Throwing Bird hunting sticks and cross bamboo boomerangs from the Celebes

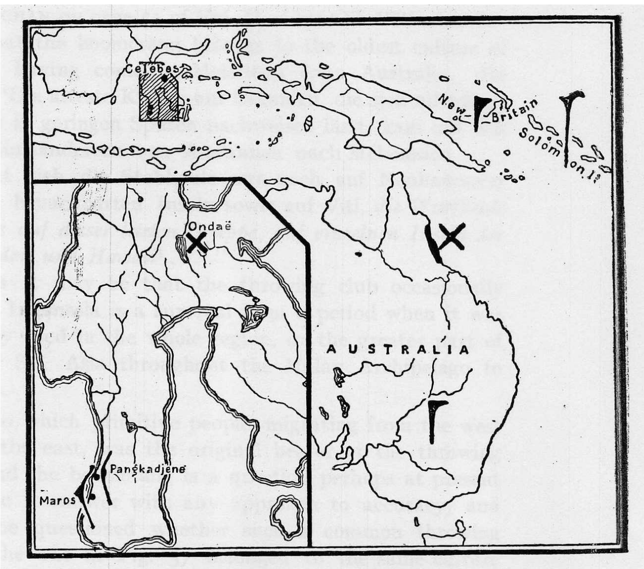
By Luc Bordes

Crafting and throwing modern boomerangs* since 1994, I became interested by ancient throwing sticks and boomerangs a few years ago. I try to figure out the great diversity of flight and use of these implements which have existed in all parts of the world .

Among many fascinating primitive objects, throwing sticks and boomerangs flights are for me some kind of pure magic things going through the so called Aboriginal « dream time » for few second, bringing you happiness. You will never be the same after catching your boomerang or watching your throwing stick hovering far away above the ground, defying gravity .

Almost everybody knows the existence of throwing sticks in Australia, but who knows about the use of throwing stick and boomerang in Indonesia? An example of throwing sticks from the Makassar peninsula in the Celebes, and the cross bamboo boomerang in used to the north in the Ondae region could open up a time window which would allow us, to consider the antiquity of these implements in Indonesia and to clarify their prehistoric relation with Australian ones.

The only article I found on the subject is from Walter Kaudern, an early 20th century ethnographer that record many aspects of the culture of the inhabitants of Celebes. All of the object drawings in this present review were taken from Kaudern's article. The purpose of this present article is to go further with the Kaudern recording of the Celebes bird hunting stick and cross bamboo boomerang, shedding light on their aerodynamic performance by crafting the same style implements and throwing them to revive these very sophisticated traditional projectiles.



Localisation of Macassar peninsula throwing sticks and cross bamboo boomerangs and other throwing sticks use noted by Kaudern in Oceania. Take note of the localisation of cross wood boomerang in Australia on the east Queensland coast.

*My terminology in this article is to call boomerangs only objects that have a 180° turning trajectory. In fact many Aboriginal words (ex bargan, boomari) which have given later this artificial name « boomerang » was attached only to light returning type of implements. Later early colonists confused by the many kinds of sticks assimilated non returning heavy throwing sticks under this same appellation. This confusion of terms continues to this day.

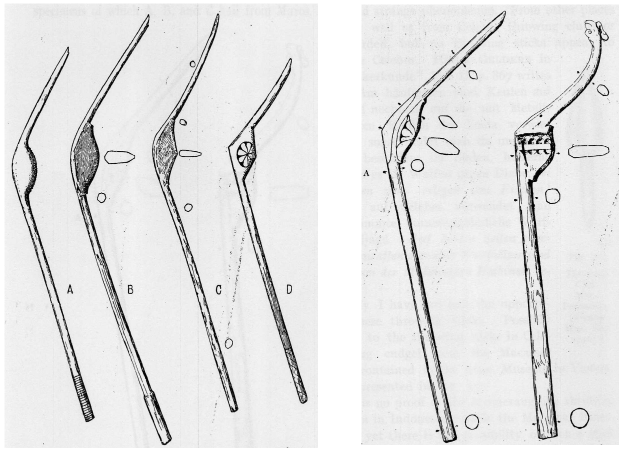
The classification of throwing sticks and boomerangs is a difficult issue that I'm trying to deal with, however it remains a subject being far beyond the point of this article.

