Some Myths of Bamboo Rodmaking and Beyond

By Peer Doering-Arjes (www.springforelle.de/en) and Goran Schmidt (www.growme.de)

Most of you know what a split-cane rod is. For you, to whom this term is unknown: It is a fly-rod, which is made from a bamboo culm from which the air is let out. The culm is split lengthwise into thin strips, which are planed triangular and glued together. Many hours pass until the rod is equipped with rings, grip and reel seat. What is fascinating about this craft is making a graceful, highly flexible fishing rod from a natural material, which has nodes and often has not grown straight. A process, which requires a lot of fine motor skill, but anyone who ties flies, has the potential for rodmaking. You just need a bit more patience.

The deeper I became involved with rodmaking, 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 rodmaking. Opinions are numerous, but facts are few; a most unsatisfying situation for me as a natural scientist. Here I point out some of what I call myths of split-cane rodmaking. I also take the opportunity to tell something about our bamboo research and my project “Tonkin for Europe.”

- Myth 1: Power fibres 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 fibres. Afterwards, growth takes place only inside (Fig. 1), completely filling most all of the hollow fibres in three years.

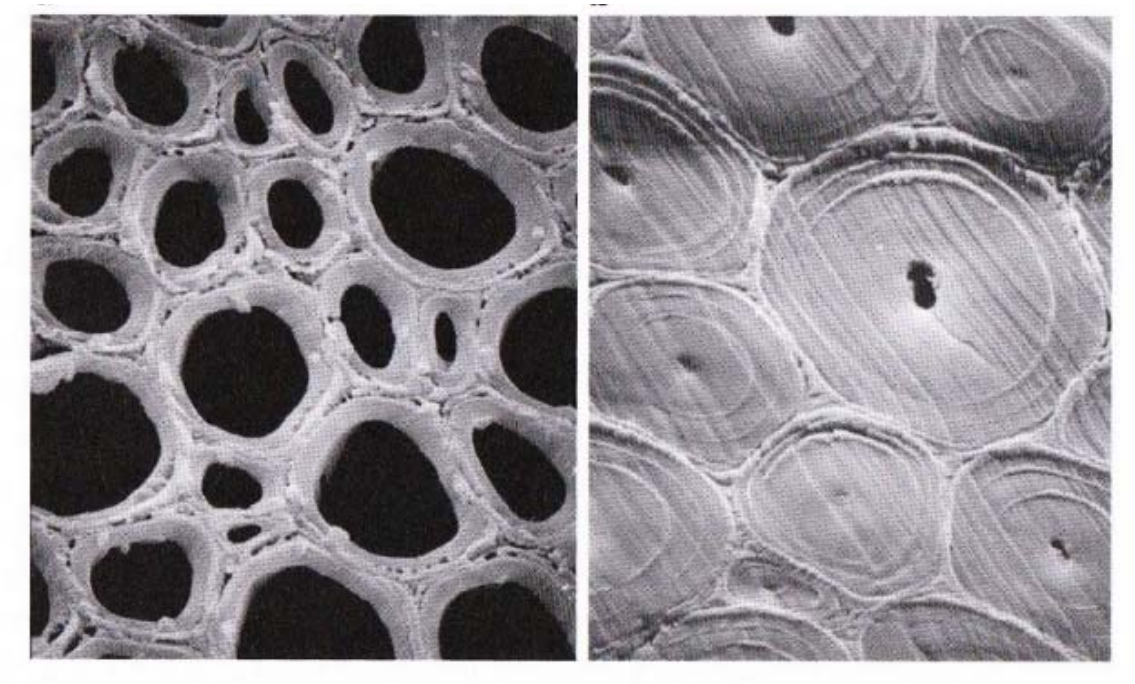

Fig. 1 Cross-section of fibres from *Phyllostachys viridiglaucescens* one (left) and six years old (Liese & Weiner 1996).

Rodmaking books misleadingly talk about power fibres, which should not be harmed. There is only one type of bamboo fibre and the word “power” is best omitted. A single Tonkin fibre is on average two millimetres long and thinner than a human hair (Fig. 2). Those fibres form bundles surrounding the vascular bundles, which transport water up and sap down the culm (Fig. 3).

