Bamboo Journal

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Italian Bamboo Rodmakers Association

In this issue:

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Front cover:	Some beautiful rods of Rolf Baginski at the European Gathering
Photo on page 2:	Birch bark grips by Kurt Zumbrunn

Twelve!

Yes we have reached issue number twelve!

I cannot believe it....

We let's have a look at what's cooking this time.

Firstly the article by Maurizio Cardamone who takes us back to the last IBRA class, which took place last November. There is nothing better than to listen to the voice – pardon me, to read about the emotions and the results of the strenuous but also thrilling days that led to the birth of an elegant bamboo rod.

A tasteful article by Alberto Poratelli on wrapping bamboo ferrules. It goes without saying that the Bamboo Journal is a treasure trove of knowledge on this kind of ferrule that are so popular and effective.

And more – as if to double the dose – another article on the subject of bamboo ferrules by the US Rodmaker J.W. Healy that discusses the making of Streamlined-style ferrules.

We continue with an article, which in my opinion is wonderful, by Enrico Francioni, about how music has managed to dialogue with water.

Alberto Poratelli replicates with an essay on the anatomy of bamboo, which I believe will help to clarify some of the "superstitions" that continue to surround this subject

Last, but not least Gabriele Gori in a very technical/scientific way, adds triangular rods to his table "Comparison between sections". The ready will find the usual precision and attention that accompany the Presidents articles.

You will find some piquant considerations.

Between articles you will find pictures painted by the artist from Lombardy – Enrico Cereda. Wonderful!!

You may have noticed that this time I did not complain about anything. In fact I have adopted a light and gay tone – almost graceful –

I'll bet! I did absolutely nothing in this issue.

All the work to prepare issue N. 12 of the Bamboo Journal, was solely on the shoulders of Alberto Poratelli, with excellent results I dare say.... I wonder if in future.....

Anyway well done Alberto!!

... snd to you all – HAPPY READING!

2005 ... 2014

This year it will be a very significant year for IBRA. The two dates contain a part of history that unites the yesterday with the today of our "young" association.

The first Itaian gathering took place in May 2005. In July of that year a few "gentlemen" , driven by an irrepressible enthusiasm, decide to unite and to create IBRA with the goal "to promote the art of making bamboo rods for flyfishing (Bamboo Rodmaking)" .

From this action – considered unrealistic by some, we have had 8 rodmaking classes that have involved more than 40 participants that have managed to learn the techniques and methods of bamboo rodmaking. We have had up to 200 members – Italian and not only!!

IBRA has been in many shows, gatherings to promote interest among flyfishermen, to show that bamboo rods exist and to demonstrate the modern methods of construction.

We are not exaggerating if we say that our association has taken the use of bamboo rods out of antiquity and nostalgia.

IBRA was the promoter of the first European Gathering and this has led to a consolidated tradition that until now has involved 4 countries. The Association was regularly present at all the rodmaking shows on the continent.

This year during the Gathering we will vote to elect the new board of directors. This will be the third time that we hold elections: we hope that IBRA will be able to have a renewed life in order to to continue improving its incisiveness, its presence and its knowledge in Italy and not only! Let's look ahead with faith.....

Gabriele Gori

Lombardy countryside

oil painting on canvas cm. 70x50

THE RODMAKING COURSE IBRA 2013 (SEVENTH COURSE)

by Maurizio Cardamone

I have been fly-fishing for exactly a quarter of a century, with alternate levels of effort and success in the sport. Always and only with graphite rods. Until May of this year of grace 2013, I only had a vague knowledge of how bamboo rods were made. The spark that lit this passion for rod making and started this extraordinary short story was a beautiful seven foot bamboo rod I held in my hands on Christmas 2012: a quad rod, blonde, shiny and perfect from a renowned American maker. It was love at first sight for the object and then I felt the sensation of infinite handicraft care and love for the material that the rod was able to convey. At the IBRA gathering in May 2013, I finally fished with a bamboo rod. I had joined mostly for curiosity and perhaps for the fact that I had found a travel companion who was as interested as I was in studying the subject. Above all, though, I met extraordinary people for their warmth, knowledge and experience. This is what started the adventure I am about to narrate.

Recently I have asked myself what the real core reason is that this activity becomes such a passion for many people. Well, I think it happens because rodmaking gives vent to that creative spark that is more or less latent in (almost all) human beings. Despite the fact that the fundamental phases of the procedure to get a finished rod starting from the bamboo culm is nowadays codified, standardised and described in numerous texts and videos, there is still enormous space for experimenting and personal inventiveness. From the modification of the classical tapers to the creation of personal tapers, from the "invention" and fine tuning of many small and great tricks to speed up or improve or make the different work phases more efficient, to the choice of the glues, to the varnishes, to the design and construction of the many details that make up a finished rod. I believe it is this that intrigues the rod maker more than the final result, more than the rod in itself or the rod as an elegant fishing tool.

I would like to write differently about the seventh IBRA course from what was written in the past. Not because I want to stand out at all costs from those who have gone before me but only because I do not want to bore the readers, with the same renowned things. However, I did tell myself that this was an extraordinary experience (it certainly was for me) and that it was fit to tell it above all as a reporter. For all those experienced rodmakers, I hope that how I saw things as an (ex) absolute beginner will make an interesting read. It is also the story of a small record: a rod finished in less than three days!

Thursday 28 November 2013. Gricignano in Sansepolcro. We arrive a few at a time. Paolo Zetti and I from the far North (Pavia); we had found quite a lot of snow on the Appenine part of the route but the roads had been cleared well. The weather is neither good nor bad, ideal for someone who has to work hard. Roberto Valli, one of our instructors, is there already and Paolo Degli Antoni. Soon after, we are joined by Gabriele Gori and Alberto Poratelli, the heart and soul of IBRA, organisers and instructors and Massimo Giuliani who will give us a very useful introduction to the group purchasing. Soon after the fourth aspiring rodmaker arrives: Marco Imbriani. The last to arrive is Antonio Paglia, instructor and great expert on blade sharpening.

We are only four rodmaker “students” in the 2013 edition of the IBRA Course. Two last minute and I am sure, reluctant, withdrawals have reduced the traditional group of six. Furthermore, the 2012 edition was not held and so, including the four of us, there will be a total of forty IBRA “graduates” since its foundation.

The location is the traditional Podere Violino, which is situated in an optimal spot for an association like IBRA, whose members or enthusiasts are all over the boot-shaped country of Italy. Violino offers a fantastic solution for the rod-making course: a large space for the workbenches and the total “ergonomics” of the building (i.e. just a few metres between the dining table and the workbench …). There is a chapter dedicated to the hospitality and the cuisine because they were an important part of the success of the initiative.

Where do I start? Well, from lunch, of course. We chitchat to break the ice but really, there is little ice to break because from the start we breathe a friendly atmosphere. We talk a little about ourselves and share our fishing (and not only) experiences and we discuss the expectations we each have of the adventure we are about to embark on.

Two fly fishermen from Pavia, Paolo (one) and I, who have for some months had the dream to evolve with equipment that is really special, very personal and with the scent of the great classics. A pipe maker from Bologna, Paolo (two), who wants to try something different and creative. He is not yet a fly fisherman but the special tool he will soon hold in his hands will surely stimulate him to become one.

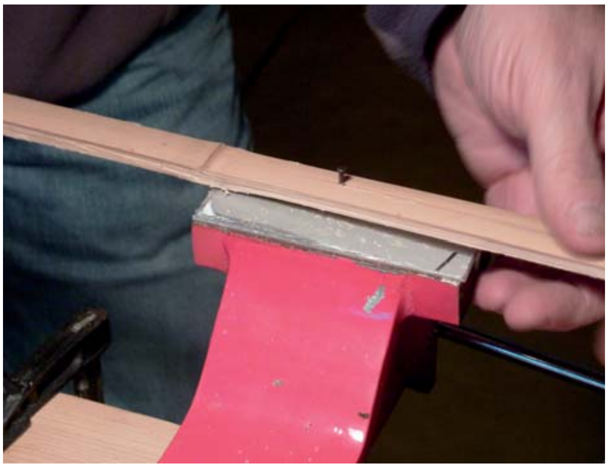
“Last but not least”, Marco, the youngest of the intrepid group, lives in Bologna, a dedicated fisherman with a lot of experience: his new bamboo rod will be a qualitative leap for him and it will fill his future with new prospects.

Then, Alberto, Antonio, Gabriele, Roberto (in strict alphabetical order), our Teachers. People who inspire trust and fondness. When Alberto says that we will succeed, that I will succeed too and that I will return home with my first bamboo rod, I believe him unconditionally and yet – I left home with a few doubts about my success.

Also because in this seventh edition of the IBRA Course we will be test subjects for a new organisational formula: the construction programme is concentrated in a long weekend starting from Thursday, instead of two weekends like the previous editions. Of course, the fact that we are only four apprentices will undoubtedly make it easier, as we will have more attention from our four “tutors”.

Let us move on to the report: we setup the workbenches in the large multi-purpose hall of Violino and on Thursday at three in the afternoon, we are ready to start. We each have an individual workbench with all the necessary tools, a workbench in common for the planing and there is even a “classroom” corner with chairs and a board. Right here we start with an introduction by the president Gori and Massimo Giuliani who explains the advantages of the group purchasing to buy the tools and materials, which, truth be told, are a little strange, so not easily available at the DIY shop round the corner.

Alberto introduces the first phase: the selection, cut and splitting of the culm. So on with the gloves (cut resistant because bamboo is like a razor) and down to work!



The splitting of the culm looks easy when Alberto does it with confidence and speed with the steel nail method. Then, once you try on your own, you discover that cutting through the nodes unscathed; keeping the cut perpendicular to the surface of the pole and the strips quite straight is not always simple.

Yet, it is right here that there are the bases for a good rod. I, for example, managed, not only to obtain the classic lateral wandering of the split but also an interesting form of “bypass” that forced me to throw away some strips and to, in the end, borrow some from my friend Paolo

At the end, we have our little bundle of strips, more or less ugly, full of nodes and skew.

There is only a vague hope that from these abortions we will get a bamboo rod, thin and as straight as an arrow. Every time we are in difficulty, our teachers appear suddenly to resolve our problems, often very concretely!

The straightening of the strips and the node treatment, with hot air and vice make them better looking but it is still hard to see anything more than a bamboo stick.

We move on to the excellent theoretical-practical session held by Antonio, who very professionally shows us how to sharpen the blade of the plane. Sharpening is fundamental in rod making and all this time spent on it will be paid back in terms of quality and less physical effort, (bamboo turns out to be very tough, to be a grass …).

I love sharpening the blade: to prepare the appropriate (and precious) tool with all the necessary care, prepare the whetstone, the regular movement, trying the sharpness on the back of your hand. I find this a relaxing intermission between one planing session and the other. Antonio is always on hand to offer advice and support to anyone who needs him.

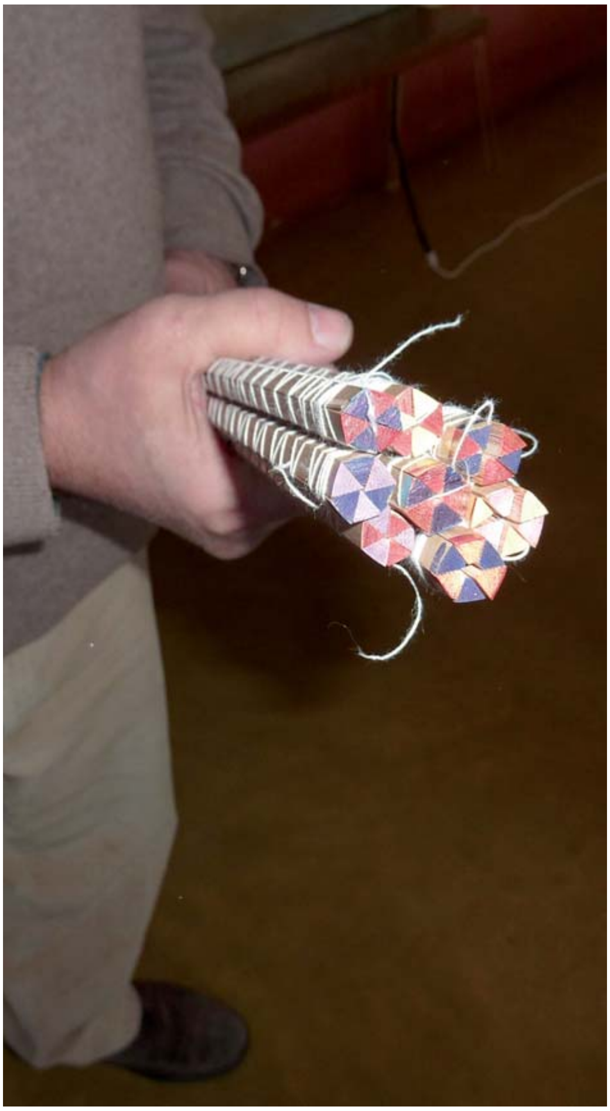
During the course, we alternate brief theory sessions with practical applications of what we have just learnt. A very efficient method from an educational point of view: we face the theory and then put it into practice immediately to consolidate it! All this keeps us busy until midnight, except for a brief (but very tasty) dinner and once I finally reach my room, more than falling asleep, I faint on the bed. By the way, in the room instead of a bedside table, there are old kneeling-stools. Could this be a message from the organisers?

We meet on Friday morning at eight for breakfast, rested and eager. We quickly return to the workshop.

Our creatures are waiting for the preliminary planing phase with the wooden planing form. I understand that this operation serves to form the first 60° triangle and to reduce the strip to a size (side and thickness) appropriate for the taper we will have.

This was the hardest phase for me because I started with rather big strips. Therefore, I had to plane a lot of material and I produced cubic metres of shavings (but that is how I learnt the importance of the initial splitting of the strips!). Roberto's ever-present and tireless help was crucial.

This initial rough planing is followed by the heat treatment. We each prepare our two groups of six and six strips skilfully tied, by hand with the well-known double spiral (I must meditate on why the two spirals have a different pace ...). Into Gabriele's impressive oven they go at 185°C for 12 minutes and finally here is the material ready for the planing of the taper.



Almost ready because we still need to remove the bamboo enamel. There is a debate on whether it should be removed with a scraper or with sandpaper. I try both, to be safe. In this phase, it is important to dress the nodes well. The nodes, after the oven, could be "swollen" and if they could, they will (Murphy's first rod maker law).

Finally, the time has come to face the steel Planing Form that must first be prepared for the specific taper we want to achieve.

The rod of the 2013 course is a Dickerson 7012. It is a 7-foot for a 4 weight line and we learn that the second part of the code, 12, is the size of the ferrule, in 64th's of an inch (an agile unit of measurement invented by the Anglo-Saxons a long time ago to complicate their lives and the lives of all their posterity on the planet). All the measurements of the thickness of the taper, at 5-inch intervals, the famous "stations", are often given in inches and fractions of inches. Luckily, the callipers and the digital depth gauges switch easily from one unit of measurement to the other, saving us from a lot risky calculations.

I found the setting of the planing form very amusing and gratifying, one reason being that it was an operation within my reach. The manoeuvre of the two opposite nuts with an eye on the depth gauge is not difficult; all you need is a lot of attention to get it right.

The final planing of the strips was psychologically strenuous: we were starting to see the result of all our hard work and the possibility of ruining it with one swipe of the plane was giving me a little anxiety. Especially the strips of the taper that are extremely thin at the tip; it is almost a miracle that no one had any unpleasant accidents. Mastering my left hand that holds the strip from behind and not from in front of the planer (an instinct for most) took several thousand strokes of the plane.

Once the first passage was done for the six strips, we temporarily tied them and measured them to find a few system errors. We recalibrated the planing form and briefly planed the taper to fix it (I should not have thought of this ….). When we finished the six strips of one segment of the rod (the butt first) we repeated the exercise for the tip.

This is when a good plane, well sharpened proves to be the winning card. There is still space for finishing touches to any residual humps with the hot air gun…and lots of experience: Roberto corrected some defects I would never have noticed!

The second day comes to a close. I do not remember the lunch or dinner menus but I do remember clearly that we all liked them. Considering we had started at about 8.30 a.m. and it was now past midnight, we worked almost 14 hours.

Saturday starts with the gluing after having removed the inside tip of the strips. At this point Alberto not only explains the method to follow, the types of glue and a little history but also does it for everyone for good measure (after all his gloves were already dirty …). Nonetheless, we students were very, very attentive!

The two pieces of the rod are tied with cotton thread (the same one we used to prepare the strips for the heat treatment in the oven) with the spirals crossed with a different pace (I repeat I want to study the theory of this phenomenon in depth).

We used a slow-drying epoxy glue and thus, to save time waiting for the natural drying process, we speeded it up by using the oven at about 80°C.

Finally, we have in our hands something that resembles a fly-fishing rod. It is caked with glue and cotton threads stuck to it but we do not panic. With medium and small-grain sandpaper mounted on a small block (kept horizontal on each side of the hexagon), we clean everything off thoroughly, bringing to light the blonde surface with streaks of the hard fibre: splendid to look at and just as splendid to touch.

There is still a lot to correct but with help of the hot-air gun we fix residual curves and as in my case, a slight torsion in the tip.

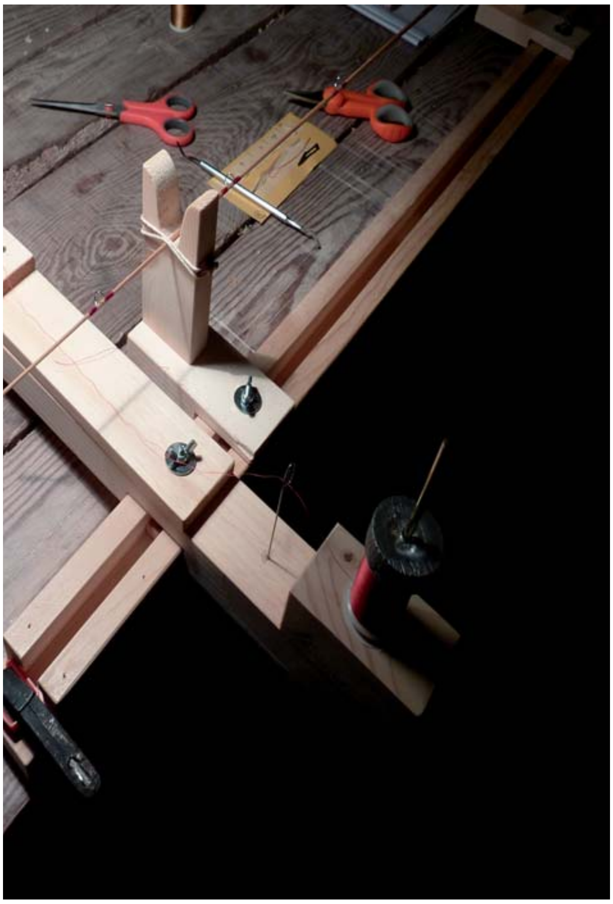
We are now ready to cut the two pieces for the ferrules. Here Gabriele's engineering approach comes into play with a comprehensive mathematical explanation that considers the design length of the rod, the depth of the ferrules and the need to end up with two pieces of equal length, including the male and female ferrules. We calculated over and over again (and I did it was once more to be sure: I would not want a pseudo- Dickerson 6'11"), we cut: a decisive moment! A small note on the equipment: I fine the "Japanese" small saws exceptional.