Part A: Birds hunting stick: the Parimpah

On the Makassar peninsula in the Celebes, the use of curved throwing sticks has been observed to hunt birds. They were not, however, returning throwing sticks. Examples known are from two distinct regions: From Pangkadjen and from Maros. These two types of throwing sticks have a difference in their bend although they are very near in their general conception.
In the local language they were called Parimpah or Padimpah.

Examples from Maros

Kaudern didn't give any information about the mass nor the wood used but dimensions of these throwing stick can be directly deduced from his drawings with the scale given of 1:8. Here are some two series of sticks:



Examples of throwing stick from Maros
(Kaudern, Walter. Results of the authors expedition to Celebes 1917-1920)

To give an example, the Parimpah from Maros noted A above has a span of 72 cm with a height of 16 cm, 1,6 cm in diameter for both rounded sections of the wing, and 5,6 cm wide at the elbow.

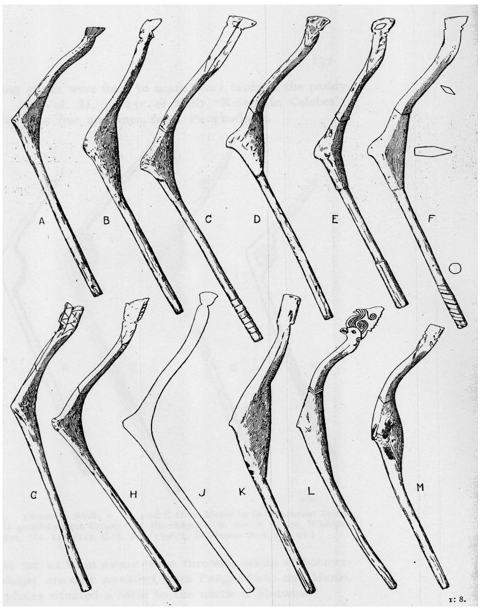
Without actually throwing any of these sticks, some information can be inferred from the precise drawing of Walter Kaudern.
We can observe that the throwing sticks of Maros are asymmetric and have a longer straight leading wing for holding and a shorter following wing curved in elaborate S shape. These sticks are enlarged at the bend which is sometimes decorated.

The airfoil cross-section of leading wing and following wing are both rounded for series on the left but the two sticks from the right series show a following wing with a différent more elliptic airfoil cross-section.
Theses rounded and elliptic rounded cross section won't allow these throwing sticks to travel very far, maybe thirty to fifty yards because off the important rotation breaking. The important mass centered on their elbow to reinforces the sticks against breakage but also it makes them climb up in their trajectory, a well known effect among boomerang thrower when you put more weight at the bend.
Obviously, these throwing sticks are not returning ones, because of their rounded cross section that do not permit enough aerodynamic lift to significantly curve the trajectory. They are also very different from Australian throwing sticks which are generally shaped using a more biconvex type airfoil cross-section.

Examples from Pangkadjen:

The sticks from Pangkadjen are similar in their conception and size to these from Maros, except for the additional wood being left at the bend, and more importantly, the following wing has a

diamond airfoil cross section.
These features give them more air penetration and rotation than the Maros sticks which have both rounded airfoil cross-sections. The ends of their following wing have some elaborate design and are partially decorated with carving. Pangkadjen sticks are a bit more elaborated than the Maros sticks aerodynamically and also from an aesthetic point of view.



Examples of throwing stick from Pangkadjen
(Kaudern, Walter; Results of the authors expedition to Celebes 1917-1920.)

For example, If we measure the dimension of the Pangkadjen stick noted F, we find 73 cm for the span, 21 cm in height, a rounded leading wing of 2 cm of cross section , 8 cm wide and 2,4 thickness at elbow, 2,8-4,8cm wide and 1,3 cm thickness for the following wing

