four groups containing 11, 21, 19, and 9 respectively.

History of the site and object: Geological surveys in the 1930s in the area of the Semliki River resulted in the incidental discovery of archaeological remains from the Middle and Upper Palaeolithic and the establishment of a basic Upper Semliki stratigraphy. Although presented in an excavation report of 1957, the Ishango bone was first interpreted as an example of proto-mathematics in 1962. A subsequent re-evaluation of the archaeological dating places the bone between c. 25,000 BP and 16,000 BP.

Cultural and symbolic dimension: Evidently the Ishango bone was designed as a tool for making incisions, but its bone handle was itself incised. The arrangement of the notches engraved on the handle, and the numbers in each group, are clearly not casual. Analysis of their numerological properties has led several investigators to conclude that the artefact is not a simple tally stick, but a kind of calculator based on special number systems. Each of the groupings in the left and right columns (*G*, *D*) contains an odd number of notches (9, 11, 13, 17, 19, and 21), while the numbers contained in the first column (*G*) are precisely the four prime numbers between 10 and 20. Certain adjacent groupings in column (*D*) contain 10 or 12 notches in total. From facts such as these it is supposed that the groupings represented numbers and the whole design represented a system of reckoning based upon counting by digits. The column totals (60, 48 and 60) suggest that a mixed base of 10 and 12 was used. It has also been suggested that the bone could have been used for time reckoning, following the observable course of the moon over a period of about 5½ synodic (lunar phase cycle) months, based on a period of a double lunation of 59–60 days.

Comparative Analysis: This interpretation of the Ishango bone provides evidence that people during earlier prehistory could have developed significant proto-mathematical knowledge beyond simple counting. This includes the selection of certain numeral bases (10, 12), specific kinds of numbers (odd, even, prime numbers), and rules of multiplication and division by two. An object such as the Ishango bone could have been used for time reckoning, for special games or other purposes.

Another decorated bone handle was discovered in 1957 from a similar archaeological context, but notes on this only became available in 1998. This object also contains engraved notches, in this case forming six groups, two of which are subdivided into a series of longer and a series of shorter grooves. The numerical sequence (20 [14 long, 6 short], 6 [long], 18 [long], 6 [long], 20 [long], 8 [6 long, 2 short]) has been interpreted as a kind of reckoning using a mixed base of 6 and 10.

Authenticity and integrity: The Ishango bone comes from a secure archaeological context and is well preserved. The artefact is fossilized and its surface shows only minor changes due to water and to the chemical effects of the surrounding soil.

Present management of the site and object

Present use: The Ishango bone is on permanent display in l’Institut Royal Belge des Sciences Naturelles, Brussels, Belgium. At least one international scientific conference (in 2007) has been dedicated exclusively to the interpretation of this unique artefact.

Protection: Virunga National Park was inscribed on the World Heritage List in 1979 (no. 63) and in 1994 it was placed on the List of World Heritage in Danger. The Ishango bone is well protected according to the usual standards of deposition and exhibition in a modern museum.

State of conservation: For the bone, normal procedures of conservation are applied, following international standards.

Context and environment: The landscape of Virunga National Park (c. 300 km × 150 km) is characterised by Lake Kiwu and Lake Edward, the Volcanoes of Virunga, the Ruwenzori Range which contains the peak of Mount Stanley (5109 m), and the Great Rift Valley. Its exceptional flora and fauna include one third of the world’s remaining mountain gorillas.

There exist several open air sites close to Ishango on the banks of the Upper Semliki River and along the northern shore of Lake Rutanzige: examples are Kabale, Katanda, and Kasaka. They reveal artefacts dating to the Lower, Middle and Upper Palaeolithic as well as to the Neolithic epoch (8,000–1,300 BP).

Archaeological/historical/heritage research: The archaeological context was first researched and documented by a team led by Jean de Heinzelin in the 1950s; Alison Brooks and colleagues undertook a re-evaluation of the Ishango site during the 1980s and 1990s and provided modern dating evidence. The ethnomathematical interpretation of the Ishango bone was first presented by de Heinzelin in 1962 and has since been pursued by Dirk Huylebrouck and others. A palaeoastronomical interpretation was introduced by Alexander Marshack in 1972 and subsequently elaborated by Claudia Zaslavsky.

Main threats or potential threats to the site: There are no potential threats to the object apart from damage caused by *force majeure*.

Additional bibliography

Brooks, A.S. *et al.* (1995). “Dating and context of three Middle Stone Age sites with bone points in the Upper Semliki Valley, Zaire”, *Science* NS 268, 548–553.

de Heinzelin, J. (1957). *Les Fouilles d’Ishango* (2 vols.). Bruxelles: Institut des Parcs Nationaux du Congo Belge.

de Heinzelin, J. (1962). “Ishango”, *Scientific American* 206, 105–116.

Huylebrouck, J. (2008). *Afrique et Mathématiques. Ethnomathématique en Afrique Noire, depuis le Temps de la Colonie jusqu’à la plus Ancienne Découverte Mathématique*. Brussels: ASP.