My subsequent attempt to cut a remnant from the butt with a common metal saw proved to be a disaster. Something well-know some may say. It was not at all for me.

We glue the ferrules with quick-drying epoxy after shaping them but above all after preparing the gluing spot on the blanks, carefully taking away the edges of the hexagon. The lapping of the male insert is done with a lot of patience and attention until we have the crucial "pop". Without too much effort, we also glue the reel seat and the cork grip –made and I must say, of excellent quality). Oh, naturally to glue to reel seat in the right direction we had to determine and mark with a pencil the "spine" of the rod, along which we will then align the rings.

We are almost at the end of our labour. We begin the delicate tying of the guides. We each choose a colour of silk: I opt for a beautiful red that will go darker and a little transparent with the varnish.

We are provided with small wooden gadgets that are very efficient to speed up the tying. I think this simple tool is indispensable to achieve a high quality result without risks to the rodmaker's nerves.



I felt more confident in this phase because I had tied a few rods in the past (not in bamboo but the principle is obviously the same). The final result is very gratifying but I do have space to improve, even the tying.

It is almost midnight and today too we worked many, many hours interrupting the work only for the meals, which were not meagre. Indeed, I calculated, naturally using one of Everett Garrison's equations that the average calorie consumption of a rod maker who planes 70% of the time (the rest is spent on sharpening the blades) is double the normal one.

At this point, I must mention Podere Violino's excellent cuisine. We were really "spoilt" by the variety and quantity from the young chef and no one returned home hungry. Actually, someone was on diet but we know "semel in anno licet insanire" – "once a year one is allowed to go crazy". Even at the dinner table.

We are all more or less equal in the work done. We cannot christen the rods by breaking a bottle on them (above all because me do not have the right mistress of ceremonies) so we say goodnight with a celebratory toast with a good grappa. Very tired but very happy I go to bed.

On Sunday after a quick breakfast, we go to Alberto's fundamental talk on the different types of varnishes and varnishing. He reveals a few tricks to us and I am convinced by the brush varnishing. Time does not allow us to varnish here so we will do it at home.

Next is a theoretical lesson by Gabriele on the physics of the rod and Garrison's calculation method. He shows us some graphs as examples of the stress and at long last, I understand how to interpret them (I believe this is the most important aspect to even think of changing – in the far future – the tapers of the great men of the past).

Now we have plenty of time to try the rods on the lawn of Violino, for the photos and for the amusing ceremony of handing out the certificates. The sky is dark, it threatens a storm and it is windy. I mount the line with trepidation: the rod looks beautiful but what if it proves to be a useless piece of wood for fishing?

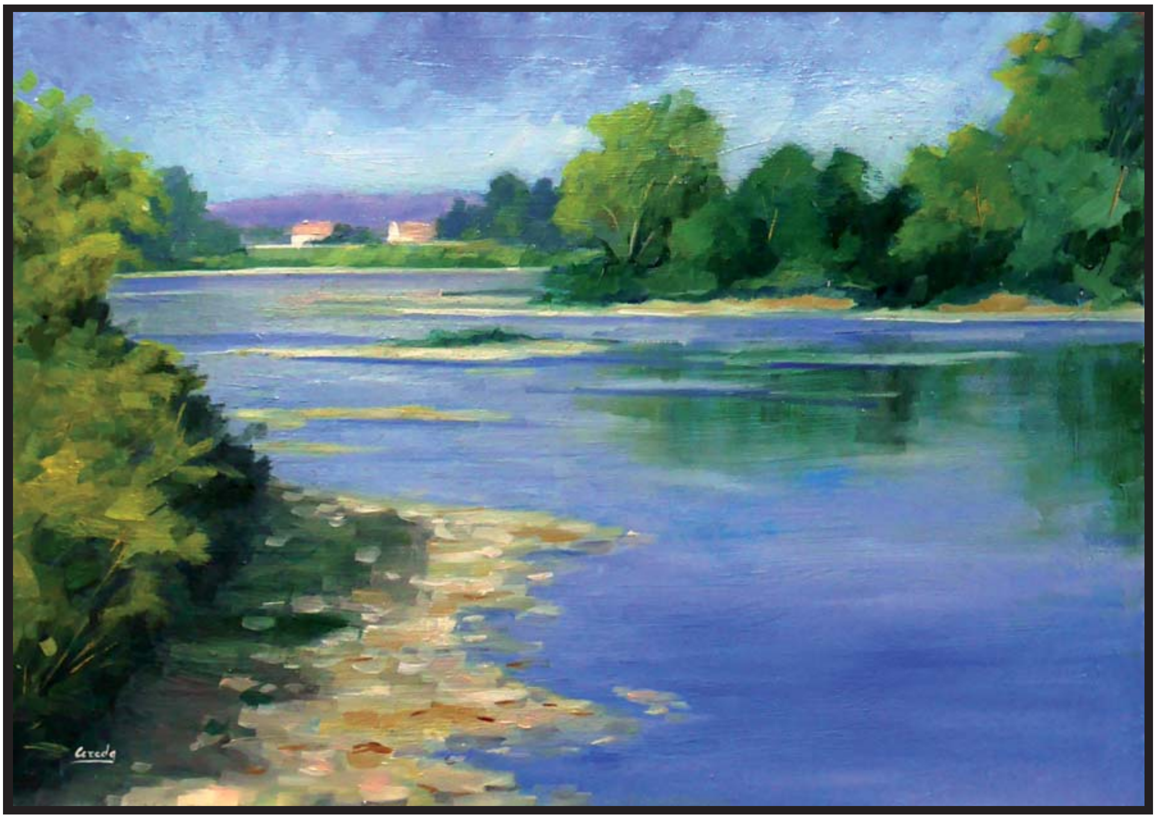
However no, obviously it is not so. It is by far the best rod I have ever cast with and I am absolutely convinced that it will accompany me on many fishing trips!

A general evaluation of the course? Definitely a positive experience (I am thinking of repeating it next year).

We leave Sansepolcro with a much more than decent rod (I will call it Number One). It has cost more than 30 hours of work and it has proven that the new "one-week-end" formula can work and it did work splendidly.

Let me sign off by thanking all those who, with their personal commitment and contagious enthusiasm, teachers and fellow students alike, made this little miracle possible.

I am not sure I will ever be a true rod make but surely today, I feel like a better person and even the world around me looks finer. As long as there are people like this around, the planet has a more hope.



The Loire river

oil painting on canvas cm. 50 x 35

Wrapping bamboo ferrules

by Alberto Poratelli

The fabrication of bamboo ferrules entails various working phases that if done properly, allow you to make ferrules that are just as good as metal ones as far as strength and lasting.

Since I have discussed the dimensioning and the fabrication amply, nothing has been written about the final wrapping, which may seem a subject of little importance but it is of fundamental importance with respect to the quality and lasting of a bamboo ferrule.

Considering that on average the thickness of the walls of a bamboo ferrules is around one millimetre, it is easy to imagine that the resistance of the female ferrule cannot be ascribed to the glue, but i t is relegated to the external wrapping; in fact I know of more than one rodmaker who does not glue the female part because they feel it is useless. The wrapping, therefore is a fundamental part of the bamboo ferrule and if executed badly or approximately, will result in a mediocre or scare bamboo ferrule.

The aspects to keep in consideration when deciding on how to wrap a ferrule are the following:

- The wrapping must offer sufficient resistance to put up with the tractive load is is subject to
- The wrapping must be sufficiently elastic to allow for tiny dilations of the connection to guarantee the right grip between male and female parts
- The wrapping must be sufficiently smooth to allow for good varnishing
- The wrapping must compose a single body and last in time

The first thing I wish to discuss is the material used for the wrapping. Normally twined nylon or silk are used. Some use kevlar because they feel it offers greater strength. I personally use a 3/0 twined silk thread. Finer threads do not offer sufficient resistance, while thicker threads don't look very nice.

After many experiments, I have preferred silk because with respect to nylon it has a degree of elasticity as far as traction goes, which is much higher and above all, silk like all natural fibres, has the characteristic that it contracts one it is wet. I have rejected kevlar because it is too rigid and if it is pulled too tightly, it can cut the edges of the bamboo. In addition, it can have problems when it comes into contact with certain solvents used normally to varnish our rods.

Above all, silk is natural!!

But what is silk? I think it is important to know about its characteristics before deciding to use it.

Silk is an animal protein produced by insects belonging to the order Lepidopthera or by spiders. The silk we find for sale come from the cocoon of silk worms belonging mostly to the species Bombyx mori. Sometimes other species are used and they belong to the Saturniidae family. From a tensile strength point of view, spider silk is superior to that of silk worms but I doubt you can purchase thread made from spider webs.

The silk worm secretes a filament, which varies in length anything between 350m to 3 Km with which it spins a cocoon in which its metamorphosis takes place. The filament is formed of two fibres fibroin (which amounts to 80% of the total weight) which in turn are covered in sericin of silk gum (20% circa).

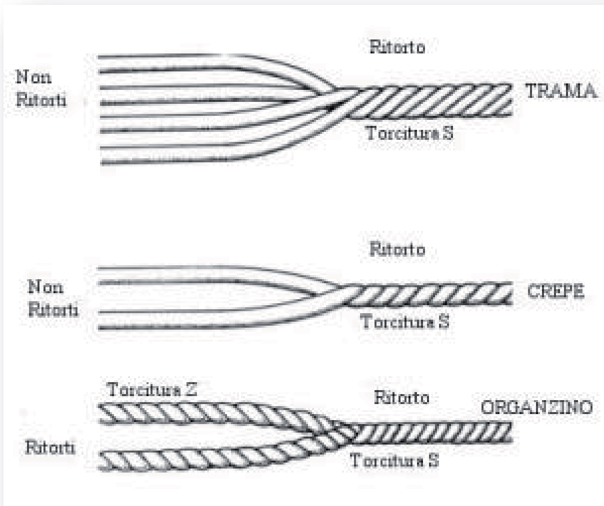
The silk gum is removed with hot water during the process called degumming. Under a microscope, the fibres has a regular appearance which is very similar to synthetic fibres. According to how much gum is eliminated you can have:

• Degummed or cooked silk when all the gum is removed;

• Sweet silk or"souplè", in which the gum is only partially removed

In the case of the “cooked silk”, you can have a chemical treatment that helps to improve the resistance of the fibre which was compromised during the degumming phase. A characteristic of this fibre is the length of the filament which can reach 700-800 metres. This process makes the fibre longer and is normally used to make silk called tram yarn and it is made of one or more fibres twined in the same direction (between 8 and 16 twists per cm)

Although silk has some exceptional characteristics (it is the strongest natural fibre we know), it must be handled with care because it is easily damaged.



This said and considering that the thread is the ideal material for our uses, we have the issue about how to make the wrapping to make it look good and last in time.

One of the problems that the wrappings on ferrules have on that bamboo ferrules are not rigid but undergo (albeit in a tiny way) stretching when you insert the male ferrule in the female but above all they have the tendency to continue flexing with the rod under stress. This is particularly evident in thin walled ferrules and in the streamlined versions.

This, in time can lead to the thread rubbing on the surface of the ferrule and it can become unstuck from the surface if it is not fixed well. I have made many bamboo ferrules, which have been simply varnished and in some cases the heavy use of the rods has brought about this problem which is only aesthetic but, especially in transparent wrappings can become a problem which will reduce the quality of the rod.

The second problem to solve is that it is necessary that the wrapping be smooth before final varnishing and that it will not absorb any more varnish. Unless these two issues are solved, the wrapping will be aesthetically mediocre albeit valid from a functional point of view.

I discussed this subjetc with my friend Davide Fiorani – a valid and talented rodmaker and a connoisseur of Parmigiano cheese and Balsamic vinegar - and he suggested a procedure that solves these problems and helps to achieve very strong, good-looking and high quality ferrules.

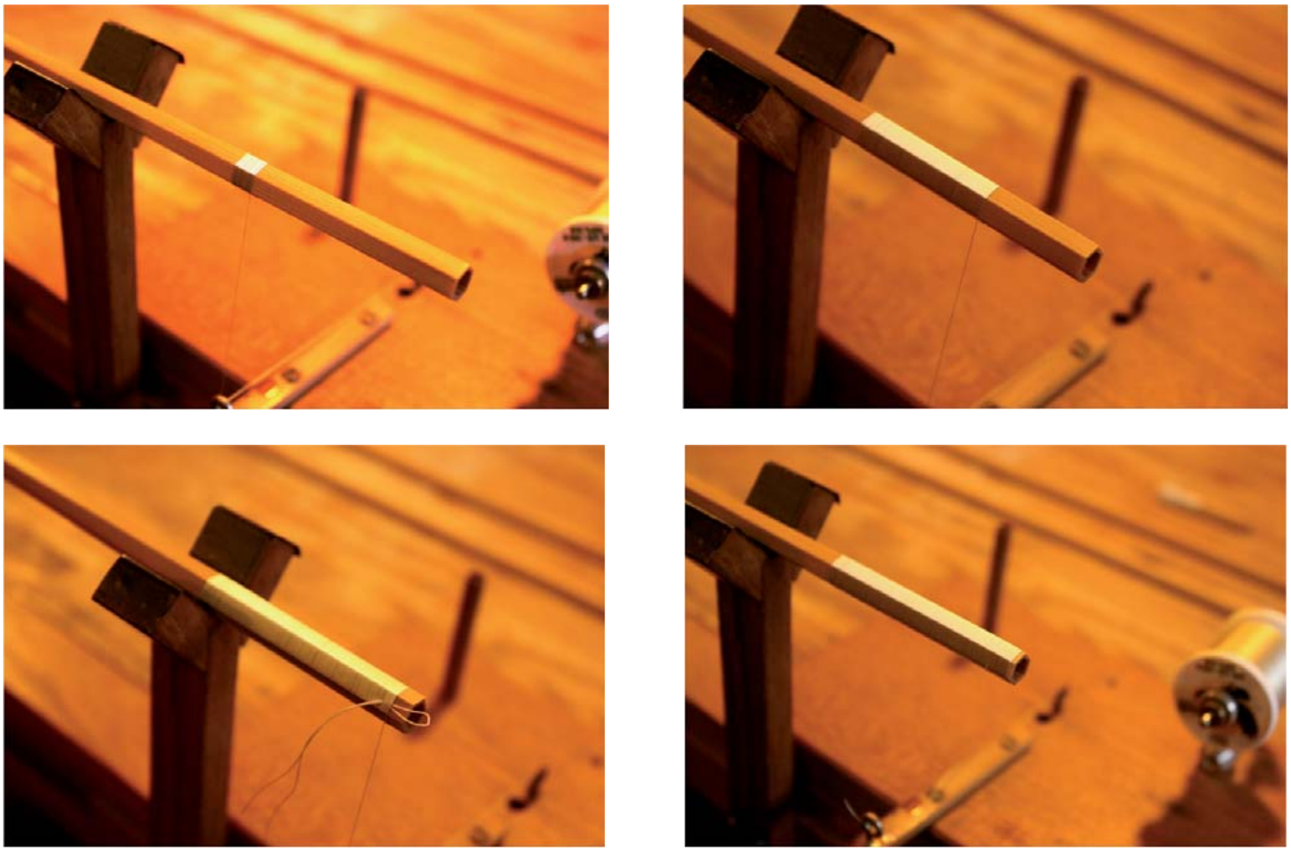
This procedure that I use and that I will illustrate in this article is not something I devised but was suggested by Davide Fiorani

Method :

After having cleaned the blank, I sand the ferrule part with 600 grain paper to make it smooth. I then degrease it with alcohol and the ferrule is ready for wrapping. After having cleaned the ferrule, it is important to not touch it because your fingers could leave sebum that then will be visible in transparent wrappings.

At this point I begin the wrapping starting from the upper part and wrapping towards the head.

The tension of the thread must not be excessive but it must be constant. Too much tension will reduce the absorption of the silk and if the tension is not uniform, you will get different absorption in certain areas and the tonality of the final colour will be different.



After having finished the wrapping, I degrease it by simply passing a small rag with vinegar diluted in water. I use a solution of 200 cc of water with 1 teaspoon of white vinegar (the red one would stain the silk).

This for two reasons:

a) the silk is degreased by the acetic acid which is compatible with fibroin.

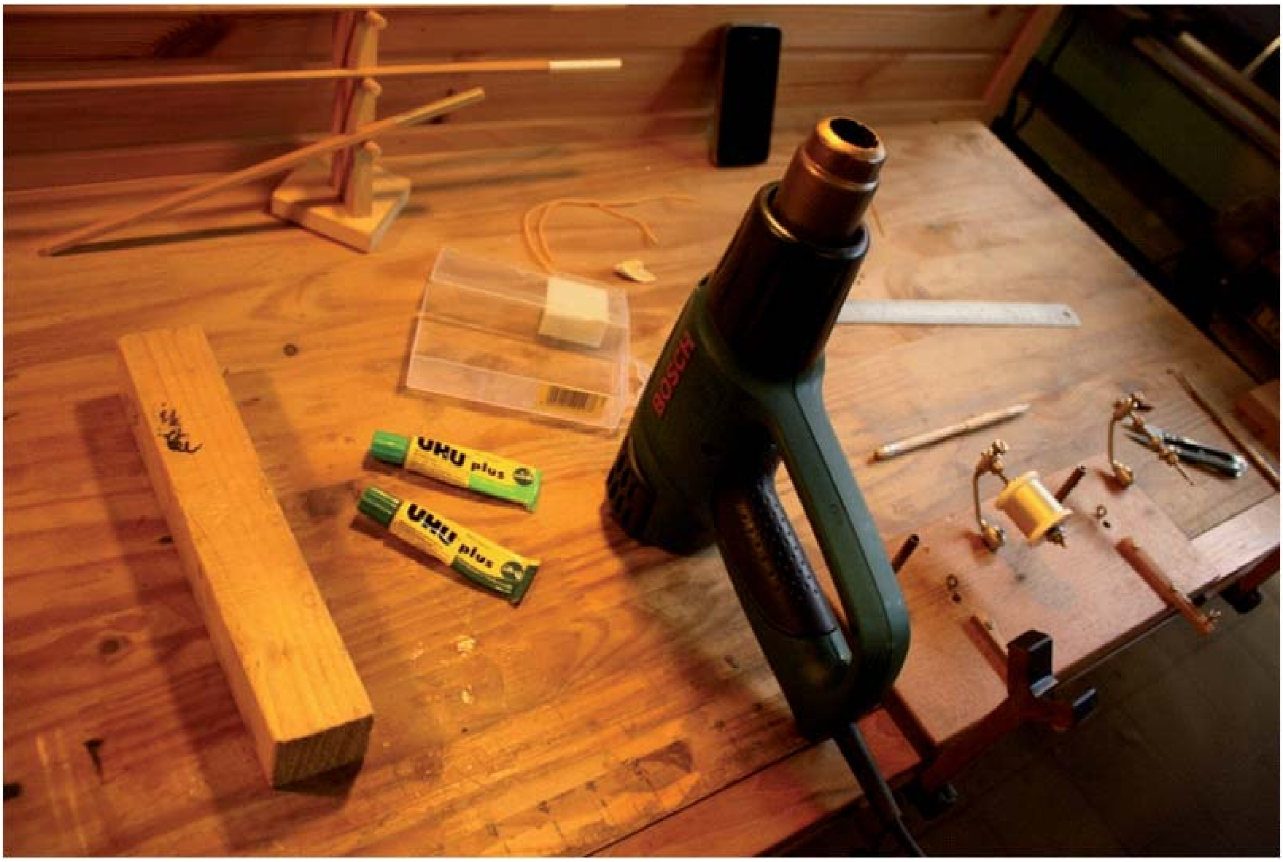
b) silk when wet, will undergo a natural tension because it shrinks.