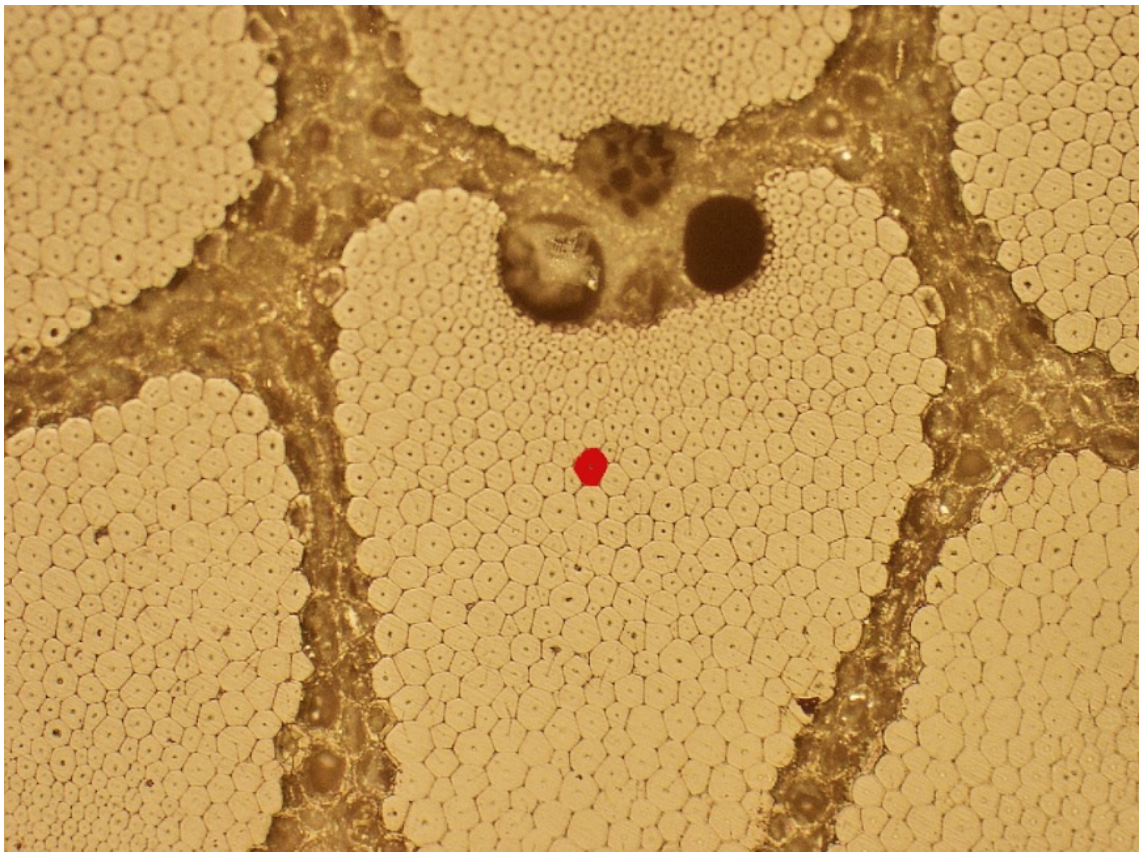

Fig. 2 Cross-section of a fibre bundle of Chinese Tonkin. Single fibre marked in red is 0.03 mm across.

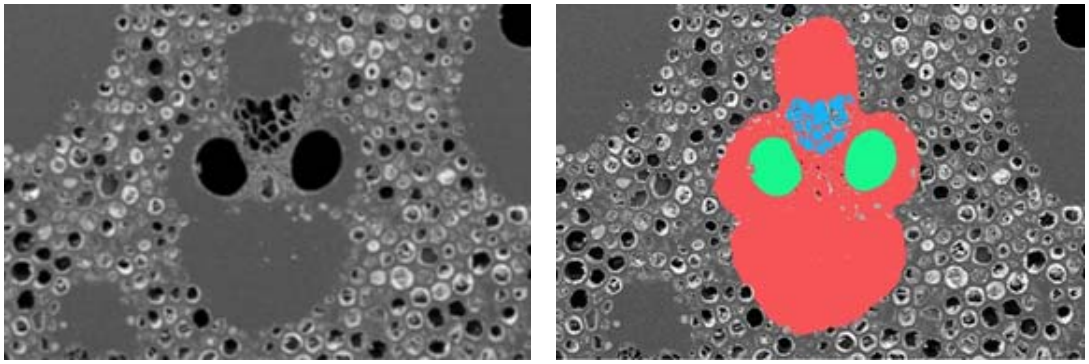

Fig. 3 Fibre bundles of Vietnamese Tonkin; red: fibre bundle, green: vascular bundle, which transports water up, blue: vascular bundle, which transports sap down.