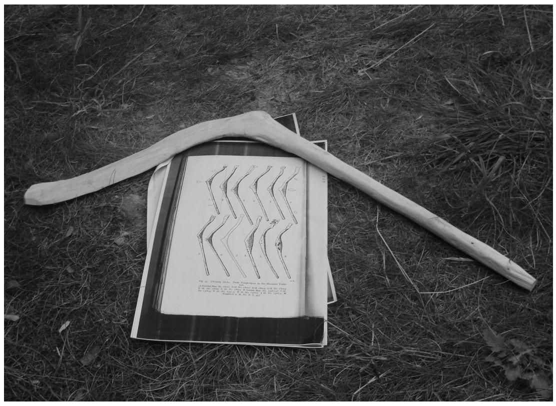
In observing these two types of Celebes throwing stick, we find that they have an important curvature (Height to spam ratio are between 0,2-0,3) and they have very narrow wing. This important curvature has a role of stabilization, preventing light throwing sticks and boomerang from flipping over in flight.
Unfortunately Kaudern didn't record the type of wood used for these implements, but an evaluation of the volume of these sticks lead to a mass around 200-250 g which sets them as light throwing sticks well designed to aim at an aerial target, but a bit too fragile for ground game hunting. Kaudern recorded that they were used for hunting birds over rice fields which have a soft muddy ground.

These throwing sticks have some very elaborate shapes, but have an overall poorly shaped airfoil cross-section, making them suitable only for short distance air throwing, which seems to be very fitting for close bird hunting. The making of the replica in the next section is going to shed light on the reason of this poorly shaped airfoil cross section against so elaborate stick shape.
These elaborate throwing sticks, could indicate a prehistoric long tradition in use of throwing stick use the Celebes that lead finally to this more recent and very elaborated specialized projectile. As only ethnographic examples has been observed we don't know how old are these Parimpah, Could have they been used already in prehistoric times or are they just only few hundreds years old ?

The Making of the replica

I made a replica of a Pangkadjen style throwing stick. My aim was to evaluate the maximum distance and kind of trajectory of this kind of stick.
I cut a suitable hawthorn tree branch, a hard wood which grows in quantity around my home with the reputation of being used for tools and weapons in Europe.
As I supposed the inhabitants of the Celebes probably had access to metal tools at the time that they crafted the Parimpah still recorded by Kaudern, In consequence, I chose a mixed metal and stone crafting method.
I made a coarse removing of the bark and outer wood with a machete, switching to a wood shaver flint block to achieve airfoil shaping, and using this same method until the stick had it's final shape. I polished it with sandstone, then smeared pork fat on the wood to protect it against moisture.

Parimpah in progress



Hawthorn wood Parimpah replica laying on the copy of Kaudern drawings

The dimensions, airfoil cross section, and thickness of both wings of the Parimpah cut according to an average stick from the series drawn by Kaudern, and also according to the size of my piece of hawthorn wood.
The final dimensions of my Parimpah are: for span 64 cm, height 22 cm , 2 cm of cross section for leading the rounded wing 5,5 wide and 1,8 cm at bend 3-3,5 cm wide 1,3 cm thickness for following wing.

Throwing the parimpah

I had my first throwing session has been tried after achieving a wood removal until a mass of 300 g in order to test a more heavy object.

With this first finished Parimpah at 300 g, it was hard to aim very high over the ground because of the weight of the throwing stick. The distance was short (20-30 yards) with a lot of braking in rotation. This first version was not designed to aim at an air target, nor was it effective to aim at a ground target, not travelling far enough with a lot of rotation. Furthermore it has the disadvantage of being more fragile and more subject to breakage than a simple throwing club on this short distance. So no need to use a Parimpah to hunt rabbits, it would be better to use a throwing club instead.

After removing more wood and shaping more on the airfoil cross section on the following wing, decreasing the thickness a bit, the mass decrease to 253 g and finally 230g after the wood dried completely.
The behaviour in flight was greatly improved:
It was light enough to allow me to throw it with much more speed at an potential air target to a maximum of 30-40 yards. The holding and handiness was fine with an throwing inclination of 45° with vertical and 40-50° over the horizon line.