Before passing to the next phase, you need to let everything dry completely. To speed things up you can use you hot air gun at 50° C.

Then we impregnate the wrapping with epoxy.

I've used various kinds of exopy: UHU300, Epon, Versamid, CSystem 10/10, but the one I feel works best for this method is UHU 300 because it has a slight yellow tinge which matches well with the natural colour of bamboo. The others have a coloration that contrasts with bamboo: eg CSystem 10/10 tends to slightly blue:

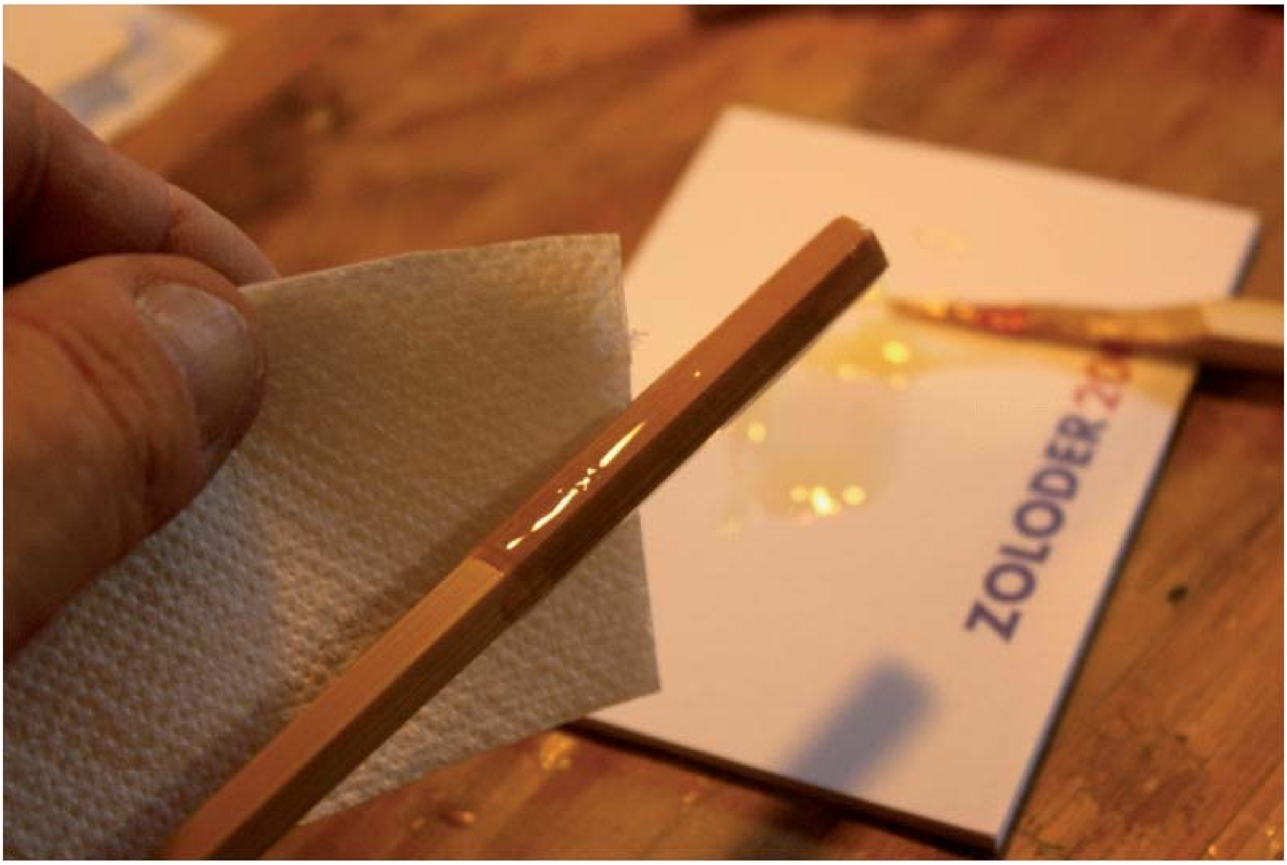
So I prepare a small quantity of glue by missing equal parts of resin and hardener.

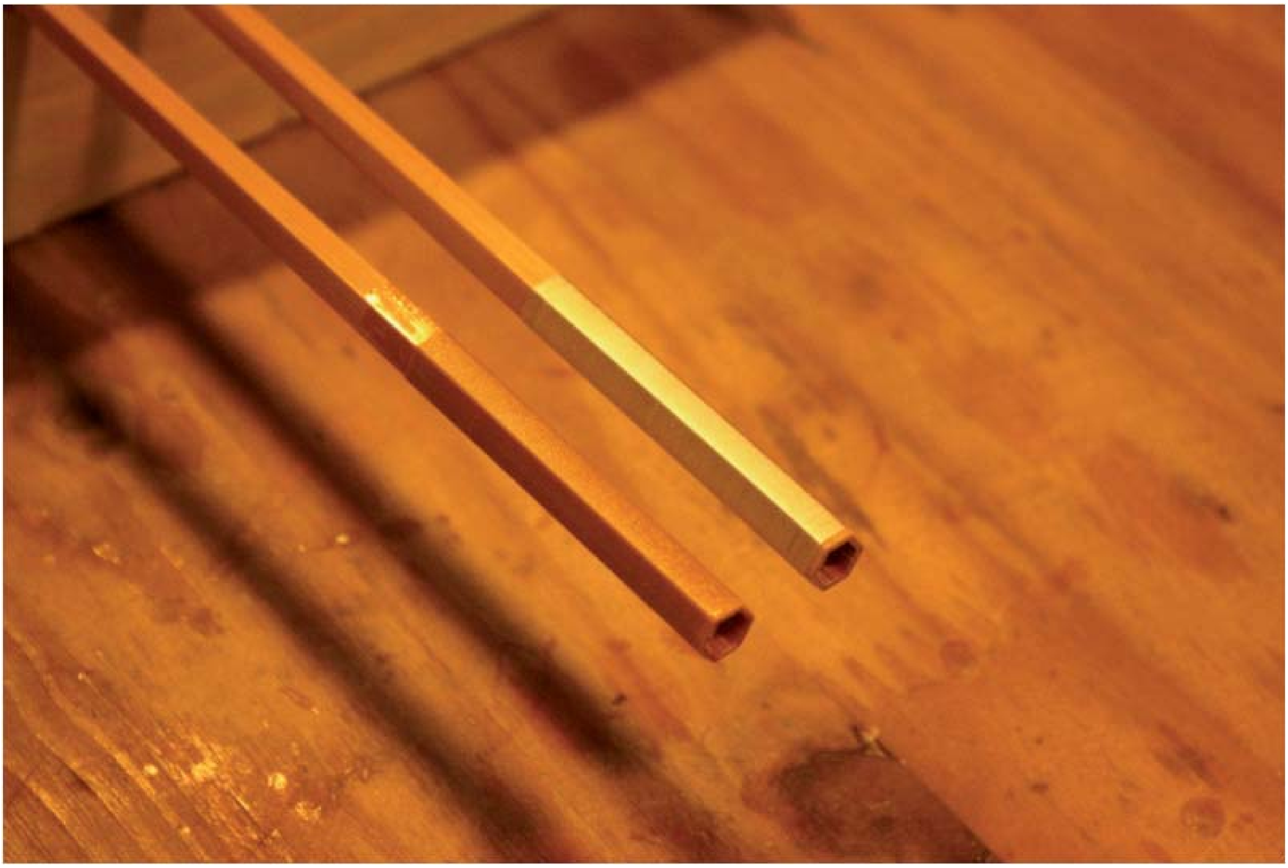


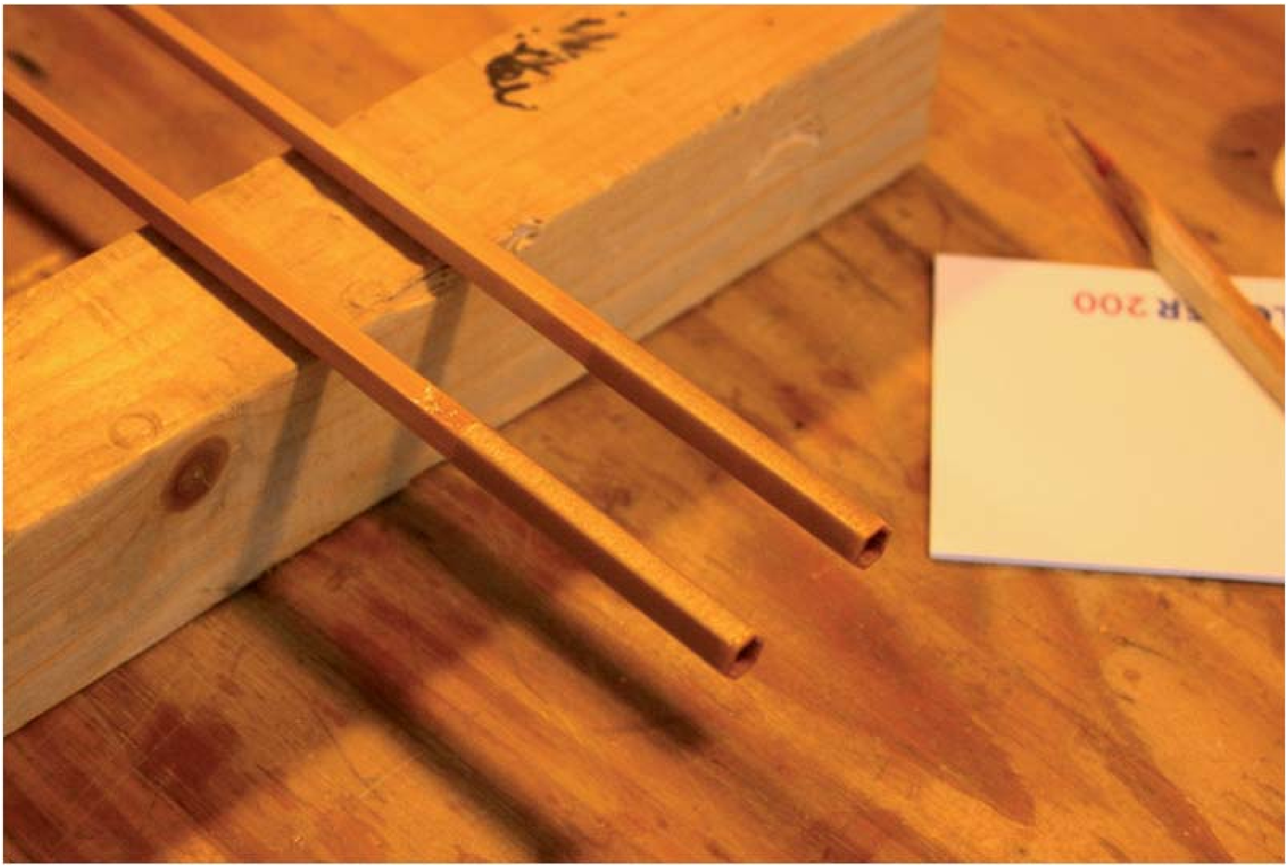
I spread it on the whole wrapping in order to cover the whole thing.

Now the silk needs to be impregnated completely with glue. To do this, I use the hot air gun at high temperature about 400° and I heat up the wrapping until the glue becomes liquid and starts running.

When the glue is liquid and has impregnated the wrapping, just before it starts setting, I clean the wrapping with tissue paper or a rag. The movement of the tissue or the rag must be light and constant and the whole wrapping needs to be cleaned until only the glue that had impregnated the silk remains. The result will be a wrapping that is perfectly transparent if we have used a light coloured thread for wrapping.







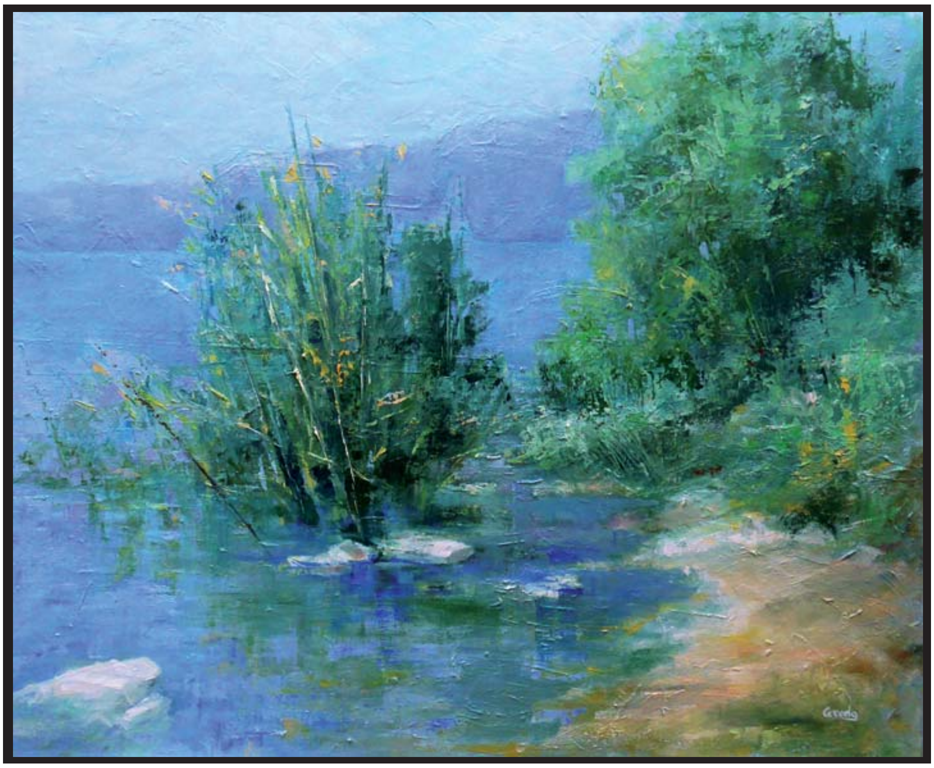
If you need to wrap a ferrule of a very powerful rod, eg a Spey rod, I suggest that you do a double wrapping. So before the glue has completely set, repeat the two phases. In this UHU 300 is useful because it has a long working time.

This method lets you get a wrapping that is a single body between silk and bamboo and we will not have those unsightly icing of the wrapping. Above all a wrapping like this can be sanded (delicately) in preparation for the final varnishing without ruining the silk.

This is the end result of a wrapping using Fish Hawk size 3/0 colour 239.

With simple wrapping:

With double wrapping:



Endine lake

oil painting on canvas cm. 60x50

How I make Poratelli's streamlined bamboo ferrules

by J.W. Healy

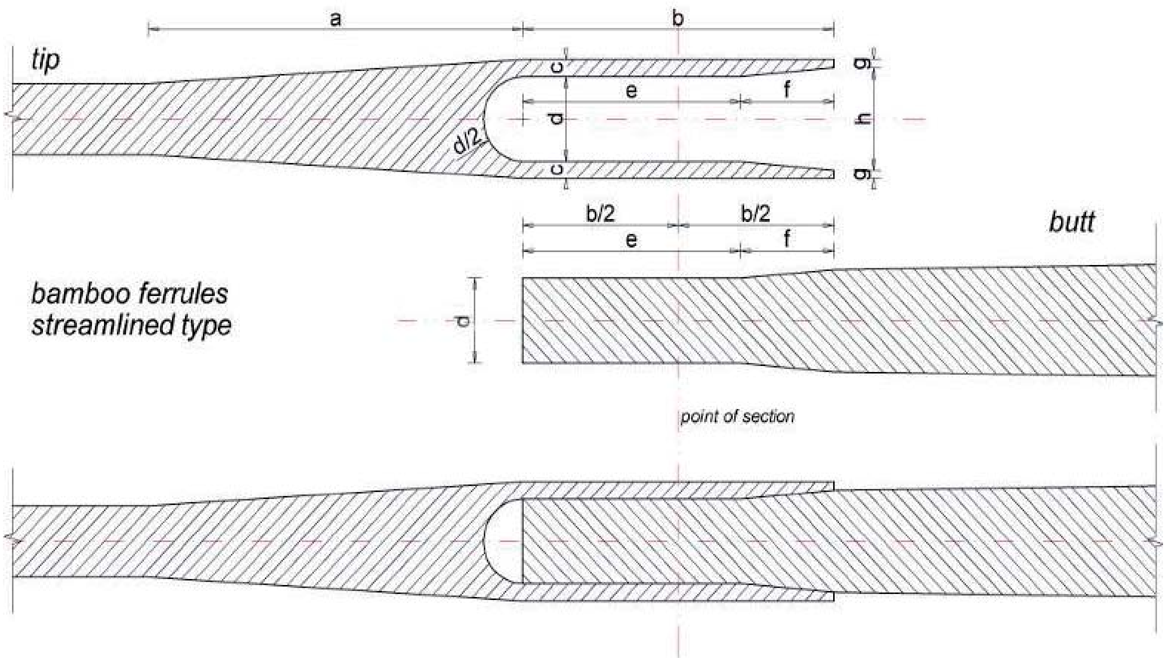
Alberto Poratelli is an innovative Italian rodmaker who has designed with Gabriele Gori the slimmest, most attractive bamboo ferrule available. He has also devised a spreadsheet calculator which calculates the required dimensions of the ferrules for any given rod length and taper. Details can be found on his web site www.aprods.it/

I have been incorporating his design into my rods for the last four years. I really like them. This article explains, in detail, how I make them.

Before you start, study the diagram below.

Diagram legend
a swell to female diameter (5" long)
b length of cavity
c wall thickness
d width of cavity/male slide
e straight portion of cavity/male slide (2/3 total)
f slope of cavity (1/3 total)
g thickness at end of bevel (1/2 c)

diagram taken from A. Poratelli's bamboo ferrule spreadsheet



Making the female ferrule

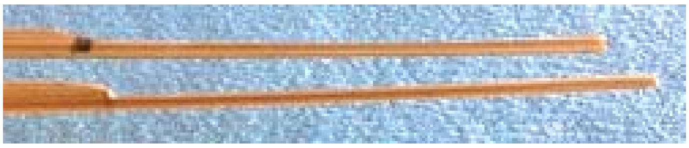
Because it is far easier to fit a male ferrule to the female, I put the female on the bottom so that an extra tip will have a male ferrule. An additional benefit of this arrangement is that the diameter around the female swell (a in the diagram) is smaller since it is coming from a wider part of the rod.

