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Dedicated to the Making of Fine Bamboo Fly Rods

Inside this issue:

Watercolor on paper courtesy of Alfonso Jaraiz Puig (http://artificialfliesdrawings.blogspot.com)

Some Myths of Bamboo Rodmaking and Beyond

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What is fascinating about our craft is making a graceful, highly flexible fishing rod from a natural material, which has nodes and often has not grown straight. The deeper I became involved with rod making, the more questions arose for me about processing methods, bamboo species used, and the occurrence of bamboo. The scientific literature contains few facts about Tonkin (*Pseudosasa amabilis*, in the past the scientific name was *Arundinaria amabilis*), the bamboo species which is used almost exclusively for rod making. Opinions are numerous, but facts are few; a most unsatisfying situation for me as a natural scientist and biologist. Here I point out some of what I call myths of split-cane rod making. I also take the opportunity to tell something about my bamboo research and my project "Tonkin for Europe."

Myth 1: Power fibers should not be harmed

The shoot of a bamboo culm escapes from the earth already endowed with its maximum culm diameter and all nodes. It then expands like a telescopic rod within several weeks up to its maximum length. The shoot achieves this so quickly by forming a scaffold of hollow fibers. Afterwards, growth takes place only inside (Fig. 1), completely filling most of the hollow fibers in three years.

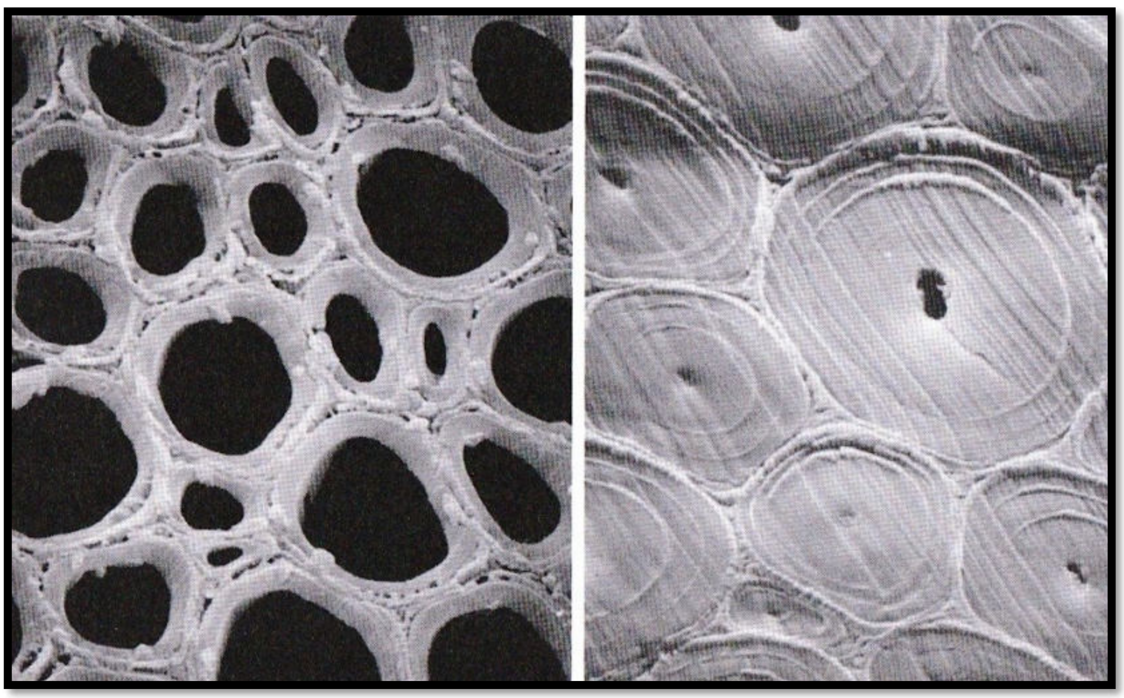

Fig. 1 Cross-section of fibers from *Phyllostachys viridiglaucescens* one (left) and six years old (Liese & Weiner 1996).

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Rod making books misleadingly talk about power fibers, which should not be harmed. There is only one type of bamboo fiber and the word "power" is best omitted. A single Tonkin fiber is on average two millimeters (0.079") long and thinner than a human hair (Fig. 3). Those fibers form sheaths surrounding the vascular bundles, which transport water up and sap down the culm (Fig. 2).