Zaslavsky, C. (1999). *Africa Counts: Number and Pattern in African Culture* (3rd edn.). Chicago: Lawrence Hill Books.



Fig. 1.3.1. Left: The Ishango bone. Based upon an image from the Royal Institute for Natural Sciences of Belgium in Brussels. **Right:** The numerology of the countable notches arranged on the stick. After D. Huylebrouck, “Afrika, die Wiege der Mathematik”, *Ethnomathematik, Spektrum der Wissenschaft* 2 (2006), 10–15.

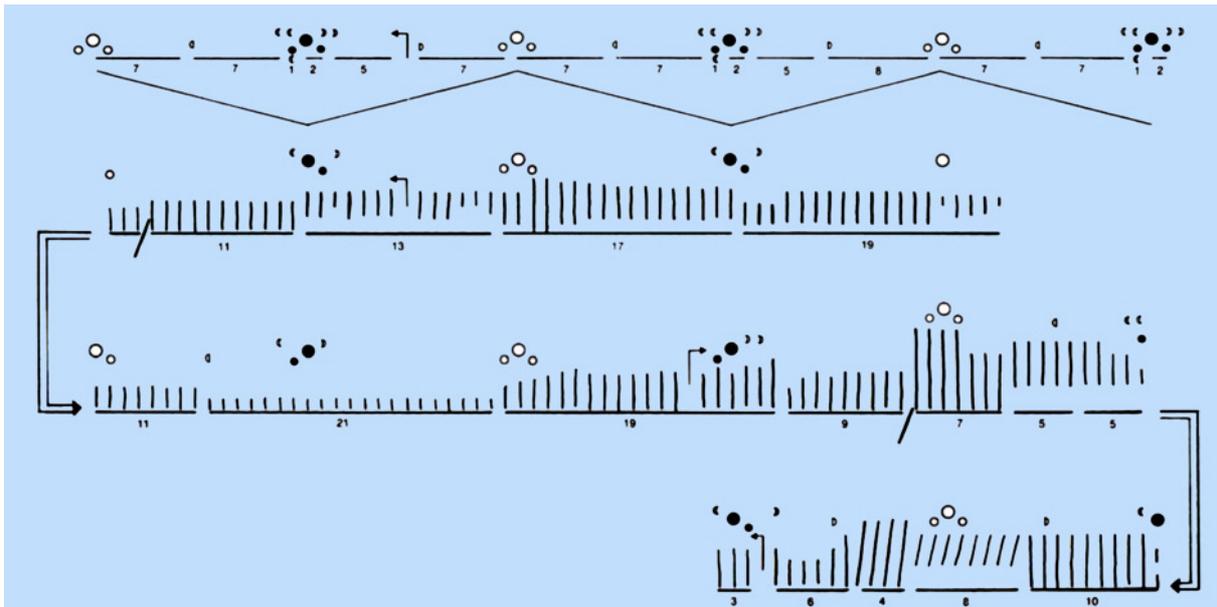


Fig. 1.3.2. The sequence of notches interpreted in terms of lunar time reckoning. After A. Marshack, *The Roots of Civilization* (New York, 1991), fig. 3.

Case Study 1.4: The Astronomical Rock Panels in the Lascaux Cave, France

Presentation and analysis of the site

Geographical position: The Lascaux cave (Grotte de Lascaux) is situated in the valley of the river Vézère, 1200 m south-east of Montignac, Département de la Dordogne, France.

Location: Latitude 45° 3′ 17″ S, longitude 1° 10′ 44″ E. Elevation 185m above mean sea level.

General description: The Lascaux cave is embedded in the Santon limestone massif, its entrance being just below the top of Lascaux hill, c. 90 m above the valley floor of the Vézère. It comprises three long and narrow subterranean galleries in the form of a letter ‘K’ and measuring almost 250 m in length, including what have become known as the Axial Gallery, the Hall of the Bulls, the Chamber of Felines, the Nave, the Apse, and the Shaft. Covering most parts of the cave are numerous monochrome and polychrome paintings and engravings. The published corpus lists 1963 figures including animals (horse, aurochs, bison, ox, stag, ibex, feline, woolly rhinoceros, bird, bear), an anthropoid, a chimera, some possible abstract representations of plants, and symbols (geometric figures, series and sets of dots etc). Carbon-14 dates (from charcoal used sparingly for painting), pollen analysis and stylistic evaluations suggest that the majority of the rock pictures should be associated with the Lower Magdalenian, c. 17,000-15,000 BP, although it is possible that a few were created much later, in the Mesolithic (up c. 5000 BC).

Inventory of the remains: A number of the Lascaux pictures have a possible astronomical significance. These include the ‘Chinese horse’ and ‘fronting ibex’ in the Axial Gallery and the ‘crossed bison’ in the Chamber of Felines (natural calendars); the stag-and-horse motif