

Paulus Gerdes <sup>1</sup>

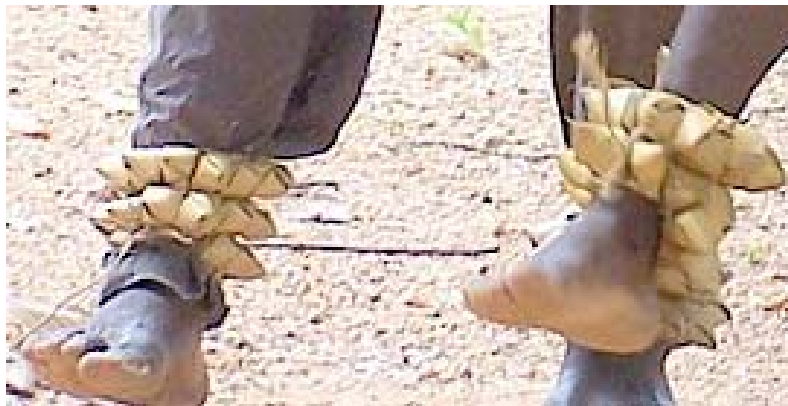
**African dance rattle capsules  
from Benin, Nigeria and Congo:  
Plaiting a symmetric, hexahedral shape**

**Abstract**

The following paper presents examples of dance rattles from several parts of Africa. The capsules of these rattles from Benin, Nigeria, and Congo are plaited in a similar way. They display a (rounded-off) hexahedral shape and each capsule is made from only one strip of a leaf. A plaited capsule can be represented in the plane as an alternating knot, precisely as a trefoil. The paper shows how to weave a strip of cardboard paper to produce the hexahedral shape.

**African dances**

Africa is very rich culturally both in diversity and in unity. Dances belong to the common heritage of the continent. Frequently dancers wear rattles or shakers wrapped around the arm, wrist, waist, knee, leg or ankle. The rattles provide a rhythmic background to music during the dance. They may consist of a chain of capsules formed by pods, fruits, or nuts. The capsules may also be woven (plaited or braided) from palm leaf strips with small seeds inside each of them. These capsules or compartments are strung together on one or two cords. Photograph 1 presents ankle rattles in movement during a dance among the Tammari population who inhabit the north of Benin and the neighbouring area of Togo in West Africa.



Tammari dance rattles from Benin  
Photograph 1

The particular, approximately polyhedral shape of the capsules of these Tammari and similar dance rattles will be analysed in the paper.

---

<sup>1</sup> Ethnomathematics Research Centre, C. P. 915, Maputo & ISTEg, Boane, Mozambique (paulus.gerdes@gmail.com)

## Various polyhedral shapes

In recent papers (Gerdes 2012a, b) I analyse the **octahedral** shape of the plaited capsules of a Nuer dance rattle from South Sudan and the **nonahedral** shape of plaited capsules of dance rattles from Cameroon, Kenya, Somalia, Mozambique, and Madagascar. Earlier I discussed and explored, in the book *Geometry from Africa* (Gerdes 1999, pp. 148-153), the **decahedral** shape of the plaited capsules of the '**bamboyo**' rattle that is produced and used among the Bassari in the border region of Senegal and Guinea. Each of the '**bamboyo**' capsules is made from only a single palm leaf strip too. In the book *Otthava: Making Baskets and Doing Geometry in the Makhuwa Culture in the Northeast of Mozambique* (Gerdes 2007, 2010, 2012, pp. 153-189) and in the papers (Gerdes 2004, 2005) I analyse the nonahedral shape of the '**nirrosula**' rattle capsules.

What will be the shape of the Tammari rattle capsules?

## Similarly plaited rattle capsules

Rattles composed of capsules plaited in a way similar to the Tammari capsules are presented in Photographs 2 to 6.