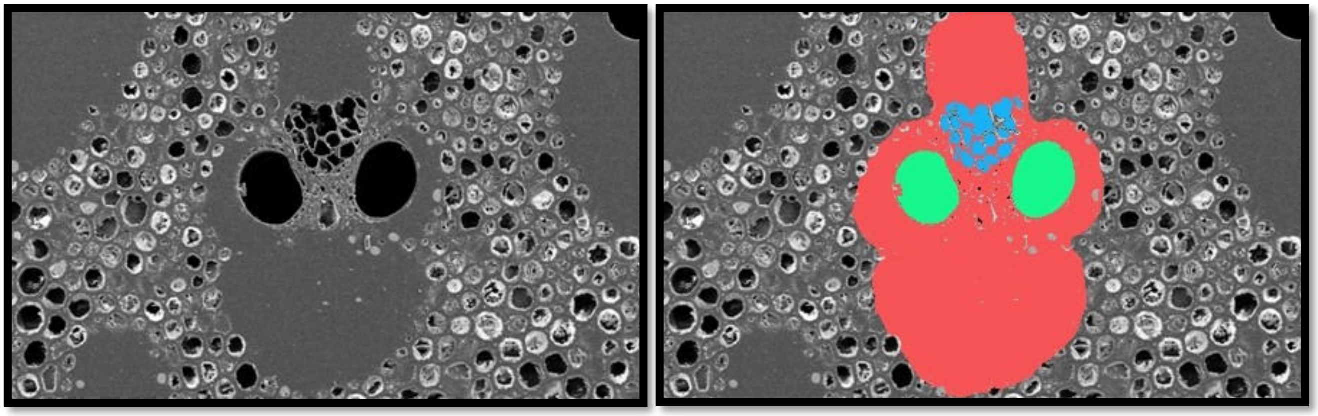

Fig. 2 Fiber bundles of Vietnamese Tonkin; red: fiber sheath, green: vascular bundle, which transports water up, blue: vascular bundle, which transports sap down.