The base of the female ferrule must begin on a planing form station in order to set the proper dimension for the strip being planed. As a result, the female will extend beyond this station by the depth of the cavity. I add an extra .05” (the small line in the photo) so that the end can be sanded square. The “111” written on the form is the setting for the female. This setting is determined by the ferrule calculator and is based on the taper entered. The rest of the stations are set to the taper selected and the strip is planed normally.

Once all of the strips have been planed to final dimensions, tape them as you would for glue-up. Draw a line across all six strips equal to the depth of the cavity plus any extra sanding allowance you choose. Now scrape the pith off using a draw knife, scraper, sanding block, file, etc. until the wall thickness is about .05”.

Be careful here as scraping is seldom even across the strips or along their length. I made a 6” long cap from 16 ga. galvanized steel to go over the planing form so the strips can be clamped to the planing form which makes the scraping much easier.

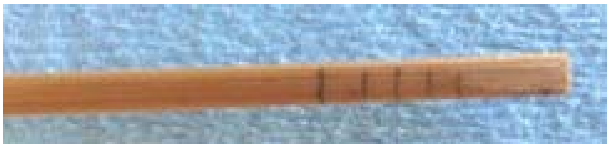
This is what the scraped strip (top) and the finished strip look like. Notice that either end of the top strip is a bit thicker than the middle. The next step is to reduce the wall of the female to its final thickness along its entire length (bottom strip). To do this you will need an flat file, small homemade sanding block and a scrapper. I make the sanding block from a piece of bamboo cutoff or leftover blocks of wood and glue a strip of 220 grit sandpaper to it. A cheap replacement plane blade makes a good scrapper. A 2' long 1x3 block of wood will allow you to raise the strip above the table which will make the filing, sanding, etc. easier.

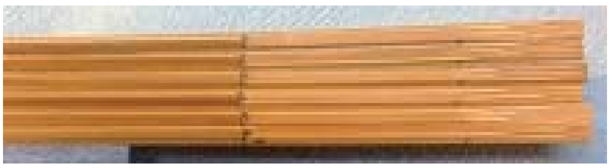


These are the tools I use to reduce the strip wall to its final thickness. Depending on the size of the female, the wall thickness will run from .033" to .045". With careful filing, sanding, and scraping you should be able to keep the wall to within + - .0005". You should frequently check to be sure you are scraping squarely. It is fairly easy to scrape one side lower than the other.

The next step is to file the slope into the strip. The slope is 1/3 of the total length of the female cavity and slopes from the wall thickness to ½ of the wall thickness. So, if the calculator calls for a wall thickness of .038" the slope will go from .038" to .019" at the end for the last 1/3 of the cavity. Putting cross lines on the inside of the strip will help you make sure you are filing and sanding evenly. If you are, each line will be erased across the entire strip at the same time. Here you can see that the file is slanted too much toward the top side of the strip.

This is what the finished strip looks like. If this is the butt section you are ready for glue up.





Follow your normal glue up proceedures. It is a good idea to have a small stick available to be able to reach inside the female cavity and pop a strip into place but, surprisingly, it is seldom needed.

It is important to complete the butt section before going on to the mid or tip section because, unless you have done a near perfect job of planing the female strips, you may need to adjust the diameter of the male to compensate for planing errors in the female.

Making the male ferrule

The reason Poratelli's design looks so much slimmer than other bamboo ferrules is that he realized that the male ferrule could be "necked in". That is, the diameter of the male could be reduced over a short distance by cutting a slope on the pith side of the strip and then, through heating and binding, the male could be bent into a form that would fit the female. Because a standard planing form is only adjustable in 5" increments it is necessary to slide the strip foreward in the planing form.

In this picture the dimension of the strip just before the beginning of the male is .122" and we want to reduce it to .104".

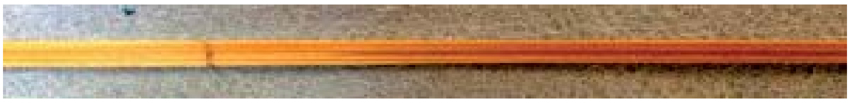
The .104 point must be on a station. Set this station as close to the .122 point as possible. In this case it is slightly more than 5" to the right. Draw a line at the .104 point then measure the length of the slide (e dimension in the diagram) and mark it to the right. This point should also be adjusted to .104". Now mark the length of the slope (f dimension in the diagram) to the left. It cannot be adjusted to .122 so leave it alone. It is simply a reference point. Now draw 4 hash marks, spread equally apart between the .122" point and the beginning of the slope. Be sure to mark the .122" point on the enamel side of the strip before you begin cutting the slope.

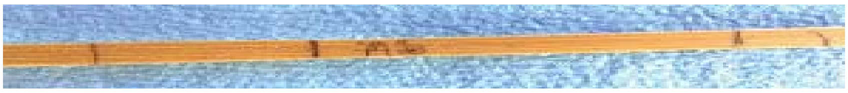
Set the strip in the form, enamel side up, so that the line you drew for the .122" point is on the line you drew for the beginning of the slope and mark the beginning and end of the slope and the end of the slide. You will need these marks to align the strips when you form the slope and when you glue up the section. Now flip the strip so that the enamel side is against one side of the form and mark the beginning point of the slope, flip the strip and mark the other side so that the beginning of the slope is marked on all three sides. Now move the strip back in the form to the .122" point, enamel side against one side of the form and begin to scrape. I use a sharp single edge razor blade and make 10 passes along the full length of the male, flip the strip and make 10 more passes.

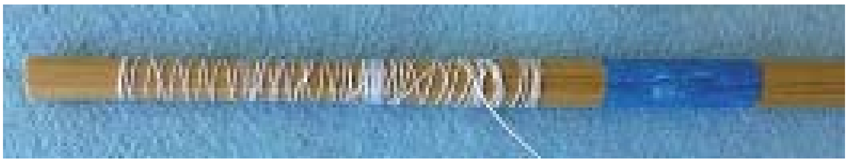
Move the strip foreward to the first hash mark and start scraping ¼ the distance down the slope, flip the strip and do the same thing on the other non-enamel side. Slide the strip to the second hash mark and begin scraping about ½ the distance down the slope, flip and do the other side and continue this proceedure until you reach the point where you marked the beginning of the slope on the form. This is what the strip will look like when you are done. Notice the reference marks on the enamel side of the strip.

Once all six strips are completed tape them together as you would after gluing (actual gluing comes later) and heat them until they are pliable. This is a bit of a guess since you cannot flex them as you would in flattening nodes. I heat them until they are too hot to hold and have to wear a glove on my left hand. Once heated quickly bind them up just beyond the beginning of the slope (the .122 point) very tightly together so that the male will be molded into shape. I hand bind and don't know whether a Garrison or 4 string binder can be used for this purpose since the amount of binding only runs between 1.6" and 2.5" long. My "hi tech" binder is pretty easy to make.

This is what the bound up strips look like. After they have cooled the strips are ready for glue up.







Making mid sections

I mostly make 3 and 4 piece rods. Mid sections simply have a female at one end and a male at the other. The only complication comes in setting the planing form. Remember, the female ends on a station so it begins to the left of the station by the length of the cavity. The length of the section is equal to the length of the rod plus the length of all the female cavities divided by the number of sections. Thus it is unlikely that the male will begin on a station. Mark the end of the female cavity on a station, mark the beginning of the female to the left of the station, measure the full length of the section (including the male) on the form, then subtract the total length of the male from that point to determine where the last taper dimension on the strip will be located. Since this is unlikely to be on a station, you will have to interpolate the required dimension.

An example will make this easier to follow (and to explain). Suppose you are making an 8' 3 pc 5wt. The rod will be 96" long. Suppose the taper calls for a female on the butt with a cavity of 2.244" and a female on the mid section with a cavity of 1.732". Thus the total length will be 96" + 2.244" + 1.732" or a total of 99.976" and each section will be 1/3 of that or 33.325". The female cavity will end on station 35 and the top of the female will be at 33.268 (35 – 1.732). The section will end at 66.593 (33.268 + 33.325) including the male so the last dimension will fall at 64.349 (66.593-2.244).

To figure the dimension at 64.349 subtract the dimension for station 60 from the dimension for 65 and divide by 5 to get the rise per inch. Now multiply the rise per inch by 4.349 and add it to the dimension for 60. If the taper calls for a dimension of .216" at 60 and .227 at 65 then the rise per inch is .0022" x 4.349 equals .0096" plus .216" equals .225" and the strip should be ½ or .113 (adjusted for any glue allowance you feel appropriate).

You don't have to worry about the male dimension until you are ready to cut it. The actual cutting of the female and male are the same as outlined earlier.

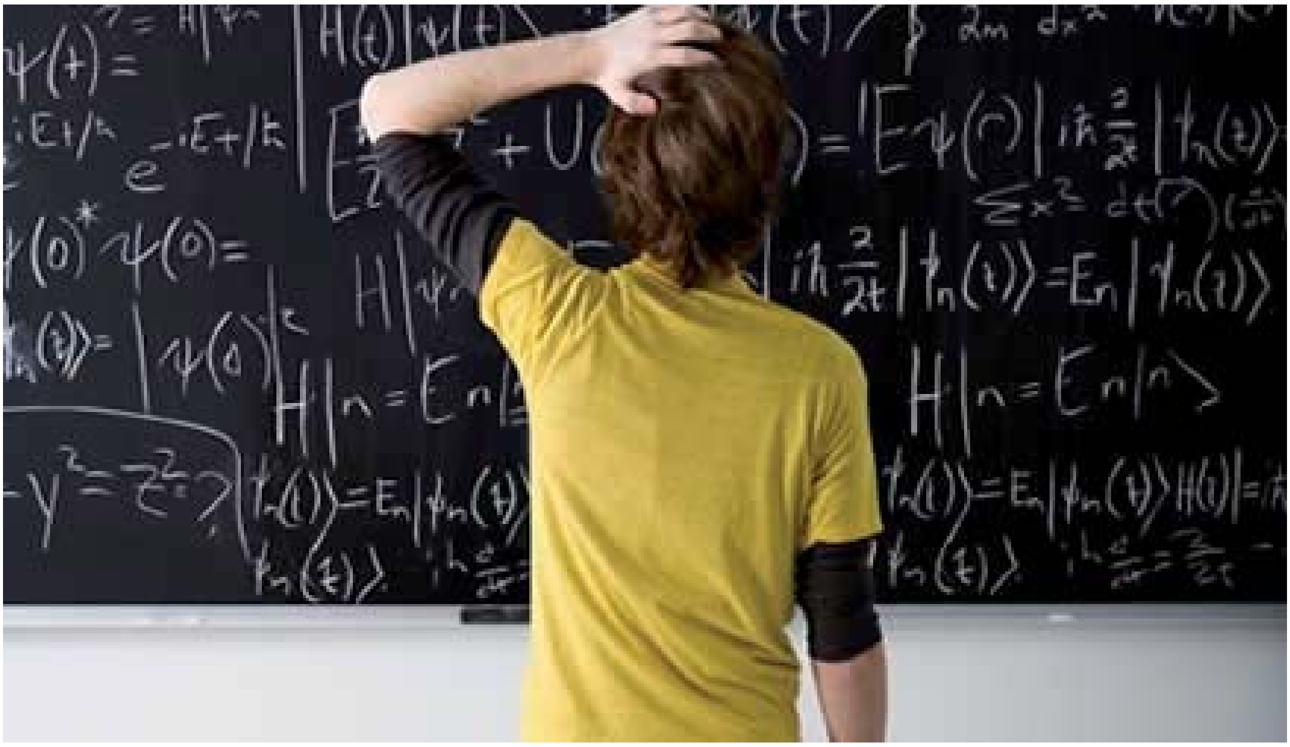
Other considerations

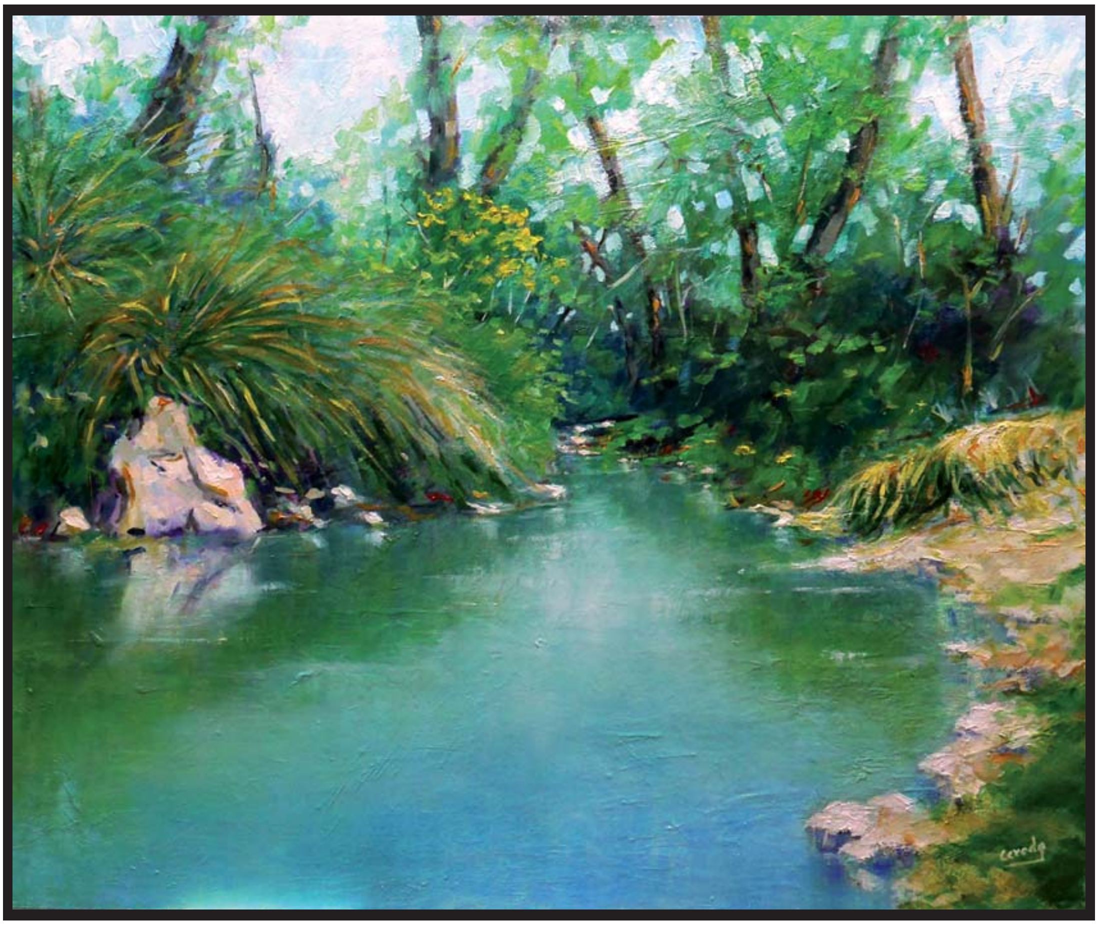
Before attempting to fit the male into the female, the female MUST be tightly wrapped with silk (or nylon) thread and coated with either varnish or epoxy. Time must be given for the glue and the thread coating to fully cure. If you get impatient it is quite likely that you will break the glue bond and/or the bond of the thread to the bamboo.

When fitting the male to the female it is also likely that the male will not easily slide into the female because the female interior surface is a bit rough. I coat the male with parafin wax before attempting to insert the male in order to lubricate the bamboo to bamboo contact. This also helps seal the bamboo. It may be necessary to do this four or five times as the wax pushes further into the cavity. If, after five attempts, the male still doesn't slide in then it will be necessary to scrape the male until it fits. Looking at the residual wax on the male will tell you where the fit is too tight and thus where to scrape. If your planing is perfect no scraping would be necessary but mine is seldom that good. If the fit is very slightly loose you may wish to use beeswax instead of parafin. Also, don't forget that varnish adds to the thickness of the male. I don't varnish the male, but rather, use a wipe on finish that can be applied much thinner than dipped varnish. Once the sections are fitted together it is helpful to put an alignment mark on each section.

That's it. Your rod is now ready for wrapping and varnishing.

Making these ferrules is much easier than it may seem. The keys are patience and thinking about what you are trying to accomplish before marking your form and cutting the cane. Give it a try. I think you will be pleased with the results.





Chalk stream

oil painting on canvas cm. 60 x 50

"WATER MUSIC"

by Enrico Francioni

A famous Italian proverb says – *"La Classe non è acqua"* literally "Class is not water" or "that's class for you" but after writing this article, I am compelled to think and say *"La musica è acqua"* – literally, "Music is water".

You don't believe me, do you? Please follow me in this brief musical-rambling-entomological-rod scientific-whatever you want trip and then try to reflect on it.

I am not afraid to say that when I initially decided to write this article for the Bamboo Journal, I was a little embarrassed about the choice of the contents. Embarrassed because I am attracted to all these overtures (which by the way are stimulating and rather curious) because they all refer explicitly, or with a slight mental effort, indirectly to the aquatic world and consequently to the fishing universe and to the fisherman. I am led to the following themes:

The music of water, the music on the water, in the water, the music of the sea, for the sea, in the sea, at the seas; the music of the fisherman, for the fisherman; music of the fish, for the fish and even a theme that is very close to us: the music of bamboo, with bamboo. And it certainly doesn't end here.

In this short trip, which I have divided into many paragraphs, I thought it would be a good idea to add some Hyperlinks that will allow the reader to listen to and watch the clips I am referring to (perhaps even with the same PC you are reading the article on).