Igbo, Nigeria (2012)  
Photograph 2



Birom, Nigeria (1962) (Vernacular name: *wàgà*)  
Photograph 3



Zande, Congo (1913) (Vernacular name: *akwa*)  
Photograph 4



Mangbetu, Congo (1912) (Vernacular name: *sese*)  
Photograph 5



Border area Cameroon / Central African Republic (1970)  
Photograph 6

The Zande and Mangbetu rattles shown in Photographs 4 and 5 were collected by the Armand Hutereau expedition in 1913 and 1912, respectively, along the Uele river in the Northeast of today's DR of Congo. They are kept at the Royal Museum for Central Africa (RMCA, Tervuren, Belgium). The Zande population lives also in South Sudan and in the Southeastern Central African Republic. Photograph 7 displays an ankle shaker from Nigeria, kept at the Ethnographic Museum of Zagreb (Croatia). The museum describes the rattle as “made of a chain of reed cones filled with seeds and fixed on thin twine.”

Let us analyse the shape of these “cones.”



Nigeria  
Photograph 7

### Shape of the plaited capsules

Photographs 8 and 9 present a close-up of a few plaited capsules of the Zande and Mangbetu rattles, respectively.



Close-up of a Zande rattle  
Photograph 8



Close-up of a Mangbetu rattle  
Photograph 9

Each plaited capsule has three components, as Photograph 10 illustrates: (a) the proper capsule plaited of one strip, (b) the seeds, (c) a shorter strip to fix the capsule to the two cords.



The three components in the case of an Igbo rattle capsule  
Photograph 10

Having observed a capsule unravelled, opened-up as in Photograph 10, the author succeeded in producing a cardboard paper version of a capsule. Photograph 11 presents two views of the result. The shorter strip helps to flatten one curved face of the capsule, so that one may get the impression that the capsule itself has the shape of a ‘cone’ or of a ‘square pyramid.’



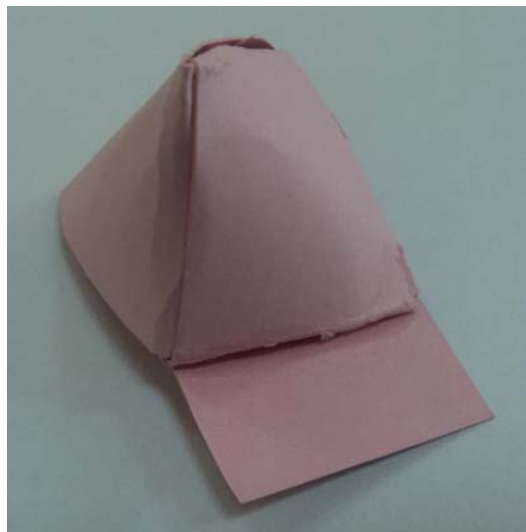
a



b

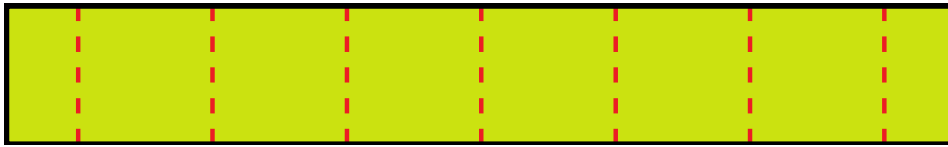
Two views of a capsule made of cardboard paper  
Photograph 11

If one only plait the proper capsule without joining the shorter strip, one sees that its shape is more rounded-off. Photograph 12 shows a cardboard capsule before cutting off the outstanding strip part. The surface of the capsule is composed of three congruent, curved faces. Each face is a square curved in space.



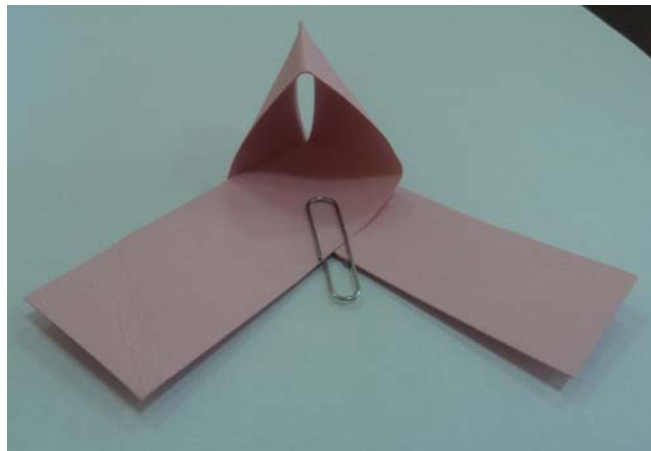
Cardboard capsule  
Photograph 12

To weave such a cardboard capsule, one may produce a piece pattern whereby six squares are visible as the unravelled capsule in Photograph 10 suggests. Figure 1 presents the piece pattern with six squares. The red lines are the fold lines.