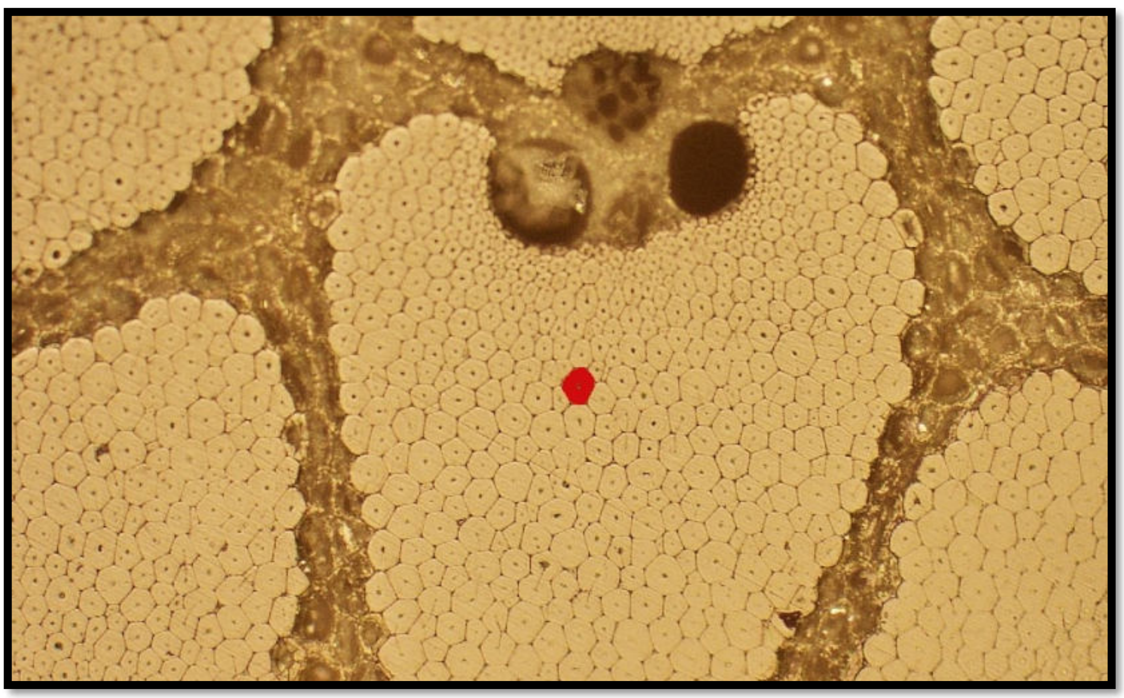

Fig. 3 Cross-section of a fiber bundle of Chinese Tonkin. Single fiber marked in red is 0.03 mm (0.001") across.

The maximum height of a Tonkin culm is thirteen meters (43 feet), which means that the fiber bundles consist of thousands of single fibers from bottom to top of the culm. With this in mind, the common rod-making advice to not damage fibers seems absurd. While planing, inevitably very

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many fibers will be cut. Better advice is: as few fibers as possible should be removed from the outside of the culm, because there the bundles are more compact and thereby provide the greatest stability. Electron-microscope images show that the first fiber bundles lie below a 0.01 mm (0.0004") thick layer of enamel and a further cell layer of 0.06 mm (0.002") thickness (Fig. 4). Thus, even removing a tenth of a millimeter (0.004") damages the first fiber bundles. My experiments show removing just half a millimeter (0.020") diminishes the breaking strength significantly (Fig. 5).

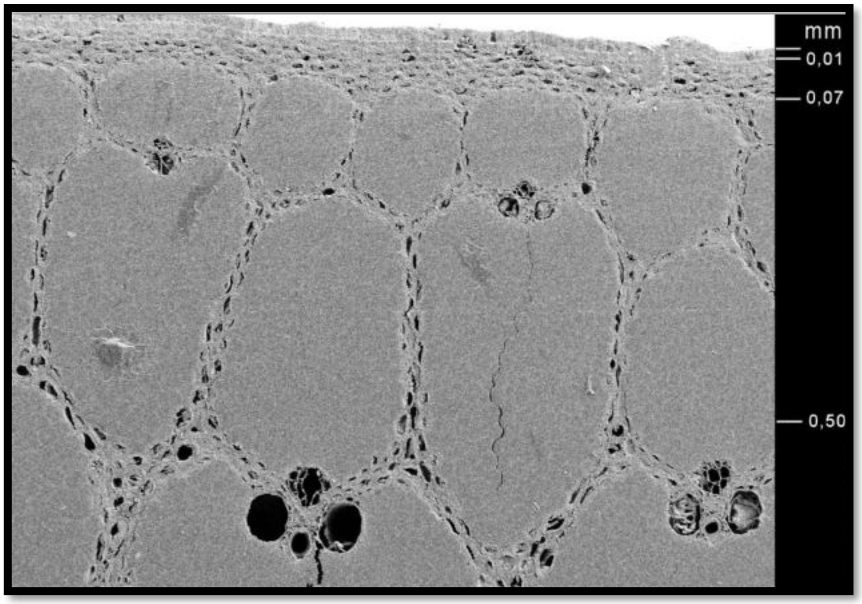

Fig. 4 Cross-section of the outermost area of a Tonkin culm showing, at the top, a 0.01 mm (0.0004") thick enamel layer, underlain by 0.06 mm (0.002") of soft tissue, and, below that, fiber bundles.