I realized suddenly with this successful and efficient flight the very reason of this clever design of these throwing stick:

The following wing has an aerodynamic diamond airfoil cross section to enhance rotation so the Parimpah from Pangkadjene accelerates a lot at the start of the flight with the initial energy of the thrower, but by keeping a rounded airfoil cross section on the other leading arm, it slows down very quickly after 30-40 m, so the Parimpah could go not too far and get lost. These particular throwing stick have no curved trajectory but their aerodynamics are fitted with short distance high quick shots to make them easy to recover. The Parimpah flies very straight and is very accurate until 30 yards, flying with blinking speed.
I didn't make replica of Maros Parimpah but I can guess that they have less lift than Pangkadjene Parimpah, because of their rounded following wing cross section. It is for that reason that some examples of Maros have a more elliptic cross section on the following arm: its look like a evolution to imitate pangkadjene sticks, enhancing the shaping of their airfoil cross section to get less rotation braking.

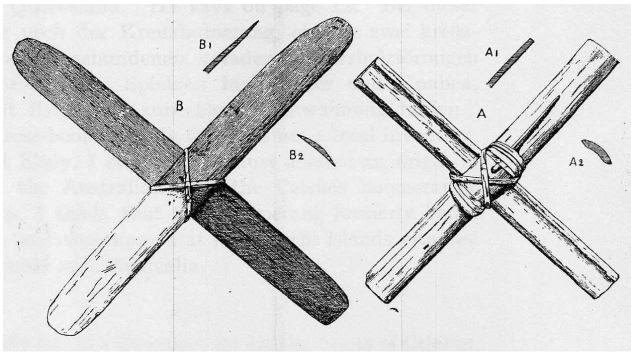
Even if a park near Paris is far from Celebes tropical environment, my few test throw showed the Parimpah is designed to aim high and could easily target a flock of bird.

The people of the Makassar peninsula have found an interesting alternative to light throwing sticks or heavy boomerang to hunt bird, avoiding a curved trajectory with low surface and a rounded airfoil cross section on the leading wing or as Maros examples on both wings.
They created very elaborate bird hunting sticks, very adapted to a tropical environment with limited open field. Do these sticks correspond to a last development of a prehistoric throwing stick tradition in Indonesia, or were they imported few hundred years ago? How old are they? A lot of question to answer with further study on these Parimpahs.

Part B: Bamboo cross boomerang

One could believe that modern cross four wings boomerangs are completely modern invention: that is not true.
Kaudern recorded the use of the cross bamboo boomerang in the village of Kelei in Ondae in Northeast Celebes. He observed some young boys playing with this bamboo boomerang with returning flights.
On the drawing of Kaudern, we can see that they are made of the assemblage of two bamboo boards around 29 cm in length and 3,2 cm wide. These boards have an almost plan-convex airfoil cross section, keeping the convex natural outer side of the bamboo and a slightly concave face on the inner side where the matter is removed to attain the right weight.
The estimated weight would be around 50 g, as I based my estimation on the density of bamboo that I used for my own experiment. That lead to a mass/surface ratio of 0.2-0.3 g/cm2.
But the density of the bamboo used by the Kelei people to make these boomerang could make them a little heavier or lighter.
Both concave sides are lashed together with a rattan strap, facing each other, convex side up and down.
The thickness of one bamboo board is approximatively 6 mm. They were exclusively use as a toy and are a returning boomerang like the different type of Australian boomerangs. They were called Motela. They could be the first precursor of our actual modern helicopter!

The striking fact is that this kind of cross boomerang is also known in a limited region along the east coast of Queensland and only in this specific region of Australia. Australian aboriginal people crafted their cross boomerang in wood because they have no bamboo available but keep the same rule of construction: Convex side toward outside, and flat or slightly concave side against each other for good tightening between the two pieces of woods. Rattan strap was also used for this type of cross boomerang.
The same mode of construction and some existing examples of wood cross boomerang imitating the natural concavity of the bamboo on the underside lead us to think that the use of this kind of boomerang in Australia is relatively recent and probably imported from the Celebes.



Drawing of Kaudern showing comparison between bamboo cross boomerang of the Celebes (right) And Australian cross boomerang crafted in the cairns regions (left)

Indeed, maybe a few thousand years ago, some Indonesian people fishing trepang along the north coast of Australia brought with them this particular cross boomerang unknown to aboriginal people in the Cairns region. Archaeological evidence of settlement from this Indonesian fisherman, the Macassan has been found along the north Australian coast and is dated from 1700. But Indonesian people came also with dingo six thousand years ago. Were they the of same people and had they already mastered the art of making this bamboo cross boomerang?
We have here some interesting examples of pre-colonial technology transfered from the Celebes to north east Australia and from bamboo made implements to wooden ones. This evokes the

question that maybe some early wooden objects could have been made of versatile bamboo before being made of wood, and that some bamboo technology could have been far older than wood technology in tropical bamboo growing regions of the world.