1. THE MUSIC OF BAMBOO

In this piece, bamboo is used both as a column resonator and as a percussion musical instrument:

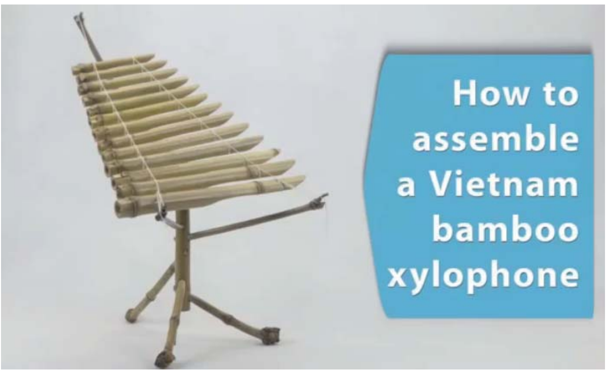
http://www.youtube.com/watch?v=q9o5X0fRMB0

...remaining in the world of percussions, here you have sounds generated mechanically:

http://www.youtube.com/watch?v=3gkMvpSWxKs

The “Vietnam bamboo xylophone" can be purchased in a neat assembly kit box:

http://www.youtube.com/watch?v=vmlKvajfs_I



Among the percussions, the "buncacan bamboo tube" is also very interesting; in this case, the complex percussive sound is given by the vibration of the two ends of the pole as well as the first part that can produce two different percussive tones with the movement of the thumb of the player:

http://www.youtube.com/watch?v=05lpSOMcxgk

In this example, the bamboo becomes a wind instrument (with a natural mouthpiece), a beautiful base flute, played on a pentatonic minor scale:

http://www.youtube.com/watch?v=fdpRE0rdVdA

"Bansuri" an Indian bamboo flute that can play sinuous and wide glissando:

http://www.youtube.com/watch?v=7QuDEx3_Ygo

…and what about these "Bolivian flutes"? Cut in two distinct registers (please note the use of the range clef in the bass flute):

http://www.youtube.com/watch?v=cjn-8EvvIac

…and then the examples where the bamboo is embellished and placed on a pedestal as a conventional instrument, a flute, a bamboo flute, obviously:

http://www.youtube.com/watch?v=L_soae20uUk

In other examples, the bamboo becomes a didgeridoo:

http://www.youtube.com/watch?v=pd9l87v8qYo

…the use of sophisticated and virtuous emission techniques:

http://www.youtube.com/watch?v=g0iAYLtCLf0
http://www.youtube.com/watch?v=QUuCEJGRQas

…in polyphony …beautiful!:

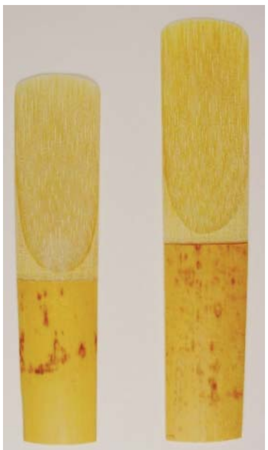
http://www.youtube.com/watch?v=Y3e-G0OX5ZY

This "Bamboo bass" is also amusing:

http://www.youtube.com/watch?v=hDrMewmx5jY

…and the list of examples could go on forever. I leave you the prompt to continue the search.

Furthermore, let us not forget that bamboo is the raw material of many traditional musical instruments: the reed of the wind instruments, the single reed in the clarinets, the saxophones and the double reed in the oboe, in the English horn and the bassoon …



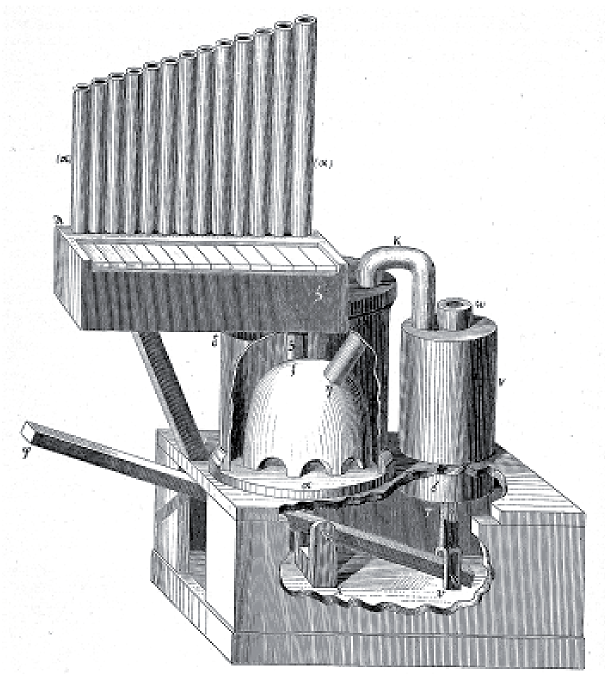
In this category, we could definitely include all the sounds of the rod maker.
You don't believe it, do you? Let's think of the "involuntary" sound events produced (or maybe they are voluntary, just for the fun of the rod maker in the construction phases of his rod): from the manipulation of the pole, to the cutting of the strips, the rubbing of the file and the sound of the planer on the planing form, as well as the characteristic sound of our rod when we test the "spine" and here the list of sound/noise events would be endless.

Then, the musical repertoire that each rod maker prefers during the construction of his rod in the privacy of his workshop.

2. MUSIC AND WATER.

Elaborating on my theme, there are many examples to satisfy my curiosity
An example where water is the (indirect) cause of the production of sound is without doubt the water organ.

[http://it.wikipedia.org/wiki/Organo_idraulico]

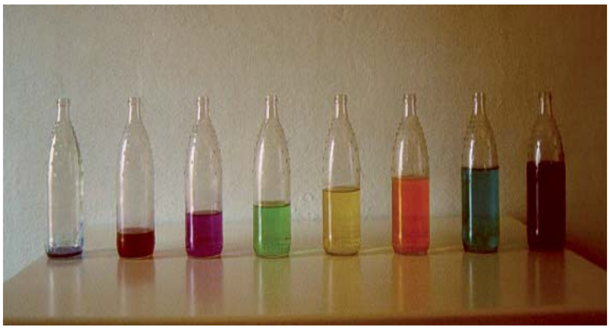


Please look at the water organ, which is housed in the Villa D'Este in Tivoli

[*http://it.wikipedia.org/wiki/Villa_d'Este_(Tivoli)].*

Here it is not the water directly "playing" even if there is no lack of musical examples where the water is indeed the direct material from which sound is generated (like air, strings or percussive materials).

Who has not tried to blow into a "bottlephone" (may I call it so?) at least once? It is an instrument composed of a series of bottles filled with different quantities of water that vary the volume of the vibrating air column and thus the height of the sound.



...and then there is a more simple musical instrument we can all make with some glasses (perhaps at a restaurant table) with varying quantities of water to graduate the height and this reminds us vaguely of the "glass harmonica".

Going deeper into the world of "concrete sounds" to get to the soundscape where the water itself can be listened to as a "musical event", even for therapeutic reasons; think of the roar of a waterfall or the flowing of a stream or river or the sounds of the sea ...

[http://www.youtube.com/watch?v=t94oFWMxVMg].

...and lastly what can one say of water in a solid state (ice) or transformed in another element (for example petrified), I'm sure we could all mention examples of very original listening experiences of this kind.

In the academic musical literature, there are many examples specifically dedicated to water, one for all, the "Water music" by Georg Friedrich Händel (1685–1759)

[http://www.youtube.com/watch?v=Kuw8YjSbKd4];

it is a series of orchestra movements, often considered three suites. The debut of this work was held on 17 July 1717 following the request of King George I to have a concert on the River Thames.
The concert was played by 50 musicians on a barge near the royal barge where the king was listening with some close friends. It is said that King George I enjoyed it so much he asked for three encores of the entire concert, even though the musicians were exhausted.

"Jardins sous la pluie" by Claude Debussy (1862–1918) reminds us of the evanescent image of an autumn rain. It was composed in E minor, it lasts about three and a half minutes and it stands out for its typically dreamlike quality.
It is part of a suite for piano composed in 1903, in which the composer started associating his music with visual impression of the East, of Spain, landscapes and others in a sequence of short pieces.

http://www.youtube.com/watch?v=zqO3fsWeTV0

Rain is also the subject of Pop music like "Piove" by Jovanotti

http://www.youtube.com/watch?v=-UbHYttXZCQ

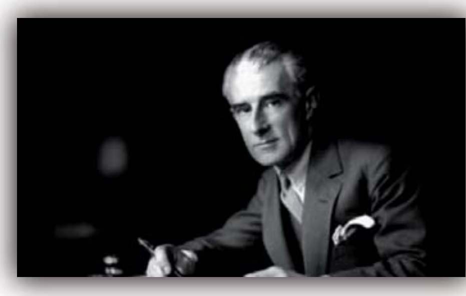
and also of the famous "Piove - or Ciao bambina" by Domenico Modugno

http://www.youtube.com/watch?v=nJDHGwlWMdE.

And then there are the "Jeux d'eau" by another musician tied to the impressionist/symbolist movement like Maurice Ravel (1875–1937)

[http://www.youtube.com/watch?v=V_m6oqVy48E].

"Jeux d'eau" is a descriptive piano composition that represents scenes of "water games". The short piece has an evocative atmosphere and from a musical point of view, is rather difficult. The constantly fluctuating tone and the often-wavering harmonic progressions contribute to this image that is no longer expressed only as melody but also harmony and timbre: the chord blocks contrasted with the fleeting arpeggio figures evoke still water, then splashes and the various choreographies of water in movement.



Water games also remind us of Franz Liszt (1811–1886) "Jeux d'eau à la villa d'Este" for piano.

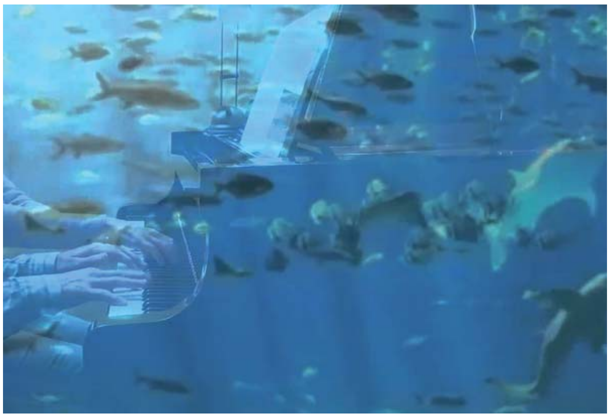
What about the Italian composer Ottorino Respighi (1879-1936) with his "The fountains of Rome" for orchestra?
Each of the four movements is dedicated to a fountain in Rome at different times of the day.
The first movement, "The fountain of Valle Giulia", shows this fountain at dawn in a pastoral landscape where the animals spend the morning.
The second movement - "The fountain of Triton in the morning " – shows the Naiads and the Mermen dancing in the morning light like the figures of Bernini's fountain. Gods and goddesses that play shells are represented by the horn.
The third movement, "The Trevi fountain in the afternoon", is introduced by a jubilation that announces a recent victory of the god Neptune.
The final movement "The Villa Medici fountain at sunset" has a melancholy atmosphere as the brightness of the sun fades.

[http://www.youtube.com/watch?v=XAVZ2d-7laY]

Another Frenchman, Camille Saint-Saëns (1835–1921) with the famous "Aquarium" from the Animal Carnival

[http://www.youtube.com/watch?v=AsD0FDLOKGA].

The pianos, the flutes, the glass harmonica and the string instruments play a sweet monotonous tune in Andantino tempo. The phrasing and the arpeggios explore unusual sounds; they describe the intangible and sweet environment of the Aquarium. The ascending musical scales of the string instruments and the piano describe the bubbles of the aquarium very well. The pianos play in high register.



"Water music" by John Cage (1952) is an excellent example of aleatory music.
The piece was composed for a pianist, using also a radio, whistles, water containers, a pack of cards, a wooden stick and items for constructing a piano:

http://www.youtube.com/watch?v=AnfRTh26RIE.

3. MUSIC AND THE SEA

The sea and more commonly water have inspired many musicians. How many storms have crossed the history of music, often reflecting the tumultuous agitations of the characters involved? But let's also think of the sea at the theatre, from Othello to Tristan, from Christopher Columbus to the Gioconda.

The examples and musical references are not lacking:
starting from Antonio Vivaldi (1678–1741) with "Storm at sea" a concert for violin and string instruments

http://www.youtube.com/watch?v=EKxohZRSL1g

The piece starts with an agitated orchestra and a boisterous entry of the violin. The theme is like a waterfall, with roars of torrential rain. A brief middle section, with a restless and incessant tempo is like the eye of the cyclone before the storm calms. Then an abundance of bizarre changes in atmosphere before the impressive finale.

On the subject of storms listen to this Sonata N.6 for string instruments (two violins, cello and double bass), pertinently entitled "The storm ", written by Gioacchino Rossini (1792–1868) in 1804 when he was only twelve.

http://www.youtube.com/watch?v=ZcCqEFsEw8A

The French composer Claude Debussy (1862-1918), was a great lover of the sea and as a young boy dreamt of becoming a sailor. "La Mer, trois esquisses symphoniques pour orchestre" or simply "La Mer" is his orchestral composition with an impressionist character. He started the composition in 1903 in France and finished it in 1905 during his stay in Eastbourne on the coast of the English Channel. The debut was performed in Paris in 1905. It was not well received, above all because of the bad execution but in a short period of time it became one of Debussy's most admired and played compositions. Even today, "La Mer" is widely considered one of the best compositions for orchestra of the twentieth century.

http://www.youtube.com/watch?v=RLAIJjWdJRQ

The "Sea Symphony", a majestic choral symphony by the English composer Ralph Vaughan-Williams (1872-1958)

[http://www.youtube.com/watch?v=WANMioZCpGQ].

And many pieces of Pop music speak about the sea: "Sapore di sale" by Paoli, "Un'estate al mare", "Mare mare" by Luca Carboni, "Tra te e il mare" by Pausini, "Com'è profondo il mare" and "Stella di mare" by Dalla, "Il mare d'inverno" by Bertè, "Gente di mare" by Tozzi, "Una rotonda sul mare" by Bongusto.

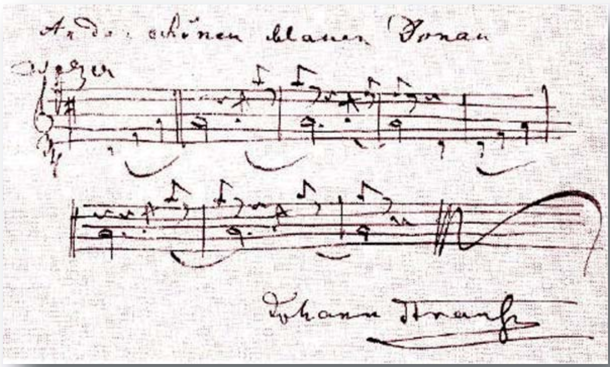
4. MUSIC, RIVERS AND LAKES

"Vltava" is a symphonic poem composed by Bedřich Smetana (1824–1884) and it is part of a symphonic cycle "My fatherland". The composer celebrates the beauty of the River Vltava, which is born in the Bohemian Forest and runs through the country to Prague and into the Elba, which in turn flows into the North Sea. It starts with two flutes that play the waving melody of a stream, and then the clarinets enter followed by the string instruments.

http://www.youtube.com/watch?v=wCXE0DYeBV0

"An der schönen blauen Donau" (On the blue Danube) op. 314, is the "waltz " by Johann Strauss Jr. (1825–1899), universally recognised as the most famous waltz written by the composer and among the most famous pieces of classic music of all time.

http://www.youtube.com/watch?v=uDIA6ragkPM



"The Lady of the Lake" is an opera by Gioacchino Rossini, derived from the poem of the same title by Walter Scott, published in 1810.

http://www.youtube.com/watch?v=LmHWHbxJP34

"Swan Lake" is one of the most famous and most acclaimed ballets of the 19th century by Pëtr Il'ič Čajkovskij (1840-1893). The debut took place at the Bolshoi Theatre of Moscow in 1877. The libretto is based on an ancient German fable and it is the first of three ballets by Čajkovskij.

http://www.youtube.com/watch?v=Sa3Angk4RFI

Let’s not forget "Ondine" by Ravel (from “Gaspard de la nuit” n.1) for piano, a piece that evokes the image of a lake nymph singing with the intent to seduce the listener and lead him to explore the depths of the lake. It is characterised by continuous “undulating” sounds that represent the incessant back and forth motion of the waves.

http://www.youtube.com/watch?v=T_-1qMPDf-A

A different musical genre takes us to "Il Piave" a folk song popular in Italy during the First World War .

http://www.youtube.com/watch?v=VluxUjVSMW0

From the Sardinian folk repertoire "Il ruscello", "On the Volga" from Russia, "Marechiare" from the Neapolitan tradition.

http://www.youtube.com/watch?v=taqNaBfArUg

"On Lake Tanganica"; from Veneto the folk songs "Il barcarol del Brenta"

http://www.youtube.com/watch?v=HV8_mkQ8rwo

and "Oh pescator dell'onda", lastly from Abruzzo "Tutte le funtanelle"

http://www.youtube.com/watch?v=TzGomFu7utY

5. MUSIC, FISHERMEN AND FISH

From the French composer Georges Bizet (1838–1875) "Les pêcheurs de perles" (The Pearl Fishers) an opera in three acts which is considered the first operatic masterpiece of the composer that at the time was not yet 25.

http://www.youtube.com/watch?v=3GPeK6Qo4dk

Then the piece all trout fishermen should know, "The trout", a quintet for piano and strings by Franz Schubert (1797–1828)

http://www.youtube.com/watch?v=wlxVTpEyMEw

taken from a song of his for voice and piano "Die Forelle".

The piece was composed in 1819 when Schubert was twenty-two and he chose instead of a normal quintet for piano and string quartet, to write a piece for piano, violin, viola, cello and double bass.

[http://www.youtube.com/watch?v=NF9DrUXowBo]

In other words a fatal attraction between music and the world of water (rodmakers included).
… by the way the head office of I.B.R.A. – what a coincidence – is at **Podere "Violino"**!