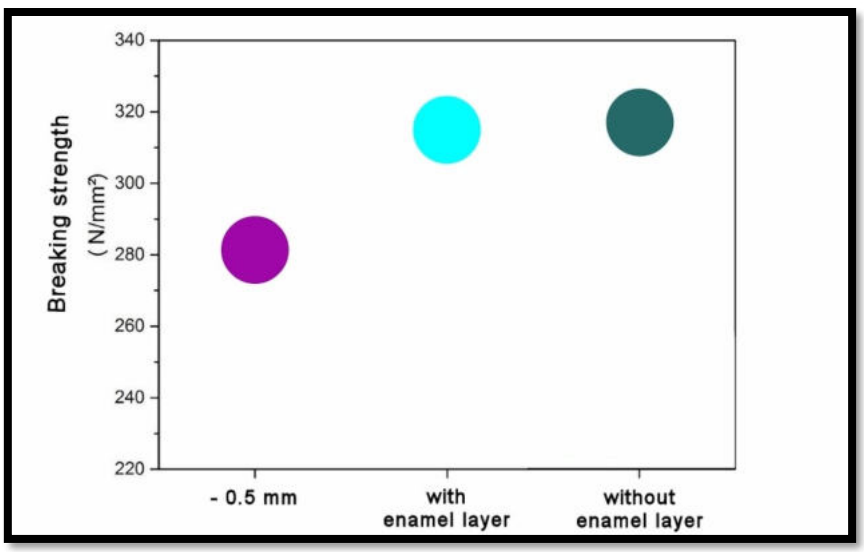

Fig. 5 Breaking strength of standard samples (3 x 5 x 80 mm) (0.12 x 0.20 x 3.15") without outermost 0.5 mm (0.02"), without enamel layer, and with enamel layer.

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Myth 2: The best bamboo species for rod making is Tonkin

Today, Chinese Tonkin from the area around Huaiji in the province of Guangdong is used almost exclusively for rod making. Marden (1997) writes that Tonkin possesses the highest fiber density of all bamboo species. Thereby it should have the highest breaking strength, which is of great importance for fishing rods. Garrison and Carmichael's "A Master's Guide to Building a Bamboo Fly Rod," often considered the bible of rod making, notes that Tonkin is the best natural material for building fly rods. It is fair to assume that a comparison of bamboo species occurred, but no specific documentation remains if and what other species or other places of origin were tested. I know of one exception: Ivor Davies, a former employee of Hardy Brothers wrote me that Tonkin was not selected by chance. In the early 1880's Hardy in Alnwick tested numerous samples from various regions of China for toughness and recovery power. Hardy did make rods from "Calcutta" cane and, in the then secretive world of cane rod making, information on bamboo species may have been shared informally.

More than 1,400 bamboo species are known of which only a few hundred are "woody" bamboos. *Pseudosasa* belongs to the temperate woody bamboos. Even if only a small percentage would be suitable for rod making, this represents considerable potential for possibly better rods. Interestingly enough, the species Madake (*Phyllostachys bambusoides*) is used by some Japanese rod makers.

I started to investigate the mechanical properties of Tonkin with 3-point-bending tests because of the lack of published data such as is available for other bamboo species which serve, for example, as construction material. In our case, perhaps it might be best to conduct these tests by breaking entire rods. This would be very laborious, and I decided that it is sufficient to break samples of accurately defined size and to know what part of the culm they originated from. I explored the properties of the outermost three millimeters (0.118") of Chinese Tonkin, Vietnamese Tonkin, and Tam Vong. A crucial factor for breaking strength and stiffness is the density of the fiber bundles in this outermost area, which is the part of the culm used for rod making. The fiber density of Tonkin allows, without doubt, the making of marvelous rods. A bamboo with a higher fiber density might allow building a split-cane rod with even better mechanical properties. Are there better bamboo species for rod making? The question remains unanswered, but fascinating.

Myth 3: Tonkin comes only from the Chinese province of Guangdong

Only four publications about Tonkin appear in generally accessible literature databases. Recently a colleague from China sent me publications about Tonkin from his country, which describe three sub-species of Tonkin growing in the province of Guangdong (Xu and Xu 1984). Essentially all books about bamboo rod making cite only this province as a source for Tonkin.

An occurrence of Tonkin in Vietnam was reported verbally to me and, in 2015, I set off to find out for myself. The year before, I was lucky to meet Professor Dr. Dr. h. c. mult. Walter Liese, the pioneer of bamboo research, who helped me gain insights and contacts in the world of bamboo. He provided me with detailed knowledge about the mechanical properties of bamboo and provided contact to the bamboo scientist Dr. Tang Thi Kim Hong in Vietnam, who guided me to an occurrence of

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Tonkin east of Hanoi. There I took samples in a forest containing bamboo used by the local population (Fig. 6). The Vietnamese Tonkin differs from the Chinese Tonkin in that the internodes, the sector between the nodes, are up to 70 cm (28") long, while the Chinese variety has a maximum internodal length of 50 cm (20"). This is significant for the rod maker because fewer nodes means less node preparation for making a rod.