Making replica

As I was curious to know how these bamboo boomerangs fly, so I decided to try to make some a replica in bamboo.

Reduced size replica with section of bamboo of 2.5 and 5 cm in diameter

At first I tried with the only a short length of bamboo that I had at my disposal which has a small diameter of 2.5 cm, sawing approximately a 20 cm length. I cut out from this section two boards 1,7 cm wide with my machete, and finished with a small flint shaver and a grinding stone. Although the thickness of these fine bamboo board was only 2 mm, the obtained thickness with the concavity give 4 mm by board. Having no rattan under hand I tighten my too bamboo board with linen cordage.

This first version of a reduced size bamboo motela was a complete disaster: flying straight, with not enough rotation nor aerodynamic lift to give any returning effect. The concavity of this version was too accentuated

A parameter that I was immediately aware of after this first try was the very slight concavity drawn by Kaudern and needed for the bamboo board. If this concavity was too accentuated, the total thickness of the cross boomerang would be too important and the rotation braking would be critical and prevent a good flight. The total thickness of this first version was around 0,8-10 mm, that was too much for its reduced total size.
I evaluated the bamboo section diameter used to make the Motela on the Kaudern drawing with the small cross section showed on the right and found a diameter of 8-10 cm and wall thickness between 6 and 7 millimetres. That was very far from my little piece of bamboo I tried!

Having no such big section of bamboo at my disposal, I decided to make another, yet better version of the cross bamboo boomerang with a short section of bamboo but with a larger 5 cm diameter and increased thickness of 5 mm
The maximum distance between the joint was under 30 cm allowing me to replicate only a reduced size version of these Motela with a length of 25 cm for the bamboo board instead of 30 cm.
But in the Kaudern article, the author said that there existed some shorter versions of 25 cm too, so I try to go ahead with this bamboo section.
This Big bamboo of 3 meter length was given to me by another French boomerang thrower who cut it himself.
I originally wanted this piece of bamboo in order to make two didgeridoo but it also give me the materials to make few bamboo boomerangs ! The two didgeridoo are sounding pretty good too.

With the same method as my first try I cut two new bamboo boards of 25 cm length and 3 cm wide board but the concavity with such wide board was again too accentuated, the cross bamboo boomerang was going straight in flight.
I believe at this point that this was the result of too much weight. In fact the cause of this first unsuccessful flight was my inexperience in tuning and lashing these cross boomerangs.

So I decided to lighten my boomerangs, reducing the width to 2 cm and to achieve a more biconvex cross section airfoil leaving only very little or no concavity under the board. The final thickness of each of my board was around 4-5 mm

My next problem was to tighten the two boards together firmly enough so they didn't move against each other in flight braking down the rotation, which happened on my very first try and prevented good rotation and nice flight.

So I decided to make a slight notch in one of the boards so it fit the other one. I didn't know if Celebes people have a special trick to tighten their board together because there is no trace of a notch on Kaudern drawing.

I also started to find a solution by changing the linen cordage with some more flat wide piece of raphia fibber which have more friction with the bamboo surfaces.

At first I didn’t pay enough attention to the lashing itself passing my cordage alternatively in a cross over and under the two boards and along the four side of the square formed by their intersection. I found that even with the notch added the two boards were moving a little in flight, wasting rotating energy.
Having a second look at the Kaudern Drawing, I notice that Celebes people lash their Motela differently, making only a cross lashing over and under the two boards, and lashing many turns only on two opposite sides. This clever lashing wedges a board between this two lashing bundles, preventing much of the moving possibilities and sparing rattan strap length. I tried this lashing solution and found that this was far better, My Motela gained in rotation in its return. However when hitting the ground, very often a board is moved a little longitudinally and reattaching is needed.