The maximum height of a Tonkin culm is thirteen metres, which means that the fibre bundles consist of thousands of single fibres from bottom to top of the culm. With this in mind, the common rod-making advice to not damage fibres seems absurd. While planing, inevitably very many fibres will be cut. Better advice is: as few fibres 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-microscopy reveals that the first fibre bundles lie below a 0.01 mm thick layer of enamel and a

further cell layer of 0.06 mm thickness (Fig. 4). Thus even removing a tenth of a millimetre damages the first fibre bundles. Our experiments show removing just half a millimetre diminishes the breaking strength significantly (Fig. 5).

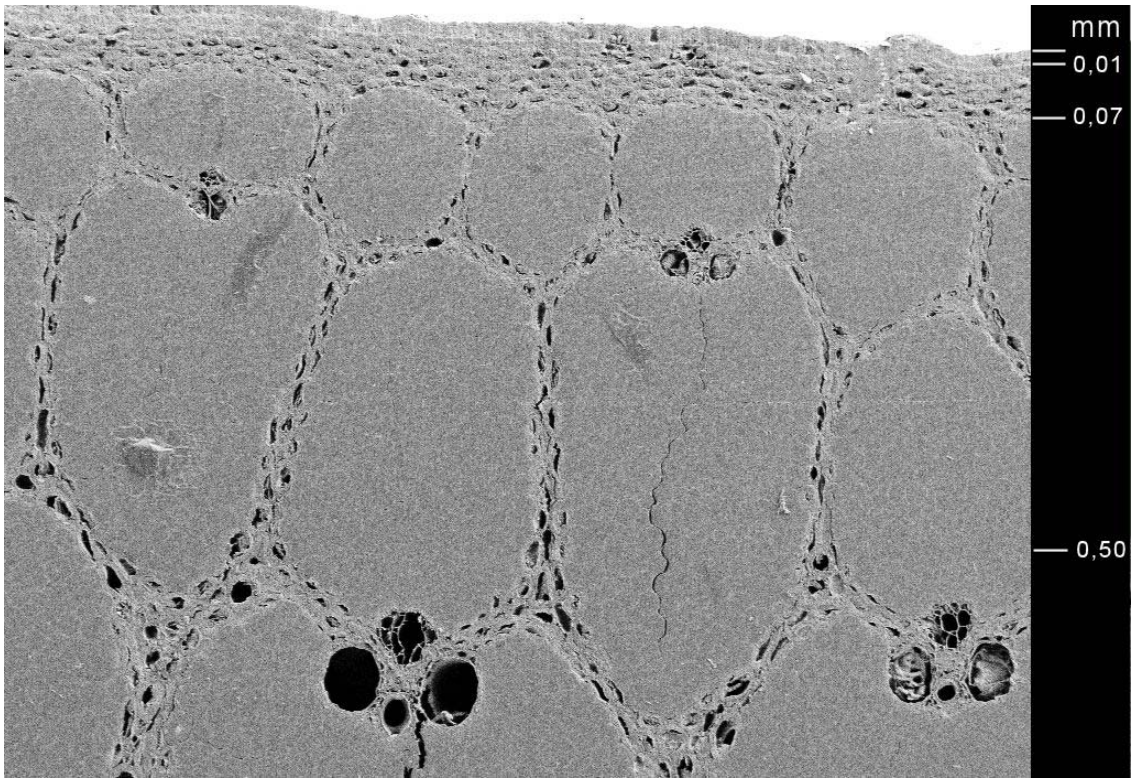

Fig. 4 Cross-section of the outermost area of a Tonkin culm showing, at the top, a 0.01 mm thick enamel layer, underlain by 0.07 mm of soft tissue, and, below that, fibre bundles.