Piece pattern  
Figure 1

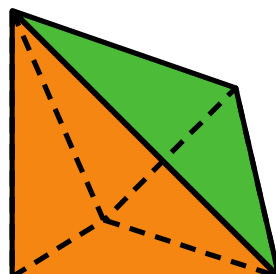
Photograph 13 shows where and how to join the two halves of the strip as starting point for plaiting the capsule.



Starting point for the plaiting of the capsule  
Photograph 13

### Hexahedral shape

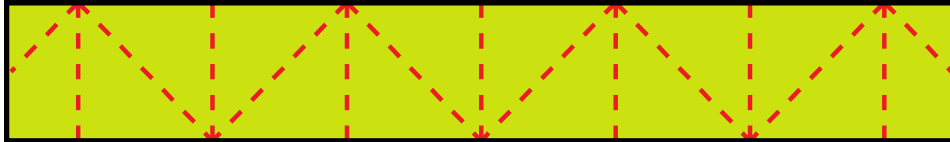
By turning one diagonal of each curved square visible, the initial three curved squares become six congruent isosceles, right triangles. And the shape of the capsule becomes that of a triangular dipyramid (Figure 2).



Triangular dipyramid  
Figure 2

Figure 3 presents the pattern piece for plaiting this hexahedron.



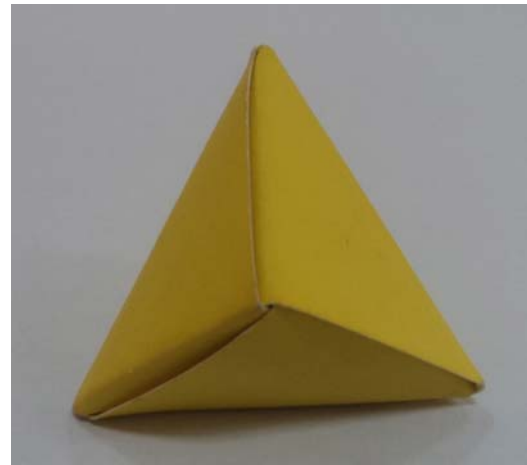


Pattern piece  
Figure 3

Photograph 14 presents two views of a triangular bipyramid made with one strip of cardboard paper. The shape is the same as that of the *mini-nirrosula*, introduced in my earlier studies of variations of the nonahedral *nirrosula* dance rattle capsule from the Makhuwa population in the Northeast of Mozambique.



a



b

Two views of a plaited hexahedron  
Photograph 14

### Alternating knot representation

The surface of a plaited hexahedron may be represented in the plane (imagine how to expand the curved strip in Photograph 13) by a trefoil. Photograph 15 presents an amulet of the Yaka in the Southwest Congo and Angola, used around the neck or pulse to drive away wrongdoers. Interestingly, it has the same symmetric, trefoil structure as the alternating knot representation of the plaited capsule in the rattles and shakers from Benin, Nigeria, Congo, ... considered in the paper.



A Yaka amulet in the form of a trefoil  
Photograph 15

**Another 'polyhedron' corresponding to the trefoil**

Consider the three edges on the symmetry plane of a plaited mini-*nirrosula*. They correspond to the diagonals of three folded squares. In the pattern piece they are valley folds. What will happen if instead of using only valley folds, one alternates valley and mountain folds?

The result is the pseudo-hexahedron presented in Photograph 16.



Two views of the plaited pseudo-hexahedron  
Photograph 16

## References

Gerdes, Paulus (1999), *Geometry from Africa: Mathematical and Educational Explorations*, The Mathematical Association of America, Washington DC, 210 pp.

Gerdes, Paulus (2004), Weaving Polyhedra in African Cultures, *Symmetry: Culture and Science*, Budapest, Vol. 13, No. 3-4, 339-355.