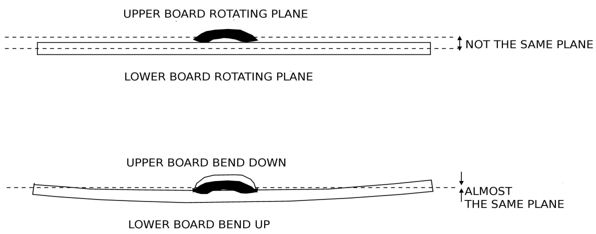
Two first smaller version in 5 cm diameter bamboo with raphia lashing. You could notice the two under boards with concavity facing up and the two upper side boards facing down, bamboo board always naturally bending facing with concavity toward inner face in the drying stage.

Throwing and tuning:

The three first small reduced models of my bamboo cross boomerangs were returning after 10 meters of maximum distance, going up very quickly, due to the maximum weight in the centre.
Even if this first series of motela was not exactly the same in size as in the Kaudern drawing, I learned a lot of things on their subtle tuning and properties of bamboo.
First, I observed that they must be thrown very vertical to prevent them from going too high and in order to have a clean return.
The main default with this version was that it lacks some gliding when returning.
Clearly, It was from a lack of final rotation of this type of boomerang because the two boards are lashed on top of each other
, each of them being not exactly in the same rotating plane as the other, consequently getting more braking with relative wind in their rotating movement.

First, I decided to slightly bend up along the length of both of my bamboo boards, putting them in hot water for few minutes, wanting to bend both boards, face up that would give more lift to the boomerang, a well know tuning on modern multiple wing boomerangs. I wanted to bend one of the board with concavity on the inner side of bamboo and the other with concavity on the external side.

But after drying both boards bent with a concavity on the inner side because of the more important withdrawal of the inner bamboo part. There seemed to be no way to bend my bamboo boards toward the external side. I used the boards slightly bent like this, in my boomerang one concavity up and the other down. At that point I thought that these two opposites bendings would result theoretically with no effect.



Natural bending of boards toward the inner side of bamboo put the upper and lower plane in a single middle rotating plane

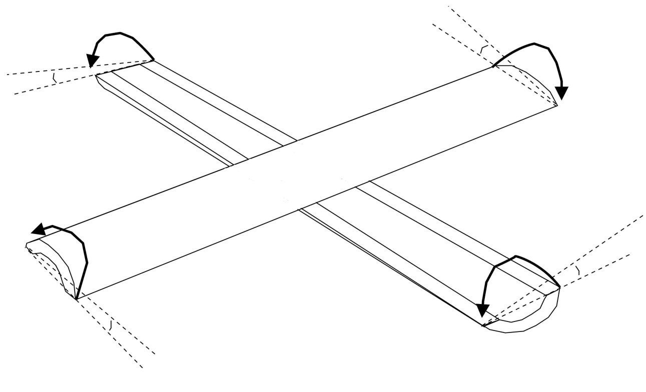
But with another try, there was a clearly positive effect on the lift and the boomerang has more gliding with this tuning due to a increased rotation.

My explanation is that the bending of both boards move their extremities closer from a single middle plane between them and in this way the extremities of one board are following the extremities of the other closer to a same plane, so the resistance from the relative wind on both boards is less and rotation is increased.
In throwing sticks and boomerangs, the more aerodynamically active areas are the extremities of the wing because they are moving along a longer path in one turn, giving more lift in their advance against relative wind, than the centre that is more aerodynamically neutral.

I discovered after my third Motela with such a narrow board of bamboo were bent slightly with concavity toward the inner face, with only natural drying, so not much heat is needed , unless you want more bending. Bamboo's natural properties does the tuning automatically !

Additional solutions to get good gliding return is to throw it with maximum of rotation keeping them vertical at the release.
The result was pretty good: I got nice flight around 10-15 meters in distance with a straight return which allowed me to catch my first bamboo Motela!

There is another important tuning parameter influencing the flight of a Motela:
The natural twisting of your two boards in the cross section direction. These twistings are called incidences. Do not confuse these twists with longitudinal bending along the board discussed earlier.