REFERENCES:
To write this article, I not only put into play my musical knowledge but I also used:

- Wikipedia
- YouTube
- Water is precious (hypertext for Middle Schools)

…and my previous works on the subject like:

- "Music and water" (hypertext for Middle Schools)
- "Music is not water" (dramatization for Middle Schools)

IN-DEPTH ANALYSIS [FOR THE MORE INQUISITIVE]:

Water in music
http://www.museoenergia.it/museo.php?stanza=12&ppost=984
Water-Psyche-Music
http://ecomuseodellateverina.eu/acqua/136-acqua-psiche-musica
When water inspires music
http://www.sanpellegrino-corporate.it/quando-acqua-ispira-la-musica.aspx
The messages from water
http://www.disinformazione.it/water.htm
WATER IN MUSIC
http://www.delfo.forli-cesena.it/iccivitella/IPERTESTO%20L'ACQUA/ACQUA%20E%20MUSICA.html
Rivers of notes
http://www.scuolapiancavallo.it/SITO/sez_progetti/Acqua/NON%20APRIRE/fiumi%20di%20note.htm
The music of water
http://www.sodastream.it/news_ambiente.php?idcat=2

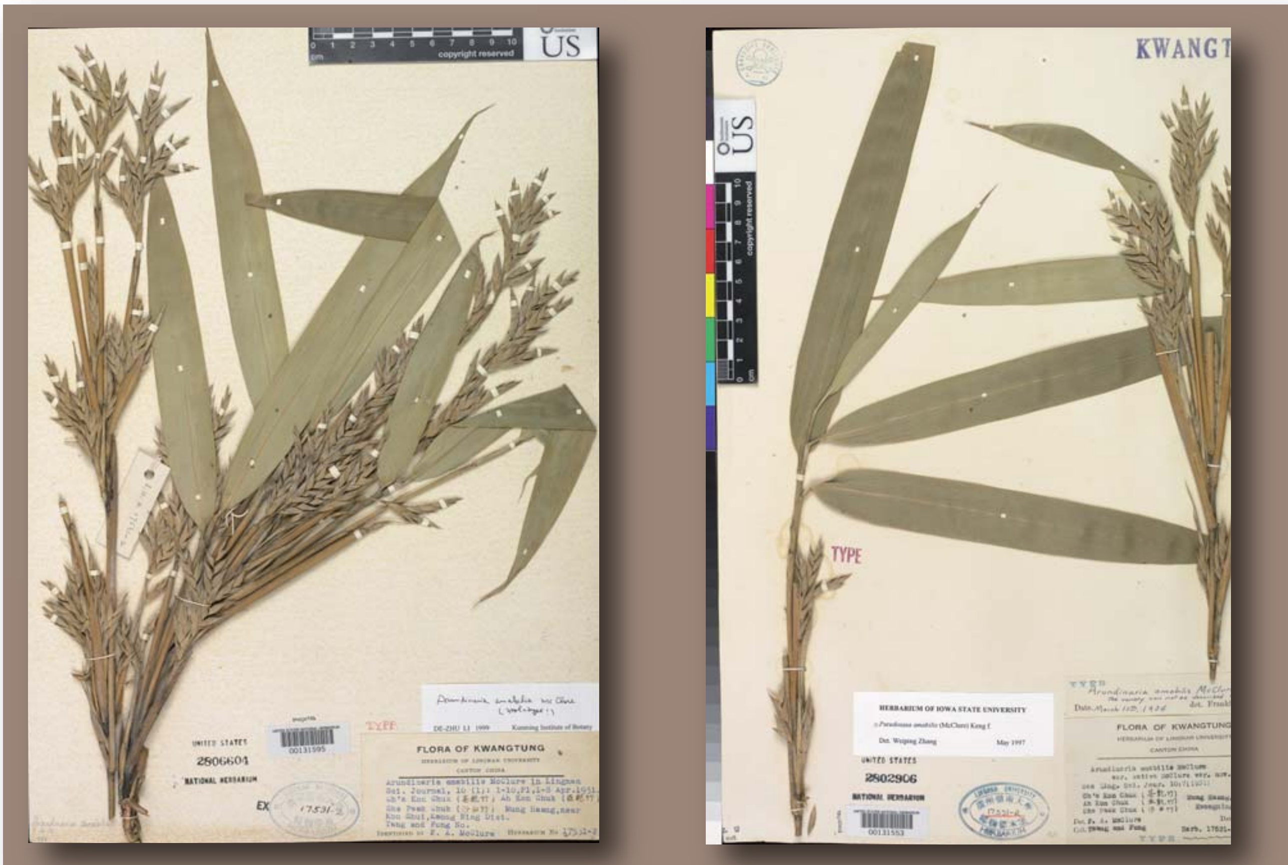
sunset after the snowfall

oil painting on canvas cm. 60x60

Notes on the anatomy and properties of bamboo

by Alberto Poratelli

"We can live without meat, but without bamboo it would mean death"
Confucius



images from the archive of Herbarium of Iowa State University

Foreword

In the world of bamboo rodmaking, the main element is bamboo. Without this raw material our passion would not exist. You often hear people talking about bamboo and its chemical and physical properties without any knowledge of the facts, but above all, some essential concepts are assumed as dogmas, for example the fact that it is better to use the lower part of the culm to make the butt sections and the tip from the upper part – all this without knowing the reasons.

The numerous alternatives in the use of bamboo depend on the unique properties of the culm.

This article, which derives and has been adapted mainly from the publication by W. Liese "Anatomy and Properties of Bamboo" and other articles, is an attempt to summarize the information, which is accessible in order to understand the anatomy, the chemical composition and the consequent mechanical properties of this extraordinary grass.

Anatomy

The properties of the culm, are determined by the anatomical structure.

The culm is formed by nodes and internodal sections. In the internodal sections, the cells are oriented axially, while in the nodes they form transversal interconnections. In the intermodal sections, there are no elements disposed radially. In the nodes, instead, there is an intense ramification of the cells; they also travel radially towards the center and form a transversal connection through the nodal membranes. In this way, all the parts of the culm are intertwined.

The external part of the culm is formed of two layers of epidermal cells. The internal layer is thicker and lignified. The external layer of epidermal cells have a waxy coating. The internal part of the culm are made of various sclerenchymatous tissue.

In this way, any transversal passage of liquids is inhibited. The pathways for penetration are therefore the cross ends of the culm and to a lesser extent, the sheath scars around the nodes.

The gross anatomical structure of a transverse section of any culm internode is determined by the form, dimensions and disposition of the vascular fibers. The vascular fibers are clearly visible because their darker sclerenchymatous tissue colour contrasts with the surrounding parenchyma.

In the outer part of the culm the vascular fibers are small and more numerous than the inner part where they are larger and less numerous. (fig. 1 , Fig. 2) . On the inside of the culm, the total number of vascular fibers decreased from the lower part to the upper part, while at the same time the density increases.

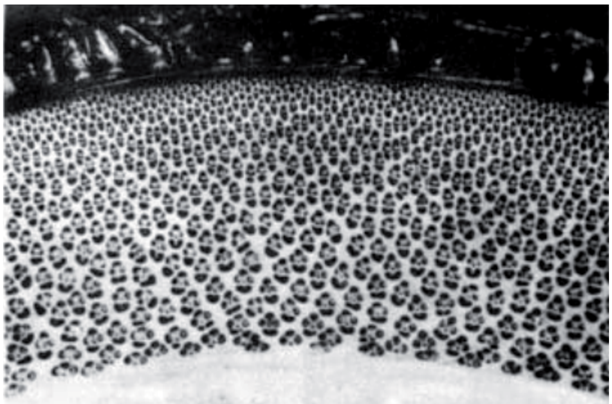


figure 1 - section of the culm of Dendrocalamus giganteus (W. Liese, Anatomy and Properties of Bamboo)

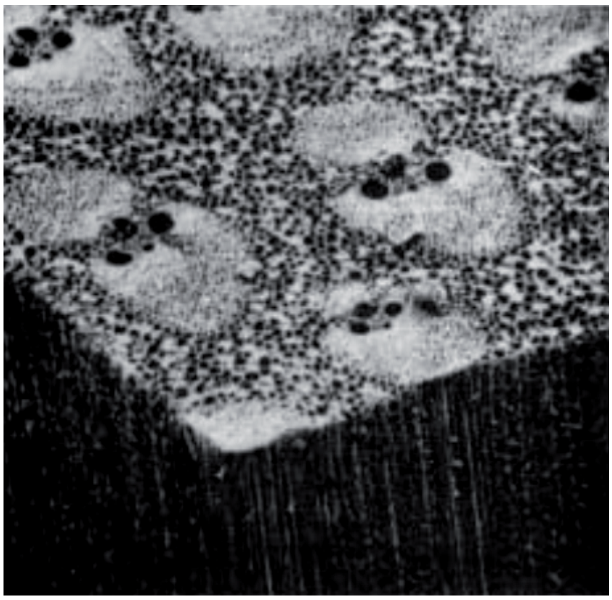


fig. 2 - 3d view of the vascular tubes in a bamboo culm (W. Liese, Anatomy and Properties of Bamboo)

The tissue of the culm is composed mainly of parenchyma, vascular fibers and fibers. The ratio of this is about 50 % parenchyma , 40 % fiber and 10% vascular tubes and filtration cells with some variations according to the species.

The distribution and direction of the cells are placed in a well-defined manner in the culm and are both horizontal and vertical.

The parenchymatous and vascular tubes are more frequent in the inner third of the wall, while in the external third the percentage of fibers is much superior. Vertically, the quantity of fibers increase from the lower part towards the upper part, while the parenchyma decreases. (Fig. 3).

We can easily say that the practice of discarding the superior part of the culm is a waste if we consider the fiber content.

Parenchyma

The fundamental tissue is formed of parenchymatous cells that are elongated vertically and are interspersed by shorter cells that are more are less cubical. The former are characterized by thick walls that are multi layered. (Fig. 4); these cells lignify in the first stages of growth. The shorter cells have a dense cytoplasm, thinner cell walls and they maintain their cytoplasmic activity for a long times. The function of these two different types of cells is yet unknown.

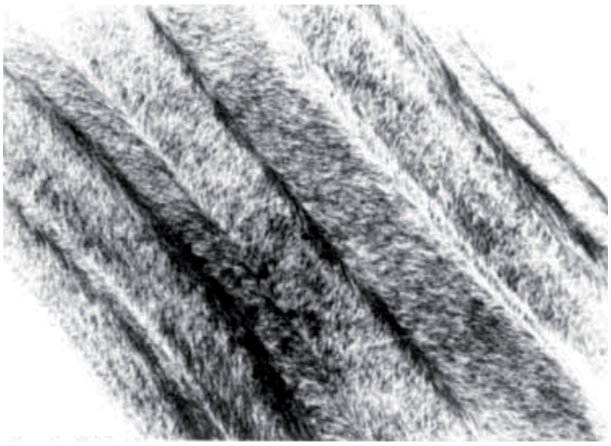
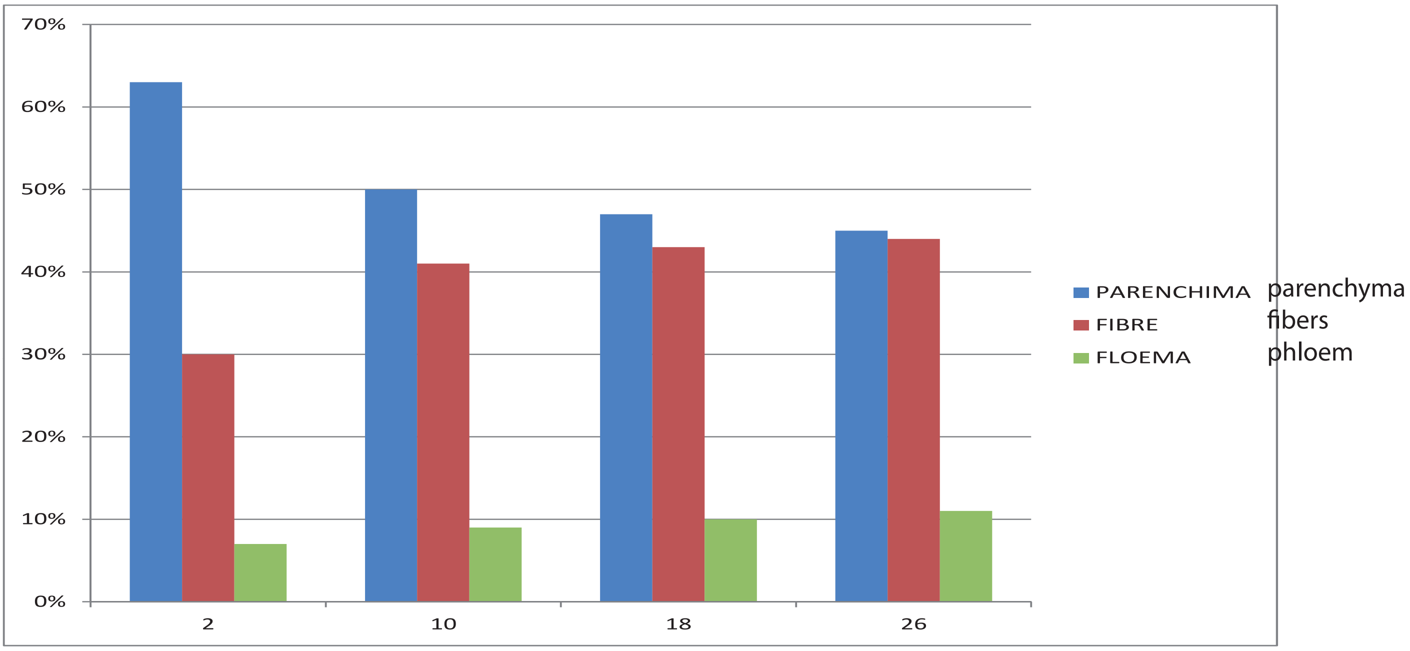


figure 4 - laminated structure of the parenchyma in the variety Phyllostachys edulis (W. Liese, Anatomy and Properties of Bamboo)

figure 3 - percentage of the type of cells vertically in the internodes. The values refer to the the internodes n. 2-10-18-26from the bottom to the top of the culm (W. Liese, Anatomy and Properties of Bamboo)



Vascular fibers

The vascular fibers in the culm consist of xylem (plant tissue that is present in vascular plants that transport water and the solutes disolved in it) and of one or two elements - protoxylem which are smaller and metaxylem and the tissue that transports the elaborated lymph which is non lignified phloem.

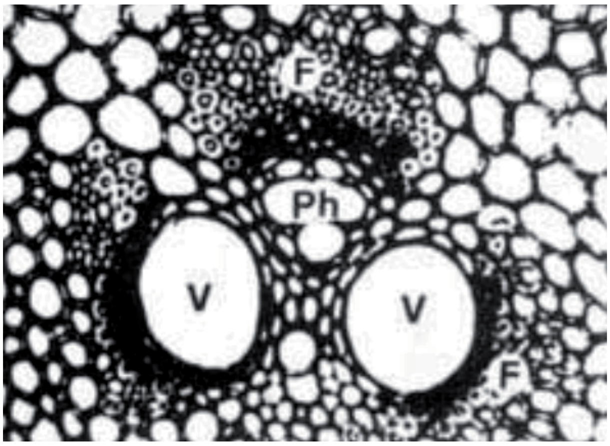


fig. 5 - vascular tubes with two large metaxylems (V) and Phloem (Ph) surrounded by fibers (F)
(W. Liese, Anatomy and Properties of Bamboo)

The tubes have a big diameter in the inner part of the culm and they become smaller towards the external part of the culm.

It is particularly interesting to find the presence of a protective layer of the the parenchymatous cells next to the small metaxylem which is composed of polysaccharide of cellulose and hemicellulose without lignification. This protective layer is typical also in monocots, dicots and coniferous plants.

Both the metaxylem and the phloem tissue are surrounded by schlerenchymous sheaths. They differ greatly in size, form and position according to the position in the bamboo culm.

We can find 4 main types of vascular fibers (figure 6). The dimensions and the form of the vascular fibers varies between internodes and also in the height of the culm.

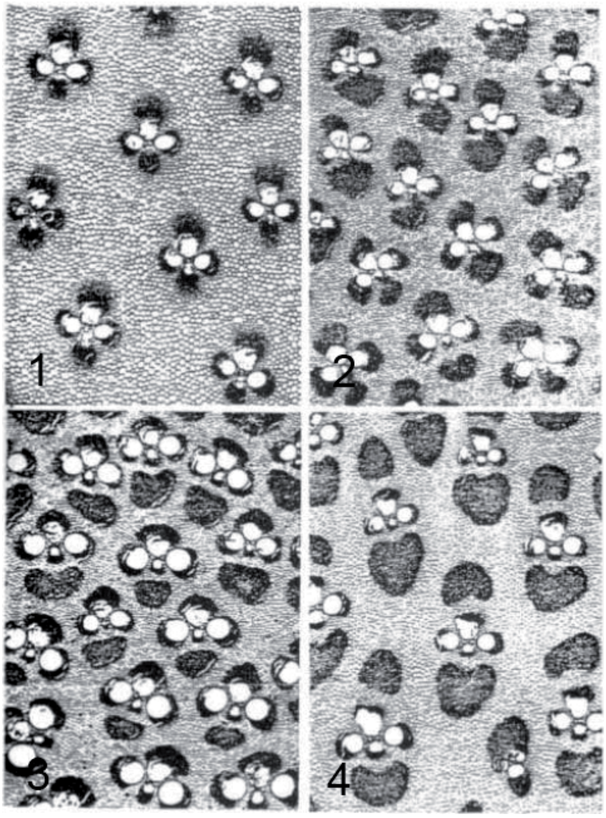


fig. 6 - different types of vascular fibers:

1 - Phyllostachys Edulis
2 - Cephalostachyum Pergracile
3 - Oxytonanthcra Albociliata
4 - Thyrsostachys Oliveri
(W. Liese, Anatomy and Properties of Bamboo)

Fiber

The fibers are composed of scherenchymatous tissue and they are placed in the internodes like capsules of the vascular fibers and in some species like isolated filaments. They constitute about 40-50% of the total tissue of the culm and 60-70% of its weight. The fibers are elongated and taper towards their extremity.

The ratio between the length and the width varies from 150:1 and 250:1. The length varies greatly among species. In general the fibers are very long in deciduous plants.

Different values have been found within the same species. The reason is due to the great difference in length of the fibers inside the culm.

From one side to the other of the culm, the length of the fibers increases toward the outside and reaches its maximum about half way and decreases toward the inside.

The internal fibers of the culm are always much shorter than the external ones (between 20 and 40%). An even greater difference superior to 100% can be found longitudinally in an internode: the fibers are always shorter close to the nodes and longer in the central part (Fig. 7).

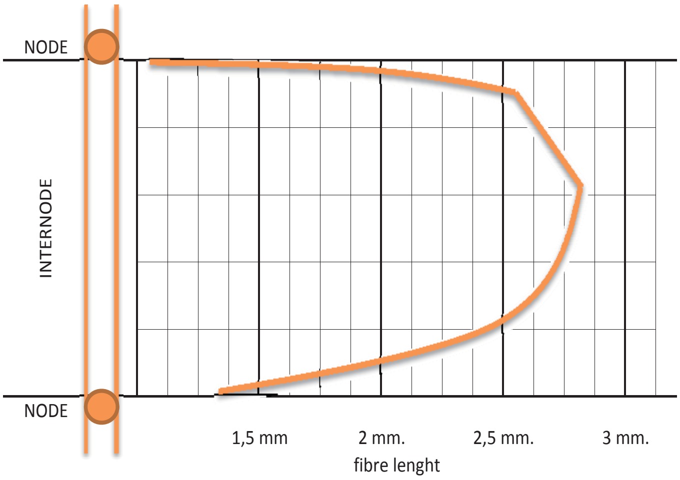


fig. 7 - variation in length of the fibers in the internodes (W. Liese, Anatomy and Properties of Bamboo)

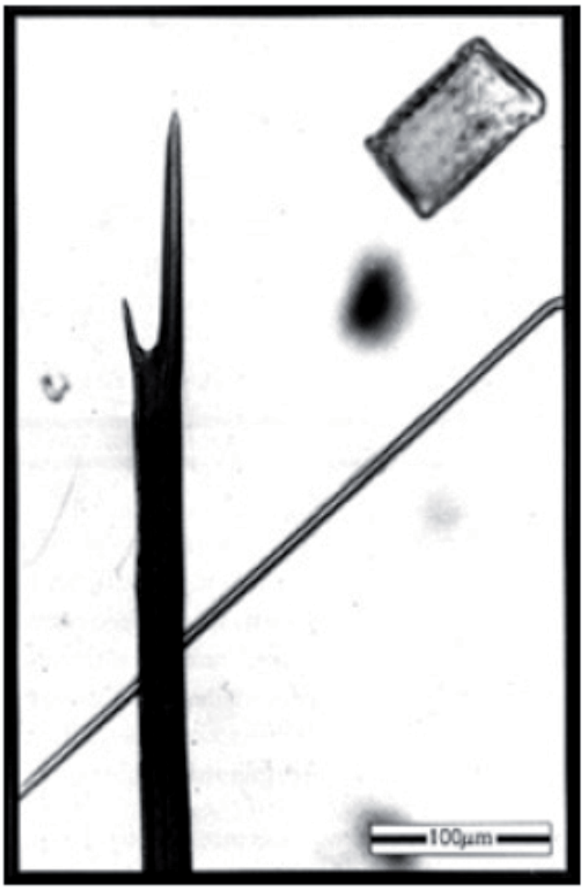


fig. 8 - small and large fibers as seen under a microscope. (W. Liese, Anatomy and Properties of Bamboo)

The length of the fibers varies from 1,5 to 3 mm. According to the variety (fig. 9), and it is correlated to the diameter of the fibers, to the cell wall thickness and diameter of the culm and diameter of the internode. The diameter of the fibers varies from to 19 micron (1 micron=1/1000 mm.).