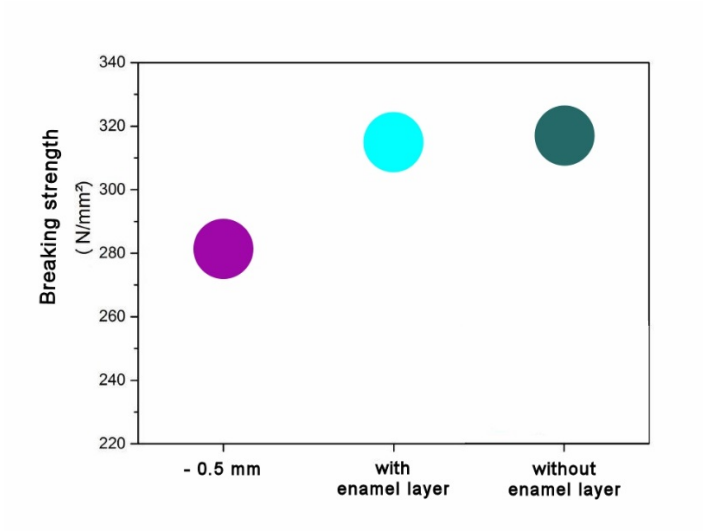

Fig. 5 Breaking strength of standard samples (3 x 5 x 80 mm) without outermost 0.5 mm, without enamel layer, and with enamel layer.

- Myth 2: The best bamboo species for rodmaking is Tonkin

Today, Chinese Tonkin from the area around Huaiji in the province of Guangdong is used almost exclusively for rodmaking. Marden (1997) writes that Tonkin possesses the highest fibre 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 rodmaking, 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 rodmaking, information on bamboo species may have been shared informally.

More than 1,400 bamboo species are known. Even if only a small percentage would be suitable for rodmaking, this represents considerable potential for possibly better rods. Interestingly enough, Japanese rod makers use the species Madake (*Phyllostachys bambusoides*).

We investigated 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. We explored the properties of the outermost three millimetres of Chinese Tonkin, Vietnamese Tonkin, and Tam Vong. A crucial factor for breaking strength and stiffness is the density of the fibre bundles in this outermost area, which is the part of the culm used for rodmaking. The fibre density of Tonkin allows, without doubt, the making of marvellous rods. A bamboo with a higher fibre density might allow building a split-cane rod with even better mechanical properties. Are there better bamboo species for rodmaking? 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. Chinese publications describe three sub-species of Tonkin growing in the province of Guangdong (Xu and Xu 1984). Essentially all books about bamboo rodmaking cite only this province as a source for Tonkin.

However, 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 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 long, while the Chinese variety has a maximum internodal length of 50 cm. 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.

Huaiji is situated in a very hilly landscape where almost exclusively Tonkin 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 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. 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.

I found that culm weight is a good indicator for fibre 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 rodmaking. The internodes are longest in the mid-section of a culm, and are shorter in the upper and the lower ends (Fig. 9). A Tonkin culm grows up to about twelve metres in length (Fig. 8). Only the so-called butt cut, the lower twelve feet have been imported to date for rodmaking 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 too small in diameter. The amount of fibre bundles is sufficient for single-handed rods.

Fig. 8 Freshly harvested Tonkin culms in entire length.

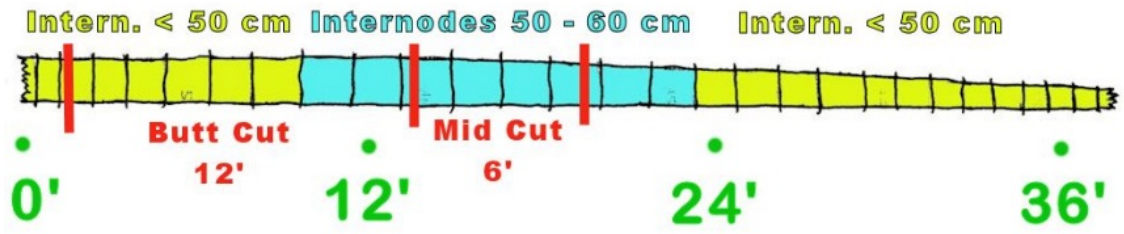

Fig. 9 Tonkin culm drawn to scale, butt and mid cut section, internodes shorter and longer than 50 cm in terms of colour separated.

- Myth 5: The culm must be dry

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). 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).

To improve mechanical properties, the splices for rodmaking are treated with heat, so-called tempering. That alone dries the bamboo, but some clients still ask if the culms are dry so they can start making immediately. They are possibly unaware of the fact, that after a rod is finished, the moisture in the cane equilibrates with the moisture in the environment, no matter how dry the rod was during building. Many soak their strips in water before planing because the plane blade then cuts more easily.