Gerdes, Paulus (2005), *Nirrosula*, an African musical instrument as a source of inspiration for mathematical exploration, in: Rosemond, Frances A. & Copes, Larry (Eds.), *Educational Transformations: Changing our lives through mathematics; A tribute to Stephen Ira Brown*, AuthorHouse, Bloomington Indiana, 367-378.

Gerdes, Paulus (2007), *Othava: Fazer Cestos e Geometria na Cultura Makhuwa do Nordeste de Moçambique*, Lúrio University, Nampula & Lulu, Morrisville NC, 290 pp. (Colour edition: ISTEG, Boane & Lulu, Morrisville NC, 2012).

Gerdes, Paulus (2008), Explorando poliedros do Nordeste de Moçambique, in: Palhares, Pedro (Ed.), *Etnomatemática: Um Olhar sobre a Diversidade Cultural e a Aprendizagem Matemática*, Edições Húmus, Ribeirão, 317-359.

Gerdes, Paulus (2010), *Othava: Making Baskets and Doing Geometry in the Makhuwa Culture in the Northeast of Mozambique*, Lúrio University, Nampula & Lulu, Morrisville NC, 290 pp. (Colour edition: ISTEG, Boane & Lulu, Morrisville NC, 2012).

Gerdes, Paulus (2012a), A Nuer dance rattle (South Sudan): Plaiting an octahedral shape, *Visual Mathematics*, The Mathematical Institute, Belgrade, Vol. 14, No. 3  
(<http://www.mi.sanu.ac.rs/vismath/gerdesoct2012/octahedron.pdf>)

Gerdes, Paulus (2012b), African dance rattle capsules from Cameroon to Madagascar, from Somalia to Mozambique: Plaiting a symmetric, nonahedral shape, *Visual Mathematics*, The Mathematical Institute, Belgrade, Vol. 14, No. 3  
(<http://www.mi.sanu.ac.rs/vismath/gerdesnovember2012/nonahedral.pdf>)

## Sources of illustrations

### Photographs

- 1 Detail of a photograph taken in 2007 in Boukoumbé, North of Benin: Rob Baker's Photo Gallery – Ethnomusicology ([http://www.robbaker.org/gallery2/main.php?g2\\_itemId=1916&g2\\_imageViewsIndex=1](http://www.robbaker.org/gallery2/main.php?g2_itemId=1916&g2_imageViewsIndex=1))
- 2 Webpage: [thedrummerslounge.com](http://thedrummerslounge.com)
- 3 Royal Museum for Central Africa, Tervuren, Belgium: MO.1962.14.23 (collected by Luc Bouquiaux). Cf. also another rattle from the Birom culture (MO.1962.14.55) with the same shape.
- 4 Royal Museum for Central Africa, Tervuren, Belgium: MO.0.0.11292
- 5 Royal Museum for Central Africa, Tervuren, Belgium: MO.0.0.10254. I thank Rémy Jadinon (Ethnomusicological Section, Royal Museum for Central Africa) for sending me the information on the vernacular names and cultures of the dance rattles presented in Photographs 3, 4, and 5.

- 6 Webpage: <http://www.arts-primitifs.com/shop-africain/music-instruments-idiophones-grelots-crecelles-congo-centrafrique-idiophones-p-2838.html>
- 7 Ethnographic Museum in Zagreb, Croatia: <http://www.muvrin.mdc.hr/en/collection/instruments/ankle-shakers,-pair,199.html?p=2>
- 8 See 4. Detail.
- 9 See 5. Detail.
- 10 Photograph taken by Dan Rice of Motherland Music, a company in California (USA) that sells African musical instruments. I thank Dan Rice for responding to me, and unravelling a capsule and sending me the photographs of the process.
- 11 New photograph by Paulus Gerdes, 2012
- 12 New photograph by Paulus Gerdes, 2012
- 13 New photograph by Paulus Gerdes, 2012
- 14 New photographs by Paulus Gerdes, 2012
- 15 Photograph 6.21 in *Ottava* (Gerdes 2007, 2010, 2012). Photo taken by René Devisch, Universiteit Leuven, Belgium.
- 16 New photograph by Paulus Gerdes, 2012

### Figures

All figures were drawn by the author.

Concluded: January 24, 2013