Fig. 6 Forest with Tonkin in Bac Giang province, Vietnam.

From Vietnam, I travelled to the Chinese province of Guangdong. Andy Royer, who was the only broker of Tonkin for rod makers at the time, invited me to join his final trip to China. There I could watch how the people harvest Tonkin and how much preparation by hand is necessary until it is ready for export.

With Andy, I travelled to Huaiji, the same area McClure (he named the species in 1931) visited ninety years ago, who stated then that these are bamboo plantations and not a forest. We still do not know if Tonkin originated in this area.

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Huaiji is situated in a very hilly landscape where almost exclusively Tonkin grows or, respectively, is cultivated. Primarily women harvest the culms from the hill slopes with hatchets (Fig. 7), cut off the branches, and pull them down steep tracks using two-wheeled carriers for further processing in the valley.

Fig. 7 Harvest in a Tonkin plantation near Huaiji, Guangdong province, China.

I assisted my friend and business partner David Serafin in selecting, by hand, mostly for export to the USA, the best out of a few thousand culms. Our selection criteria included culm straightness and an exterior as flawless as possible (especially insect damage). In addition, the culms needed to be heavy, of large diameter, and with long internodes.

Myth 4: The larger the culm's diameter, the better it is

When I walked through the plantations in China, initially I was surprised by the culm diameters. There were areas where only thumb-thick culms grew. These were not young culms, but just thin specimens.

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I found that culm weight is a good indicator for fiber density. The heavier the culm, the greater the breaking strength of the cane. The culm diameter is very variable, and many rod makers prefer large diameter culms. However, smaller diameter culms can be heavier relative to their diameter and therefore possess a higher breaking strength than a larger diameter culm. Diameter alone reveals nothing about the mechanical properties of a culm for rodmaking.

The internode length is important for rod making. The internodes are longest in the mid-section of a culm, and are shorter in the upper and the lower ends in most species (Fig. 9). A Tonkin culm grows up to about thirteen meters (43 feet) in length (Fig. 8). Only the so-called butt cut, the lower twelve feet have been imported to date for rod making because the lower end of the culm is largest in diameter. The mid cut, the section above the butt cut, that contains the longest internodes and is well suited for making single-handed rods. Many rod makers may be unaware of this, probably because that part of a culm is often considered to be too small in diameter. However, the amount of fiber bundles is sufficient for single-handed rods.

Fig. 8   Freshly harvested Tonkin culms in entire length.

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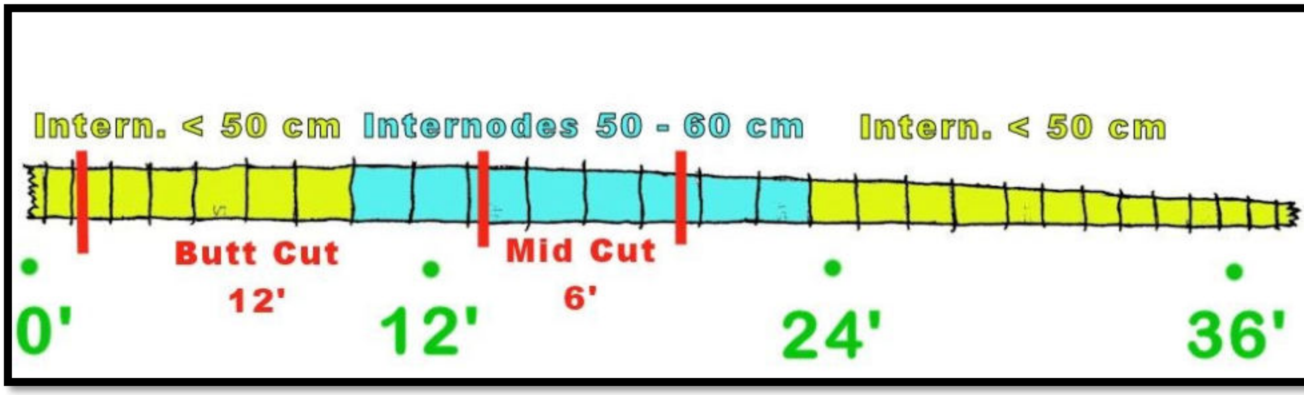

Fig. 9 Tonkin culm drawn to scale, butt and mid cut section, internodes shorter and longer than 50 cm (20”) in terms of color separated.