Species	Lenght mm.	Width micron	relation L/S 1/x
Arundinaria Alpina	2,30	23,0	100
Bambusa Arundinacea	1,73	22,0	79
bambusa Longispiculata	2,31	13,5	171
Bambusa Multiplex	2,20	14,0	157
Bambusa Tulda	1,45	24,0	60
Bambusa Vulgaris	2,64	10,0	264
Dendrocalamus Strictus	2,23	22,0	101
Guauda Angustifolia	1,60	11,0	145
Oxithenantera Abyssinica	1,51	12,0	126
Phyllostachis Bambusoides	2,15	15,0	143
Phyllostachis Edulis	1,56	13,0	120
Phyllostachis Nigra	1,04	10,0	104
Phyllostachis Reticulata	1,56	13,0	120
Pseudosasa Japonica	1,34	18,0	74
Sinocalamus Latiflorus	2,88	14,0	206
Thyrsostachys Slamensis	1,81	10,0	181

Phloem

The phloem is composes of ample filtration tubules with a narrow wall. The study of their structure has shown the presence of plastids without starch.

Chemical properties

The main chemical elements that compose the bamboo culms are: cellulose, hemicellulose and lignin; other lesser elements are resins, tannins, waxes and minerals. The composition varies in relation to the species, to the growing conditions, to the age and position (upper or lower) in the culm.

Since the tissue of the bamboo culm during the first year of maturation goes from soft and fragile to hard, the proportions between lignin and carbohydrates varies greatly in this period. However, after complete maturation the chemical composition tends to be rather stable.

The nodes contain less soluble extracts, ash and lignin but more cellulose than the internodes. Tables 1 and 2 represent the chemical analysis for some species of bamboo.

TABLE 1	Chemical composition of some bamboo (Tamolang et al. 1980)							
Species	Holocellulose %	Pentosans %	Lignin %	Alcoholbenzene %	Hot water %	1% NaOH %	Ash %	Silica %
Gigantochloa Levis	62,9	18,8	24,2	3,2	4,4	28,3	5,3	2,8
Gigantochloa aspera	61,3	19,6	25,5	5,4	3,8	22,3	4,1	2,4
Bambusa vulgaris	66,5	21,1	26,9	4,1	5,1	27,9	2,4	1,5
Range of values for 10 Indian	-	15,1	22	0,2	3,4	15	1,7	0,44
bamboo species	21,5	32,2	3,2	6,9	21,8	3,2	2,1	0
Range of values for 10 Japanese	61,9	17,5	19,8	0,9	5,3	22,2	0,8	0,1
and Indonesian bamboo species	70,4	22,7	26,6	10,8	11,8	29,8	3,8	1,7

TABLE 2	Chemical composition of Phyllostachys Pubescens at different heights (Li 1983)						
	Holocellulose %	Pentosans %	Lignin %	Alcoholbenzene %	Hot water extracts %	1% NaOH %	Ash %
Upper culm	54,1	31,8	24,7	6	7	25,6	1,2
Middle culm	53,6	30,8	24,5	7,6	8,5	27,6	1,2
Lower culm	54,4	32,9	24	7,4	9,3	28,3	1,1

tab 1 e 2 - chemical composition
(W. Liese, Anatomy and Properties of Bamboo)

Silica

The content of silica varies on average between 0,5% and 4% and it increases from the bottom to the top. Most of the silica is deposited in the epidermal cells, in the enamel while the nodes contain little silica. The inner tissues do not have any trace of silica. The presence of silica has important effects on the properties of resistance of bamboo.

Cellulose

Cellulose and hemicellulose compose more than 50% of the chemical composition of bamboo. As in other plants it consist of linear chains of 1,4 units of hydroglucose (C2H1206). The number of units of glucose in a molecular chain is called the degree of polymerization. The degree of polymerization in bamboo is much superior to those in other wood.

Cellulose is difficult to isolate in purity because it is closely associated to hemicellulose and lignin.

Regarding the presence of xylan, bamboo is more similar to coniferous plants and it can be considered as intermediate the hard woods and coniferous plants. This result indicates that bamboo has a unique structure among the grassy plants (Gramineae).

Lignin

After cellulose, lignin represents the second most common component of bamboo. The lignin in bamboo is typical of the grassy plants.

The lignification of every internode proceeds towards the base while transversally it proceeds from the inside to the outside. During the growth, the lignification of the epidermal cells and fibers proceeds from the top of the parenchymatous tissue towards the ground.

Physical and Chemical Properties

Moisture content

The moisture content in the culm varies and is influences by its age and the season in which it is felled. Young shoots at the age of one year have a moisture content of 120% - 130% both at the top and at the bottom.

The nodes, however have a lesser content of humidity with respect to the internodes and these differences can be up to 25% and they are superior at the base than at the top. Culms that are 3 – 4 years old have a higher moisture content at the base with respect to the superior part. The moisture content is higher in the inner part of the culm than in the outer.

Specific weight and mechanical properties.

The specific weight of bamboo varies between 500 and 800 kg/mc., the outer part of the culm has a higher specific weight than the inner part. The specific weight of the culm increases from the base to the top.

The mechanical properties of bamboo are closely correlated to the specific weight; bamboo has excellent mechanical properties and this depends mainly from the fiber content. The mechanical properties improve in the upper part of the plant where with a thinner wall thickness the specific weight increases due to a reduction of the parenchyma.

Resistance to crushing is not influence much by the position (upper or lower) of the culm while as far as resistance to flexing, the elastic module is superior at the top of the culm.

The mechanical properties of a bamboo culm of the variety Phyllostachys pubescens are in table 3.

TABLE 3	Mechanical properties oF Phyllostachys Pubescens in the water satured, air dry and oven dry state (Suzuki 1950)				
Property	part		water satured	air dry	oven dry
Bending strenght - N/mm2	Outer		250	270	370
	Inner		120	144	160
Cleavage strenght - N/mm2	Outer	6	7	8	
	Inner	5	6	8	
	whole		6	7	8
Shear strenght - N/mm2	whole		9	11	18
Hardness - N/mm2	outer	upper	49	63	91
		side	22	25	37
	inner	upper	27	32	66
		side	13	17	37

tab 3 - mechanical properties
(W. Liese, Anatomy and Properties of Bamboo)

Influence of age

Age is an important factor for the development of the mechanical properties. We presume that bamboo after a maturation of three years reaches it maximum strength.

Tests carried out on the variety Dendrocalamus Strictus have demonstrated that older culms have more strength than the young ones because the moisture content in the latter is higher. In normal conditions of essication however, the highest values are achieved from culms that are one/two years old.

Tests have shown that strips originating from the central part of the culm in culms one year old are stronger than those from plants that are two years old. In general culms that are more than ten years old have shown a decrease in the mechanical properties.

In the tests however, there have been major differences in the mechanical properties between culms of the same variety but grown in different areas. It goes without saying that the area of the plantation influences the mechanical properties considerably.

Conclusions

The bibliography on bamboo is vast and I hope I have managed to condensate in these few pages the basic notions that allow a rodmaker to understand what extraordinary material we have in our hands.

One thing is certain: after having read this series of interesting article, I will never make a tip using the lower part of a culm!

Alberto Poratelli

§§§

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Low tide in Brittany

oil painting on canvas cm. 60 x 60

TRIANGULAR RODS

by Gabriele Gori

With a numerous delegation of IBRA members, last October I attended the 2013 European Gathering in Charmay Switzerland. The event, which was organized impeccably by our Swiss friends was enriched by numerous and interesting seminars that covered various aspects of our common passion.

Among others, the Finnish Rodmaker, Tapani Salmi, presented his two handed triangular rods: solid, hollow and with enamel on the inside of the section. Certainly, this is an uncommon method of construction. On the other hand, making triangular rods was experimented a few years back by Lino Patrini

(http://www.passionebamboo.it/CANNE/TRIANGOLARE/TRIANGOLARE.htm).

Lino Patrini is a member of IBRA who experimented various geometrical sections.

On the Sunday, many of us had the chance to try these rods. Our dear friend Philipp Sicher, asked me to integrate my work on the Comparison of Sections, with details regarding this particular geometry.

It took it up willingly and I started the work by calculating the values of the area, moment of inertia and module of resistance of the following: solid built, hollow built with wall thicknesses of 2.0 mm and 2.5mm and the Magic Star with wall thicknesses of 2.0mm and 1.5mm.

At a later stage I will work on the fluted and “shark tooth” by Alberto Poratelli.

Do you remember what this study was about?

In practice, it was to answer the following question: “Which is the best cross section geometry to use when you make a bamboo rod?

In short and to make things easier, let me summarize the fundamental concepts.

With the term “cross section”, we mean the geometry of the transversal cross section of the rod.

Hex rods, pentas, quads, octagonal and also triangular rods have been made.

The object of this study is to compare the various geometries while taking into consideration all the most significant aspects in relation to the action of the rod.

A fundamental assumption, and I think this can be agreed on by all, is that between geometrical cross sections which have the same weigh, the one that is stiffer (more rigid) is also the most efficient.

We can all agree on this because we can design rods that will have the same action that are lighter.

The weight is directly proportional to the area of the geometrical figure of the cross section of the rod and of course we will assume that the material is always the same and it will have the same density.

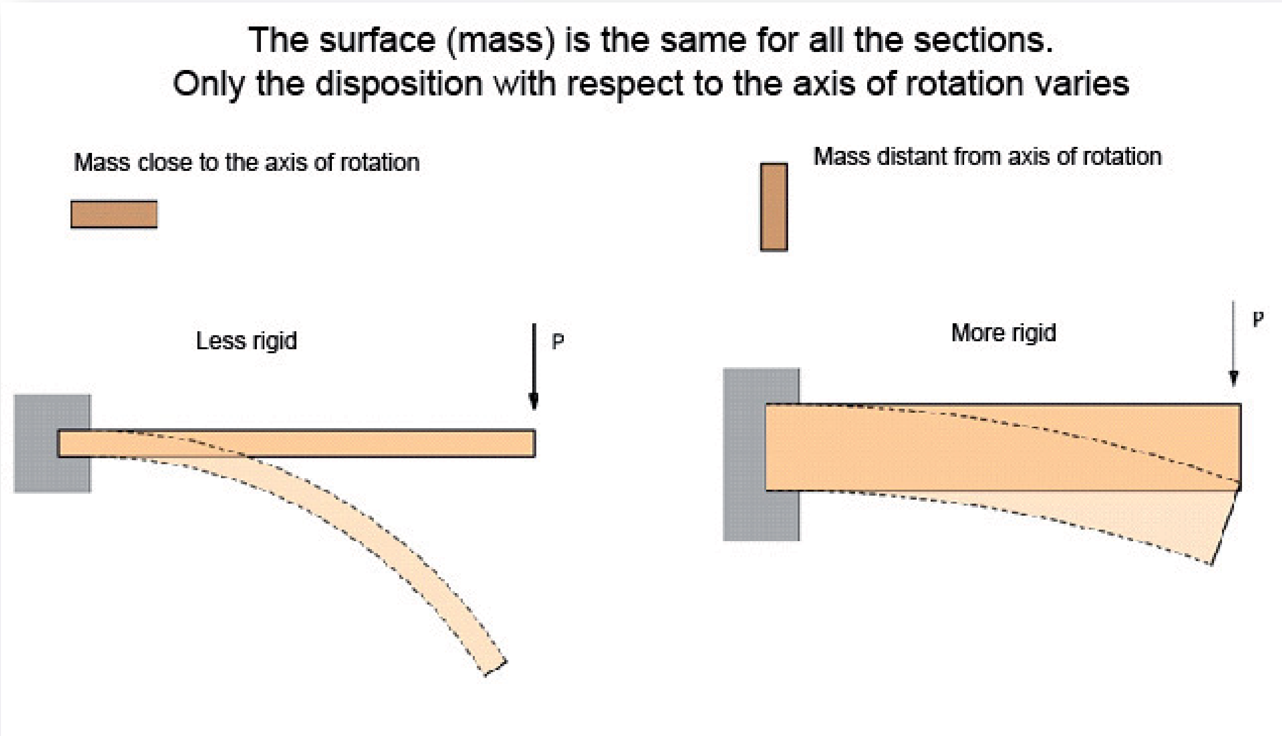
The rigidity, or resistance to flexing of the rod, is directly proportional to the elastic module of the material it is made from, (this identifies the rigidity in relation to the “quality” of the material) and the moment of inertia of the section (which represents the rigidity to flexing in relation to the form of the cross section).

If we hypothesize that the material is always the same, the rigidity will depend only on the moment of inertia of the section.

This is a characteristic of a geometrical figure that identifies the resistance that it offers to bending.

It takes into account the form of the section, that is, on how the mass of the section is distributed with respect to the center of gravity: everyone has experienced the fact that a rectangular strip is more rigid if we try to bend it along one plane rather than on the perpendicular one.

The area is the same (weight) but the rigidity is very different.



Keeping constant the same surface area, each geometrical figure – quad, penta, hollow quad etc. will have a different moment of inertia because the mass, though constant is distributed differently.

For our requirements, all that is needed to know is that if we take a series of strips, each with a different cross section – triangular, hex or whatever, all with the same length and made of the same material and we apply the same load to them after having blocked one side in a vise, we will see that each one deforms in the same way if they have the same moment of inertia.

The table "COMPARISON BETWEEN SECTIONS" is exactly this: it compares different typical geometries of our rods, whether solid, hollow, fluted and so on, but that all have the same moment of inertia and consequently, keeping all the variables constant, the same rigidity to flexing.

The table was created starting with a quad solid built with 10mm sides.

The moment of inertia of the section is 833 mm4, is the same for all the others: what varies is the area of the figure and the height of the strips.

With a smaller area, you will of course have a smaller weight – since we have assumed that the material is always the same for all the figures.

So anyone can now easily examine the various figures, consider the weight and rigidity of each one and to evaluate the efficiency of the section

The table also contains the conversion factors of the height of the strips to switch from one geometry to any another. In my previous articles and seminars, at the end of the stud of the various sections I presented various conclusions. (www.rodmakers.eu/allegati/Tabellasezcfr.jpg)

1) The solid sections increase in efficiency as the number of sides decrease.

2) On the other hand, the hollow sections, independently from the thickness of the walls and the hollowing system, increase in efficiency as the number of sides increase.

3)This does not hold with the Magic Star hollowing; in fact the presence of the spokes and therefore also of the consistent weight in the proximity of the center of gravity, make these behave as if they were solid i.e. the efficiency increases as the number of sides decreases.

The study of the triangular section, confirms the above exactly.

The solid triangular section is the most efficient, i.e. a rod with the same rigidity will weigh 8-9% less that the corresponding hex taper.

If however, we examine the hollow triangular section, we see that it is the one with the least efficiency out of all the possible geometries.

Further considerations

The study and the considerations that have emerged are valid only for homogenous materials – this is most certainly not the case with bamboo.

The fundament concepts however, do not change.

It is common knowledge that this material has a structure that can be considered a "composite of natural fibers", not very dissimilar to a composite in carbon fiber: the power fibers – i.e. the fibers that offer the maximum resistance and that ideally correspond to the carbon fibers in the synthetic compound, are immersed in a matrix that bonds them: the parenchyma in the case of bamboo and of a resin in the case of carbon fiber.

Nel bamboo le power fibers hanno una densità che diventa via via maggiore progredendo dall'interno verso l'esterno della parete.

Qualcosa di questo genere

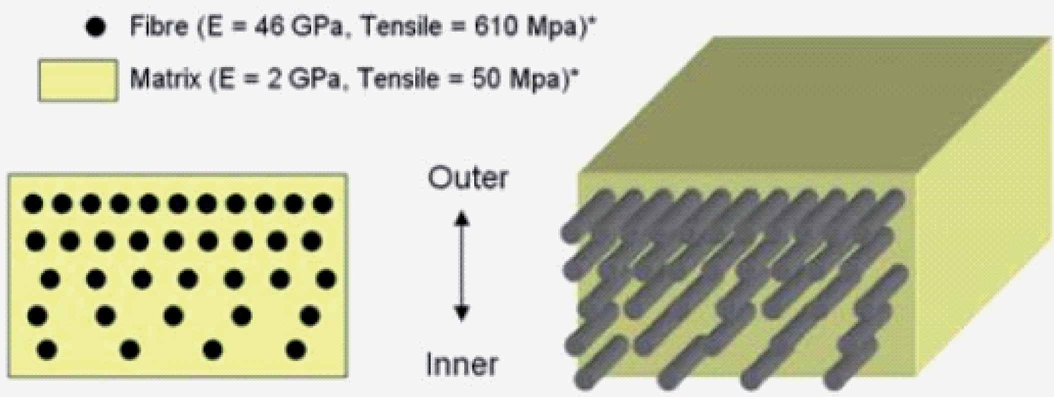


Figure 3 Bamboo Strip as Orthotropic Unidirectional Fibrous Composite (Notes * = Amada et al 1996)

Fig 7: Modello meccanico per lo studio numerico del bambù

Why does nature put the more resistant fibers towards the external part of the culm?

If we think about what was said about the moment of inertia, the answer is immediate: because the most resistant part is placed as far away as possible from the neutral axis and therefore the section will result in being more rigid with respect to its weight and therefore more efficient.

If this is true, consequently it makes no sense to glue the strips with the enamel on the inside of the section, while it is more convenient to glue them so that the more resistant fibers are as far as possible from the neutral axis.

At the end of the day, notwithstanding all the calculations, it all more simple: all you need to do is look at what nature has done. Don't you agree?

This is for the peace of mind of all those that say they have achieved great results with this type of construction: I put the power fibers on the inside and the rod casts well!

With respect to what?

Anyway this said, everyone has the right to carry out all the experiments that they wish and to have all the fun that they please.

This is all more than true but science is something else.