Tuning for a right to left flight
Viewing from the centre of the cross boomerang, twist clockwise all boards extremities to create right to left flight, or anticlockwise for left to right flight.
Depending of their direction your Motela could be a right handed boomerang, going from the right to the left, or a lefty, going from the left to the right. As they are often thrown almost vertical I even observed a right handed one thrown going from the left to the right! they could be ambidextrous boomerang and bidirectional boomerangs.
More than that, Their symmetric assemblage of the two boards flat face against each other and convex side up and down make them possible to use on any side. This is not the case with traditional Aboriginal Australian two wings boomerang which lack this symmetry. And even modern boomerangs are few to offer so many flying possibilities !

Tuning the incidence is as easy as giving board concavity: I simply dip my two boards in hot water for few minute and twist them with both hands at each extremities, applying the constraint until cold to create slight positive incidence.

More exact full size replica with a 7 cm diameter bamboo

With the experience of making three boomerangs in this 5 cm section of bamboo i decided to make a more exact replica of the Kaudern drawing. Finally a friend of mine could send me a 35 cm long and 7 cm diameter bamboo by mail which seemed to be perfectly fit to achieve this. The thickness was 6 mm which was very near to the thickness drawn by the author as well.

So i made two Motelas with this new material:

-an exact replica of the Kaudern's drawing with 29 cm long 3.2 cm wide board, keeping his natural thickness of 6 mm. the weight of the model was 53 g that lead to 0.28 g/cm2 mass/surface ratio.
-a bigger one with 34 cm long board 3.4 cm wide which reach 73 g and a 0.31 g/cm2.

Here are the different steps:

Slicing the bamboo trunk in quarters with a short machete

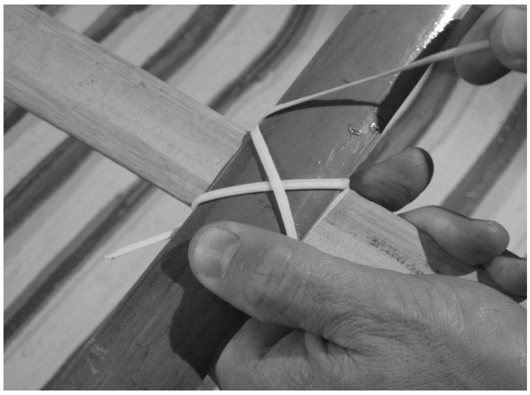
Scraping the side of this board to reach the desired wideness and achieve concave- flat cross section on the internal side, keep untouched the external side in convex cross section

Pay attention to 5 mm wideness of the flat, convex part near each edge and natural concavity kept along the middle of the board.

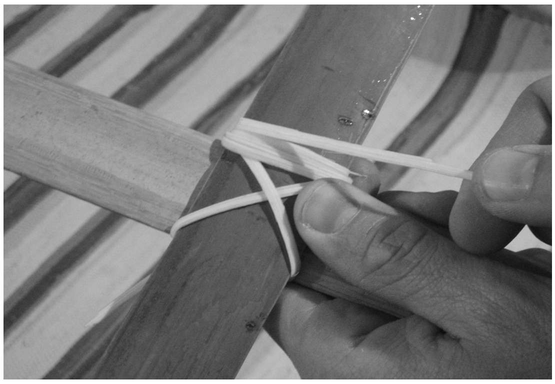
Observe the finished cross section of the inner side:
flat or slightly convex on edge and keeping the natural concavity in the middle

Having no rattan growing in my area, i finally manage to get some commercially flat rattan strand 5 mm wide which i split in half and cut approximatively 1 meter in length.

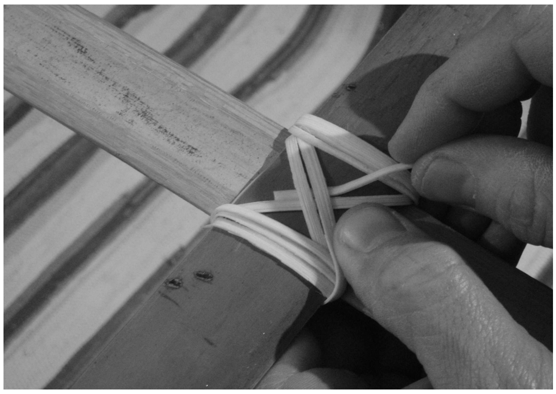
Well maintaining in position the two boards between thumb and index at the start of lashing