Myth 5: The culm must be dry

Some clients ask me if the culms are dry so they can start using them immediately. Only dry culms are imported.

To improve mechanical properties, the splices for rod making are treated with heat, so-called tempering. That alone dries the bamboo. After a rod is finished, the moisture in the cane equilibrates

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with the moisture in the environment, no matter how dry the rod was during building. The culm's state of dryness is therefore unimportant during the building process. Many soak their strips in water before planing because the plane blade then cuts more easily.

A freshly harvested culm may weigh twice as much as when dry. Shipping costs would increase enormously because they are based on weight. Obviously, no merchant wishes to import heavy, wet bamboo. To facilitate drying, the culms are hand washed with sand and water to remove the natural, outer wax layer (Fig. 10).

Fig. 10 Removal of the natural wax layer with sand and water.

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Afterwards the culms are stacked in tent form for several weeks (Fig. 11). Experience is required to estimate the correct amount of time. The culms may not be exposed to the sun too long otherwise, they crack lengthwise. They then are stored in warehouses until they are shipped (Fig. 12 — next page).

Fig. 11 Culms stacked for drying. Glenn Bracket demonstrates their enormous elasticity.

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Fig. 12 Warehouse for Tonkin (© Chad Okrusch).

I asked rod makers how they carry out tempering (Fig. 13) and many gave exact replies. They use temperatures from 120° to 190° C respectively 248° to 374° F and durations from 5 to 120 minutes. The variations in the process lead to the question: Are all variants good or is there an optimum?

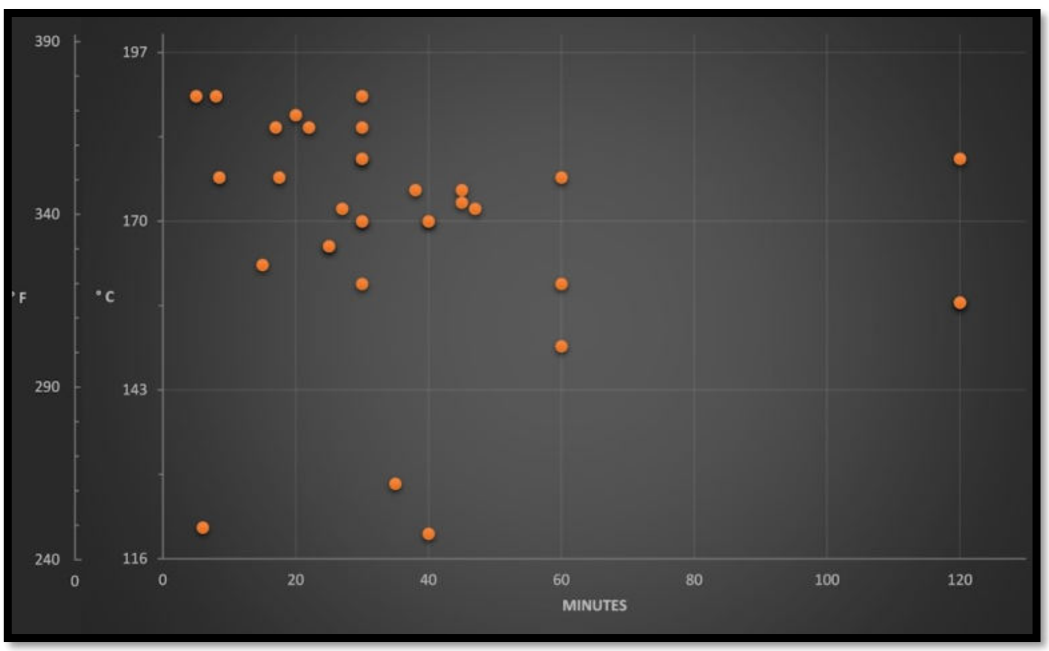

Fig. 13 Each dot indicates tempering procedure of one rod maker.

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There are many opinions about tempering, but there is not a lot of data describing the effect on breaking strength and stiffness of Tonkin. The only rod makers who conducted such experiments are Wolfram Schott (2006) and Robert Milward (2010). We conducted our own experiments in the Center for Wood Sciences of the Universität Hamburg.