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

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

Fig. 12 Tonkin warehouse

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

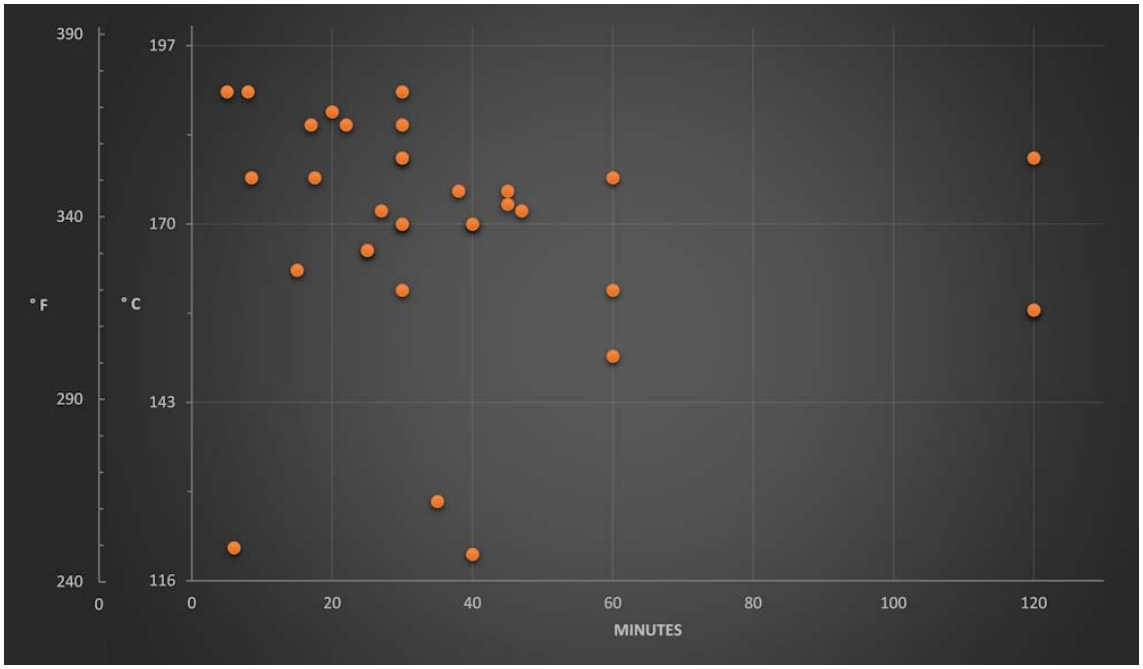

Fig. 13 Each dot indicates tempering procedure of one rod maker.

There are many opinions about tempering, but few 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 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).