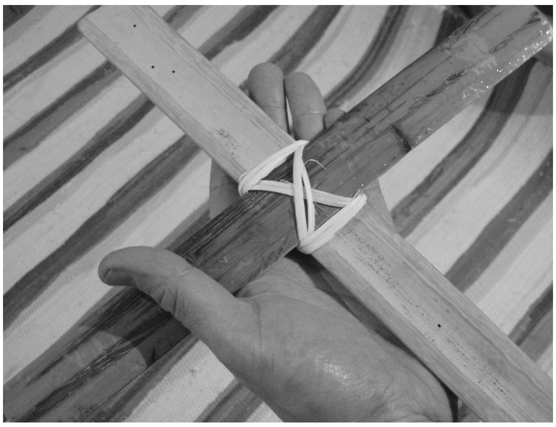
Depending of the length of your cordage one or two cross pass as tightly as you can



Continuing with two opposite bundles around one board wedging the other



Passing the end of the rattan strand in diagonal crossing part and pulling on it to tighten the lashing



Motela finished ready to fly !

Rattan lashing is far superior to raphia because of its higher rigidity and resistance which allows you to do the lashing without any knot. Pulling on the final end of the strand permits also to tighten all the lashing a little more. It is the perfect material for this use.

Throwing this full size replica:

With a good initial rotation the Motela went for 20 meters, gradually going up in a elongated ellipse and returning very accurately.
So I managed to catch it easily despite a small lack of rotation a the end of the flight. So the conclusion is that the motela drawn by Kaudern could be fully functional, even without additional tuning and could be caught by Kelei people.

The second larger Motela with 34 cm boards flew a bit too far being difficult to return probably due to it's superior weight.

I decided to slightly tune it with positive incidence to add some lift.
It worked perfectly after that and this last Motela flew even better, having more rotation, being very accurate. I am sure that the longer boards with a slight natural longitudinal bend of the two boards helped.

After this second series of tries with boards crafted from a larger section of bamboo it seems that 7-8 cm is the right diameter of bamboo to choose for replicate motela from Celebes. The greater thickness of 6 mm give the boards less flexibility in flight so it is easier to tune them. It's probably possible to craft a larger Motela, the only limit being the length between the joints of the bamboo.

All replica waiting on the grass to take their flight

I don't know if the Kelei people used to tune their Motela by bending or twisting their bamboo boards up or down this way but I guess they could also do it to improve their flights. But maybe like some Aboriginal boomerangs, catching them was not the main objective for young boys who played with a Motela in a Kelei village. Making the return of their cross boomerang as accurate as possible was the game for them. Anyway it would be interesting to verify if the boards of ethnological sample are very flat or slightly bent along their length or even twist in cross section direction to use incidence.

A final detail is about the wind conditions for their flights: as these cross boomerangs are light boomerangs having mass/surface ratio between 0.2 and 0.3 g/cm2 against sometimes 0.6-0.7 g/cm2 for heavy two winged raw wood boomerang, Consequently, they are very sensitive to wind. So they are very difficult and even impossible to handle in windy conditions, preferring no wind or a light breeze.

Far from the tropical of the Celebes, the bamboo motela is returning nicely in the fresh air of a winter day !

Despite their very simple conception, Motela revealed a complex aerodynamic, subtle lashing and interesting tuning possibilities and could be the very first ambidextrous and bidirectional symmetric boomerang.

The short maximum distance of these boomerangs is about 10 to 25 meters , their curved trajectory and their weight between 30-70 g make them usable exclusively for play, a very fascinating game for the young people of the Celebes. Did they keep the use of these clever toys until recent days ? how old are they ?

Finally I would be very interested to know about ethnological examples of Parimpah or Motela discussed in this article in Museum to make direct observations on these sophisticated implements and also other bibliographic sources. Also i dream about going to Sulawesi to meet people who have used and transmitted this marvellous bamboo playing boomerang. This invention belongs to them.

Bibliography: only that one, thank you Walter !

Kaudern, Walter; Results of the authors expedition to Celebes 1917-1920. 4. Games and dances in Celebes ; Goteborg : Elanders Boktryckeri Aktiebolag, 1925 ; (Ethnographical Studies in Celebes).

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Photo by:
The authors(crafting)
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Art boomerang Club of Paris