For tempering, I built an oven capable of maintaining a desired temperature. A sensor placed in a strip provides the core temperature of the bamboo (Fig. 14).

Fig. 14 Temperature sensor inside Tonkin. The upper sample is 3 millimeters (0.118") thick.

Results reveal that a rod maker must decide between greater breaking strength or greater stiffness (Fig. 15). There is no optimal core temperature for both factors. Core temperatures above 150° C (302° F) lead to chemical reactions, which permanently reduce the capacity to absorb water. The core temperature has a larger impact on mechanical properties than the duration of heating. For short processing times one must bear in mind that bamboo insulates very well. It takes about fifteen minutes until the core temperature is the same as the temperature of the outside of a bamboo strip.

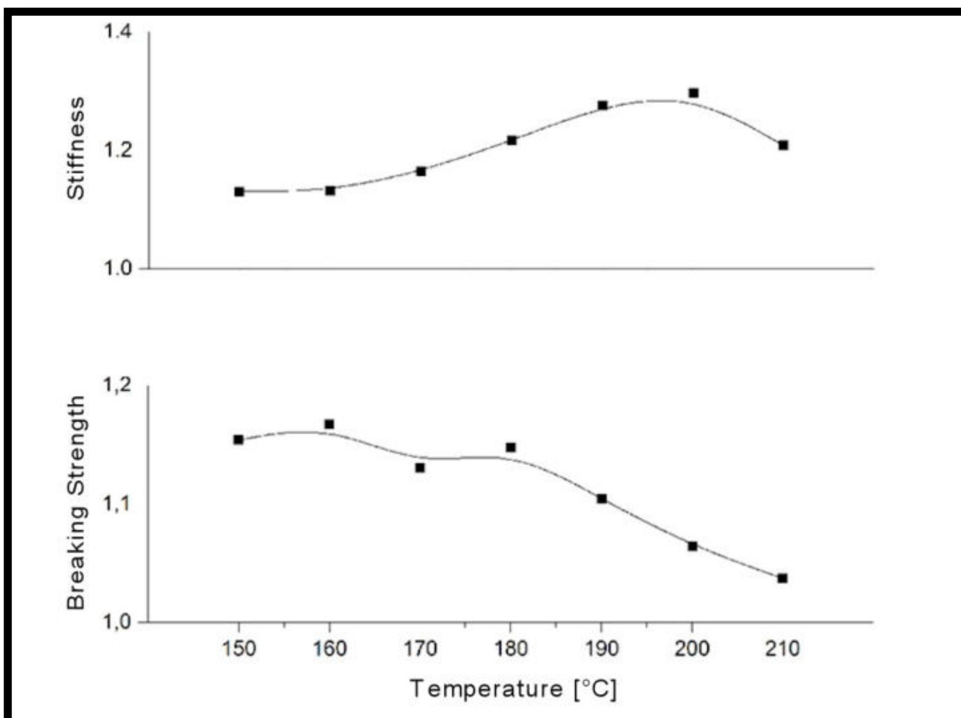

Fig. 15 Relative values of the 3-point-bending tests for breaking strength and stiffness (1 on the vertical scale = untreated samples) at various temperatures. Duration of heating always 2 hours.

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I investigated several factors: comparison of different bamboo species, tempering of the Tonkin at various temperatures, and comparison of different sectors of the culm. I found that breaking strength and stiffness are greatest in the outermost millimeters in the lower sector of the culm and decrease slightly towards the top. In comparison with other species (*Guadua angustifolia, Phyllostachys pubescens, Thyrostachys siamensis*), also versus the Tonkin from Vietnam, Tonkin from Huaiji is best with respect to breaking strength (Fig. 16). The Vietnamese Tonkin is, in contrast, stiffer (Fig. 17).