Gabriele Gori

CONFRONTO TRA SEZIONI AVENTI UGUALE MO
COMPARISON BETWEEN SECTIONS THAT HAVE THE S

FORMA / SHAPE COSTRUZIONE / CONSTRUCTION	TRIANGOLARE / TRIANGULAR	QUADRATA / QUAD	PENTAGONALE / PENTA	ESAGONALE / HEX
PIENA SOLID	Area: 93,059 mm^2 Ixx : 833,31 mm^4 Cxx1: 8,46 mm Cxx2: 4,23 mm Wxx1: 98,46 mm^3 Wxx2: 196,45 mm^3	Area: 100.00 mm^ 2 Ixx: 833.33 mm^4 Cxx: 5.00 mm Wxx: 166.67 mm^3	Area: 101,48 mm^ 2 Ixx: 833,39 mm^4 Cxx1: 6,53 mm CXX2: 5,29 mm Wxx1: 127,57 mm^3 WXX2: 157,54 mm^3	Area: 101,94 mm^ 2 Ixx: 833,27 mm^4 Cxx: 5,42 mm Wxx: 153,61 mm^3
SEMIPIENA SEMISOLID				
CAVA spessore parete 2 mm HOLLOW wall thickness 2mm	Area: 69,110 mmq Ixx: 833,18 mm^4 Cxx1:8,63 mm Wxx1: 96,320 mm3 Cxx2: 4,34 mm Wxx1: 191,97 mm3	Area: 67,13 mm^ Ixx: 833,40 mm^4 Cxx: 5,20 mm Wxx: 160,35mm^3	Area: 65,90 mm^ 2 Ixx: 833,38 mm^4 Cxx1: 6,83 mm Cyy2: 5,53 mm Wxx1: 121,93mm^3 Wyy2: 150,69 mm^3	Area: 65,07 mm^ 2 Ixx: 833,31 mm^4 Cxx: 5,70 mm Wxx: 146,24 mm^3
CAVA spessore parete 1.5 mm HOLLOW wall thickness 1,5mm	Area: 57,947 mmq Ixx= 833,35 mm4 Cxx1: 8,93 mm Cxx2: 4,47 mm Wxx1: 93,271 mm3 Wxx2: 107,70 mm3	Area: 55,98 mm^ 2 Ixx: 833,33 mm^4 Cxx: 5,42 mm Wxx: 153,88 mm^3	Area: 54,81 mm^ 2 Ixx: 833,38 mm^4 Cxx1: 7,14 mm CXX2: 5,78 mm Wxx1: 116,66 mm^3 WXX2: 144,18 mm^3	Area: 54,14 mm^ 2 Ixx: 833,32mm^4 Cxx: 5,96 mm Sxx: 139,77 mm^3
SCANALATA spessore parete 1.5 mm FLUTED wall thickness 1,5mm		r=1/16 Area: 72,07 mm^ 2 Ixx: 833.36 mm^4 Cxx: 5,13 mm Wxx: 162,39 mm^3	r=1/16 Area: 67,65 mm^ 2 Ixx: 833,43 mm^4 Cxx1 : 6,81 mm Cxx2 : 5,5 mm Wxx1: 122,48 mm^3 Wxx2: 151,53 mm^3	r=1/16 Area: 65,16 mm^ 2 Ixx: 833,44 mm^4 Cxx: 5,70 mm Wxx: 146,25 mm^3
SCANALATA spessore parete 1 mm FLUTED wall thickness 1 mm		r=1/16 Area: 66,22 mm^ 2 Ixx: 833,36 mm^4 Cxx: 5,21 mm Wxx: 159,89 mm^3	r=1/16 Area: 61,42 mm^ 2 Ixx: 833,35 mm^4 Cxx1: 6,96 mm Cxx2: 5,63 mm Wxx1: 119,80 mm^3 Wxx2: 148,0 mm^3	r=1/16 Area: 57,54 mm^ Ixx: 833,37 mm^4 Cxx: 5,88 mm Wxx: 141,75mm^3
MAGIC STAR spessore parete 2 mm MAGIC STAR wall thickness 2 mm	Area: 78,249 mmq Ixx= 833,49 mm4 Cxx1= 8,63 mm Cxx2= 4,31 mm Wxx1: 96,665 mm3 Wxx2: 111,62 mm3	Area: 82,834 mmq Ixx: 833,46 mm4 Cxx: 5,14 mm Wxx :162,15 mm3	Area: 82,92 mmq Ixx: 833,56 mm^4 Cxx1: 6,74 mm Cxx2: 5,45 mm Wxx1: 123,71 mm^3 Wxx2: 152,94 mm^3	Area: 86,70 mm^ 2 Ixx: 833,66 mm^4 Cxx: 5,57 mm Wxx: 149,67 mm^3
MAGIC STAR spessore parete 1,5 mm MAGIC STAR wall thickness 1,5 mm	Area: 69,704 mmq Ixx: 833,28 mm4 Cxx1: 8,87 mm Cxx2: 4,44 mm Wxx1 :93,916 mm3 Wxx2 :187,67 mm3	Area: 71,89 mmq Ixx: 833,18 mm^4 Cxx: 5,33 mm Wxx: 156,43 mm^3	Area: 75,90 mmq Ixx: 833,32 mm^4 Cxx1: 6,95 mm Cxx2: 5,62 mm Wxx1: 119,96 mm^3 Wxx2: 148,28 mm^3	Area: 83,50 mm^ 2 Ixx: 833,38 Cxx: 5,71 mm Wxx: 145,98 mm^3
MAGIC STAR spessore parete 1 mm MAGIC STAR wall thickness 1 mm		Area: 63,34 mmq Ixx: 833,14 mm^4 Cxx: 5,68 mm Wxx: 166,80 mm^3	Area: 63,88 mmq Ixx: 833,01276 mm^4 Cxx1: 7,4331774 mm Cxx2: 7,0693719 mm Wxx1: 112,06685 mm^3 Wxx2: 117,83405 mm^3	Area: 67,30 mm^ 2 Ixx: 833,32 mm^4 Cxx: 6,14 mm Wxx: 135,66 mm^3
CAVA AP spessore parete 1,5 mm HOLLOW AP wall thickness 1,5 mm		Area*: 81.94 mm^ 2 Ixx*: 833.33 mm^4	Area*: 84,31 mm^ 2 Ixx*: 833,39 mm^4	Area*: 81,46 mm^ 2 Ixx*: 833,27 mm^4
CAVA AP spessore parete 1 mm HOLLOW AP wall thickness 1 mm		Area*: 74,91.94 mm^ 2 Ixx*: 833.33 mm^4	Area*: 76,36 mm^ 2 Ixx*: 833,39 mm^4	Area*: 73,41 mm^ 2 Ixx*: 833,27 mm^4

NI AVENTI UGUALE MOMENTO D'INERZIA
ONS THAT HAVE THE SAME MOMENT OF INERTIA

A= area della sezione/cross-section area
Ixx = momento d'inerzia della sezione/cross-section moment of inertia
Cxx = distanza dall'asse neutro/ distance from the neutral axis
Wxx = modulo di resistenza della sezione/ cross-section modulus

ESAGONALE / HEX	EPTAGONALE PIENA / EPTA	OTTAGONALE / OCTA	DIAMANTE / DIAMOND H strip piccoli=0,5 Hstrip grandi H small strips= =0,5 H large strips
Area: 101,94 mm^ 2 Ixx: 833,27 mm^4 Cxx: 5,42 mm Wxx: 153,61 mm^3	Area: 102,13mm^ 2 Ixx: 833,32 mm^4 Cxx1: 6,11 mm Cxx2: 5,51 mm Wxx1: 136,40 mm^3 Wxx2: 151,23 mm^3	Area: 102,21 mm^ 2 Ixx: 833,29 mm^4 Cxx: 5,55mm Wxx: 150,04mm^3	Area: 100,47 mm^ 2 Ixx: 833,33 mm^4 Cxx1: 6,10 mm Cxx2: 4,88 mm Wxx: 136,66 mm^3 Wyy: 170,76 mm^3
			Area: 93,068 mm^ 2 Ixx: 833.47 mm^4 Cxx1: 6,11mm Cxx2: 4,89 mm Wxx1: 136,44 mm^3 Wxx2: 170,44 mm^3
Area: 65,07 mm^ 2 Ixx: 833,31 mm^4 Cxx: 5,70 mm Wxx: 146,24 mm^3	Area: 64,59 mm^ 2 Ixx: 833,24mm^4 Cxx1: 6,43mm Cxx2: 5,79 mm Wxx1: 129,65mm^3 Wxx2: 143,91 mm^3	Area: 64,29 mm^ 2 Ixx: 833,54 mm^4 Cxx: 5,85 mm Wxx: 142,47 mm^3	Area: 65,79 mm^ 2 Ixx: 833,60 mm^4 Cxx1: 6,39 mm Cxx2: 5,11 mm Wxx1: 130,53 mm^3 Wxx2: 163,13 mm^3
Area: 54,14 mm^ 2 Ixx: 833,32mm^4 Cxx: 5,96 mm Sxx: 139,77 mm^3	Area: 53,73 mm^ 2 Ixx: 833,32mm^4 Cxx1: 6,73 mm Cxx2: 6,06 mm Wxx1: 123,83 mm^3 Wxx2: 173,51 mm^3	Area: 53,47 mm^ 2 Ixx: 833,35 Cxx: 6,13 mm Wxx: 135,99 mm^3	Area: 54,68 mmq Ixx: 833,45 mm^4 Cxx1: 6,68 mm Cxx2: 5,34 mm Wxx1: 124,78 mm^3 Wxx2: 156.07 mm^3
r=1/16 Area: 65,16 mm^ 2 Ixx: 833,44 mm^4 Cxx: 5,70 mm Wxx: 146,25 mm^3	r=1/16 Area: 62,36 mm^ 2 Ixx: 833,35 mm^4 Cxx1: 6,48 mm Cxx2: 5,84 mm Wxx1: 128,55 mm^3 Wxx2: 142,79 mm^3	r=1/16 Area: 60,42 mm^ 2 Ixx: 833,30 mm^4 Cxx: 5,94 mm Wxx: 140,35 mm^3	
r=1/16 Area: 57,54 mm^ Ixx: 833,37 mm^4 Cxx: 5,88 mm Wxx: 141,75mm^3	r=1/16 Area: 54,46mm^ 2 Ixx: 833,39 mm^4 Cxx1: 6,72mm Cxx2: 6,065 mm Wxx1: 123,97 mm^3 Wxx2: 137,52 mm^3	r=1/16 Area: 52,04 mm^ 2 Ixx: 833,35 mm^4 Cxx: 6,19 mm Wxx: 134,62 mm^3	r=1/16 Area: 70,97 Ixx: 833,25 mm^4 Cxx1: 6,29 mm Cxx2: 5,03 mm Wxx: 132,51 mm^3 Wyy: 165,65 mm^3 wall thickness 1.1mm
Area: 86,70 mm^ 2 Ixx: 833,66 mm^4 Cxx: 5,57 mm Wxx: 149,67 mm^3	Area: 87,26 mmq Ixx: 833,31 mm^4 Cxx1: 6,29 mm Cxx2: 5,66 mm Wxx1: 132,55mm^3 Wxx2: 147,19mm^3	Area: 90,45 mmq Ixx: 833,74mm^4 Cxx: 5,69mm Wxx: 146,62 mm^3	
Area: 83,50 mm^ 2 Ixx: 833,38 Cxx: 5,71 mm Wxx: 145,98 mm^3	Area: 81,92 mmq Ixx: 833,63mm^4 Cxx1: 6,45 mm Cxx2: 5,81 mm Wxx1: 129,21mm^3 Wxx2: 143,48 mm^3	Area: 85,04 mmq Ixx: 833,54mm^4 Cxx: 5,83 mm Wxx: 143,00 mm^3	
Area: 67,30 mm^ 2 Ixx: 833,32 mm^4 Cxx: 6,14 mm Wxx: 135,66 mm^3	Area: 70,51 mmq Ixx: 833,30 mm^4 Cxx1: 6,87 mm Cxx2: 6,19 mm Wxx1: 121,25mm^3 Wxx2: 134,62mm^3	Area: 74,16 mmq Ixx: 833,58mm^4 Cxx: 6,185 mm Wxx: 134,78242 mm^3	
Area*: 81,46 mm^ 2 Ixx*: 833,27 mm^4	Area*: 82,37mm^ 2 Ixx*: 833,32 mm^4	Area*: 80,96 mm^ 2 Ixx*: 833,29 mm^4	
Area*: 73,41 mm^ 2 Ixx*: 833,27 mm^4	Area*: 74,00mm^ 2 Ixx*: 833,32 mm^4	Area*: 72,29 mm^ 2 Ixx*: 833,29 mm^4	

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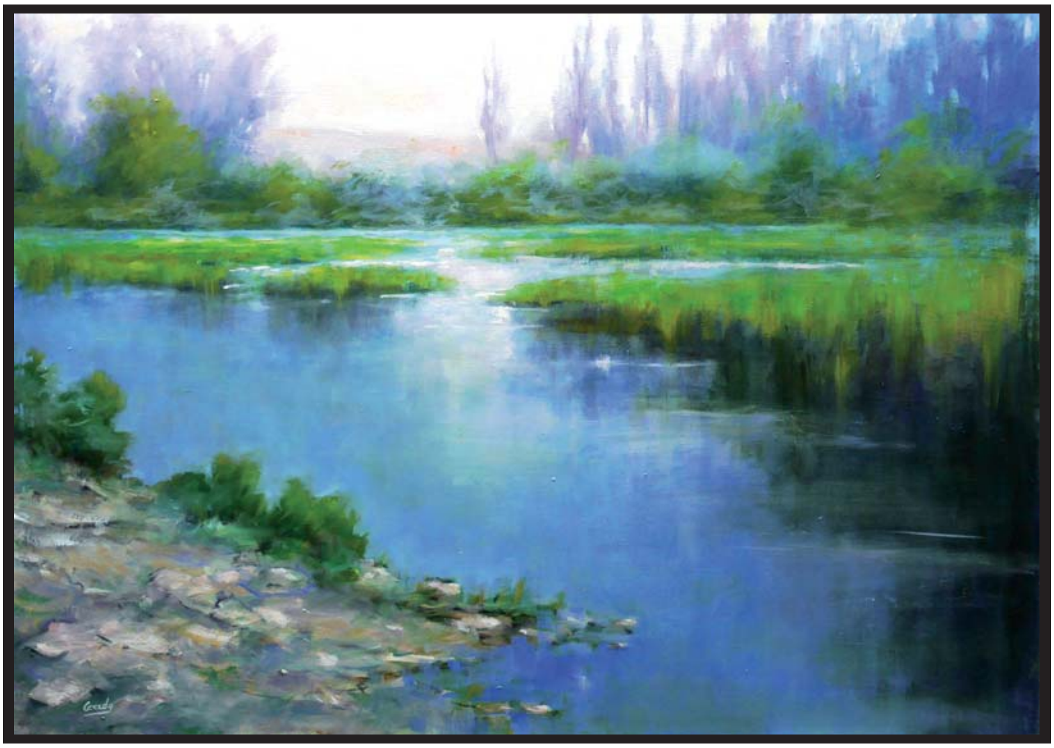

Pond

Oil painting on canvas 70x50

Enrico Cereda is an artist who is passionate about flyfishing and loves life in the "Open Spaces".

Water is a very important element for him and for this reason, it plays an important role in his paintings.

His works of art, not only depict places he has visited, but they represent landscapes of his soul and his paintings look like sequential film images that offer us renewed emotions in una sequenza filmica che ci regalano rinnovate emozioni

www.enricocereda.it

in this issue

Enrico Cereda

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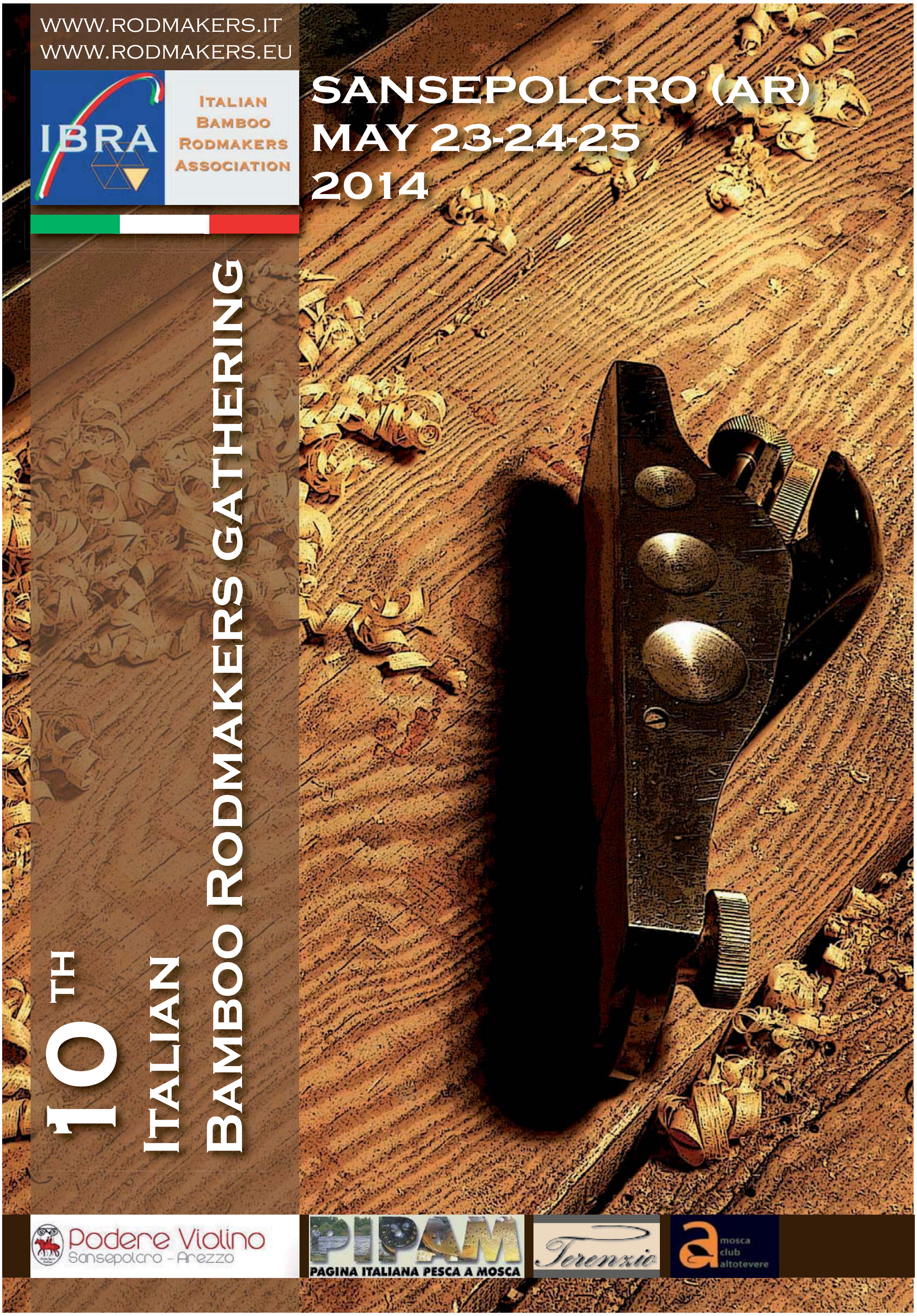
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