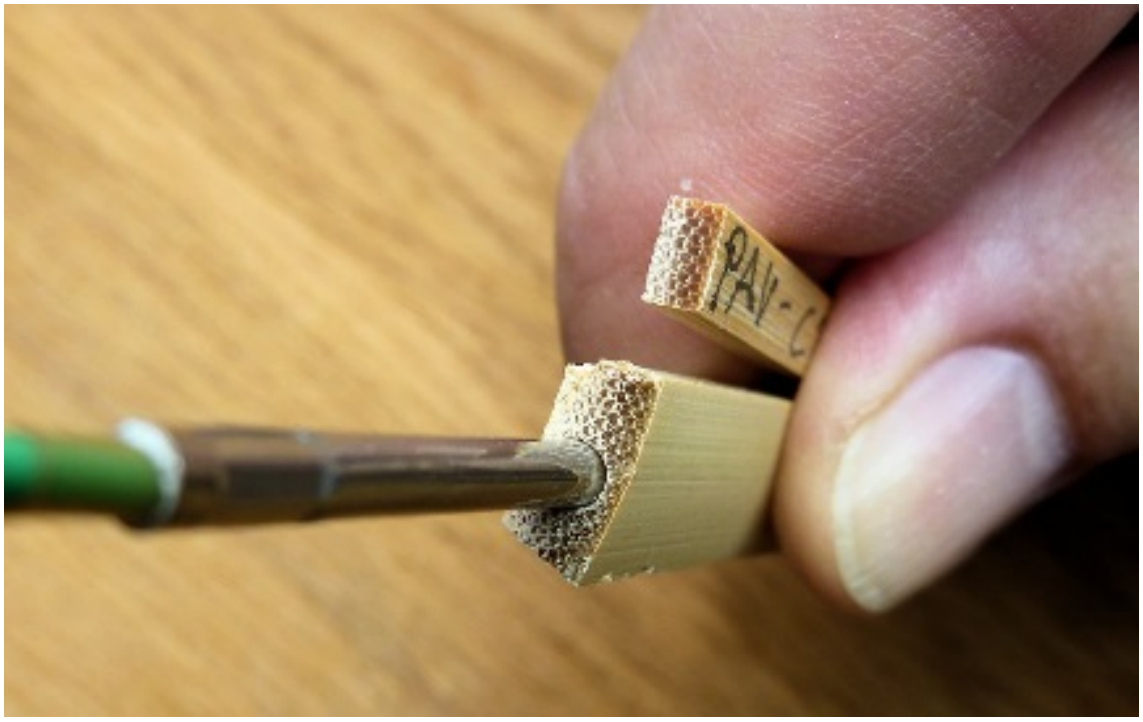

Fig. 14 Temperature sensor inside Tonkin. The upper sample is 3 millimetres thick.

Results reveal that a rodmaker 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 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 has to 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.

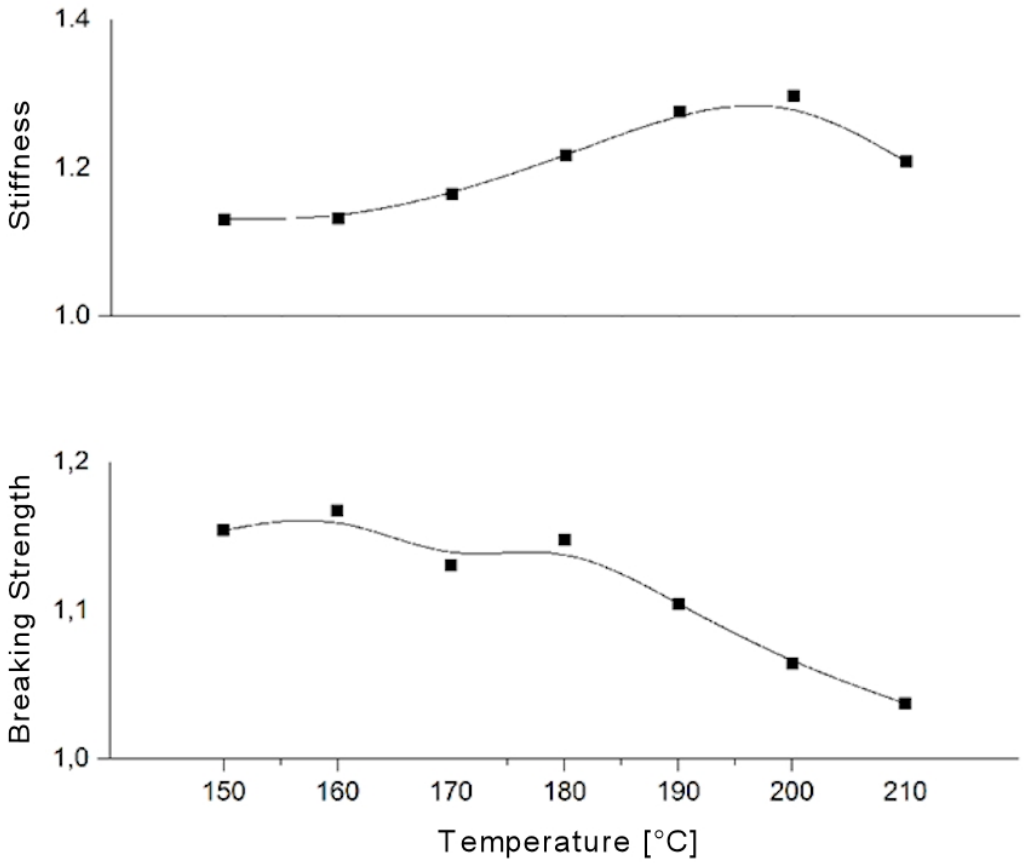

Fig. 15 Relative values of the 3-point-bending tests for breaking strength and stiffness (1 on the vertical scale = untreated samples) at various temperatures. Duration of heating always 2 hours.

We investigated several factors: Comparison of different bamboo species, tempering of the Tonkin at various temperatures, and comparison of different sectors of the culm. Breaking strength and stiffness are greatest in the outermost millimetres 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).