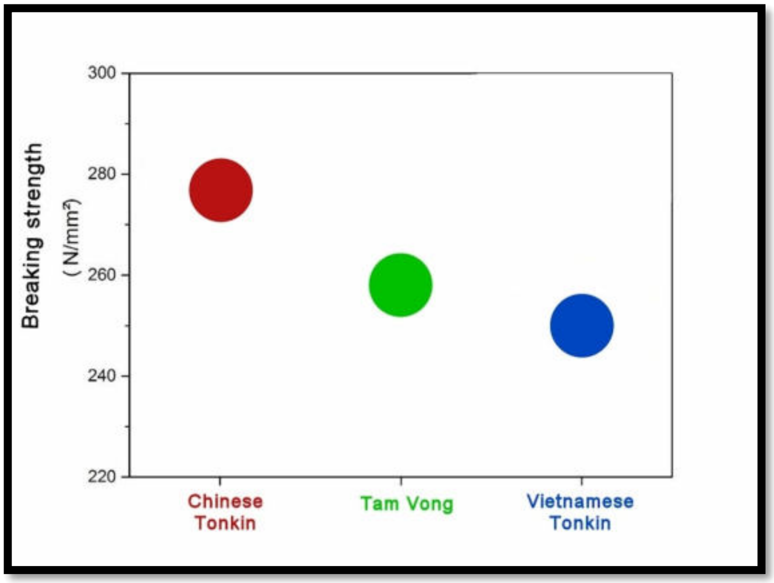

Fig. 16 Breaking strength after two hours tempering at 180 °C (356 °F) of Chinese and Vietnamese Tonkin and Tam Vong.

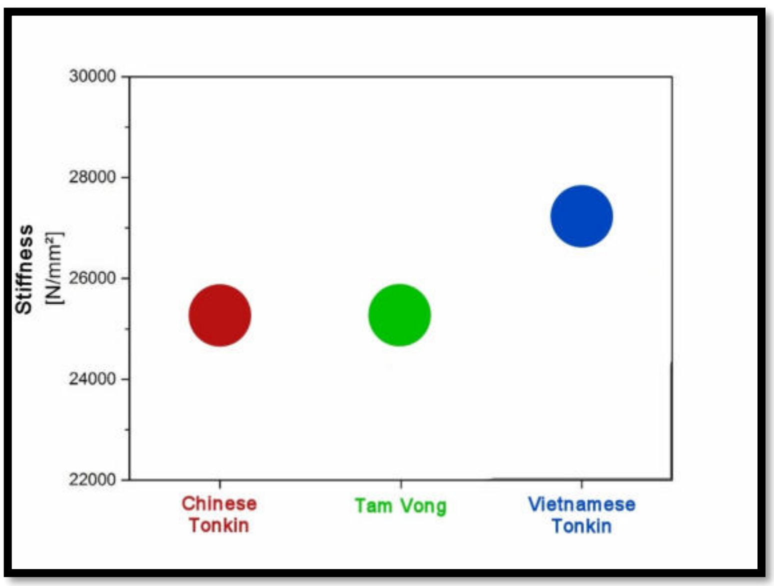

Fig. 17 Stiffness after two hours tempering at 180 °C (356 °F) of Chinese and Vietnamese Tonkin and Tam Vong.

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The project "Tonkin for Europe"

The intensive engagement with bamboo led to my importing Tonkin culms of very high quality for rod makers in Europe to provide the best raw material available. There were prerequisites for doing so. They included the scientific testing at the Center for Wood Sciences of the Universität Hamburg to provide a previously unavailable assessment of quality. The basis for export from China is personal contact with a bamboo broker in China who has more than twenty years of experience with Tonkin, especially for rod makers. Quality control in China entails co-operation with David Serafin (www.anglersbambooco.com), who was trained for several years in hand selecting culms on-site. In Berlin, I perform a further quality control before the culms leave Springforelle's warehouse.

I measured entire culms in Vietnam and China and found that internodes are relatively short at the butt, become longer towards the middle, and again shorten towards the top. The mid cut contains most of the longer internodes. Tonkin of very high quality was hard to obtain in Europe and my investigations confirmed that the Tonkin from the province of Guangdong is excellently suited for rod making. In the spring of 2017, the first container for my project "Tonkin for Europe" arrived in Berlin from China with four and a half tons of butt and mid cuts of Tonkin cane.

Many interesting questions about Tonkin and other bamboo species remain unanswered and I intend to continue my research on them in the future.

Fig. 18 Peer Doering-Arjes with Chinese Tonkin mid and butt cuts.

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