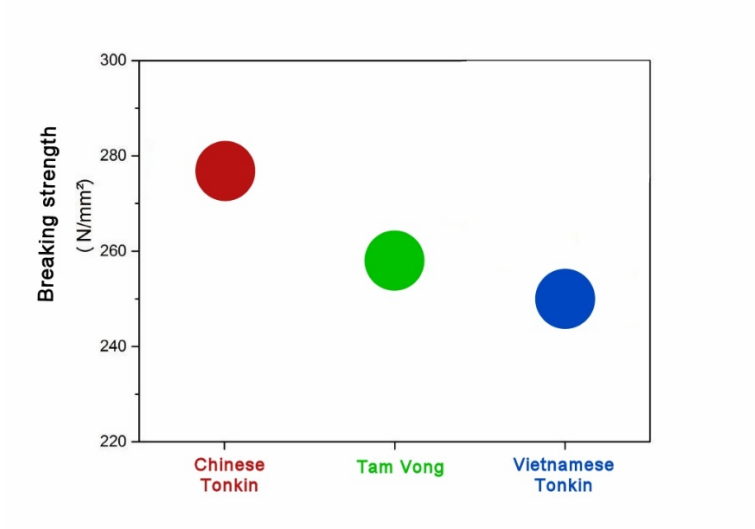

Fig. 16 Breaking strength after two hours tempering at 180 °C of Chinese and Vietnamese Tonkin and Tam Vong.

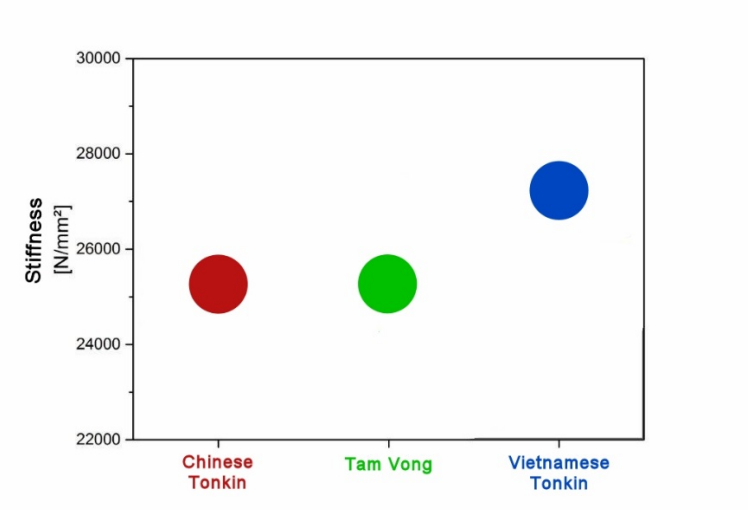

Fig. 17 Stiffness after two hours tempering at 180 °C of Chinese and Vietnamese Tonkin and Tam Vong.

- The project “Tonkin for Europe”

Tonkin of very high quality was hard to obtain in Europe and our investigations confirmed that culms from the province of Guangdong are excellently suited for rodmaking. This led to my importing Tonkin 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, 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. In the spring of 2017 the first container arrived in Berlin from China with four and a half tons of butt and

mid cuts of Tonkin cane (Fig. 18). Many interesting questions about Tonkin and other bamboo species remain unanswered and we will continue our research on them in the future.

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

Literature

Garrison and Carmichael. 1977. A Master's Guide to Building a Bamboo Fly Rod.

Liese, W. and Weiner, G. 1996. Ageing of bamboo culms. A review. Wood Science and Technology 30, 77-89.

Marden, L. 1997. The angler's bamboo. Lyons & Burford, New York.

McClure, F. A. 1931. Studies on Chinese bamboos. I. A new species of Arundinaria from southern China. Part 1. Diagnosis. Lingnan Science Journal 10. 5-10, plate 1-8.

Milward, R. E. 2010. Bamboo: fact, fiction and flyrods II. A technical review and guide for the amateur and professional rod builder. Self-publishing, Bowen Island, British Columbia.

Schott, W. 2006. Bamboo in the laboratory. A few observations on heat-treating of bamboo for rodmaking purposes. Manuscript, 29 pp.

Xu, Y. and Xu, B. 1984. A preliminary study on the biological characteristics of *Pseudosasa amabilis* in Huaiji county, Guangdong province. Journal of Bamboo Research 3 (2). 48-61

Figures

Contact: **info@springforelle.de or +49 174 787 05 86.**