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A Glimpse on 65 Years of Passion-driven Work for Bamboo

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Abstract. My first contact with bamboo took place in 1951, when shortage of timber for the coal mining industry in West Germany led to the idea to use bamboo as pit props. However, they failed under axial load. In 1952, pioneering the use of the electron-microscope for cell wall structures, bamboo was also tested. These photos excited a visiting Indian wood preservation expert, since structural knowledge might improve the preservative treatment of bamboo culms. So, in 1957, I went to India for 4.5 months as an FAO expert to improve methods for bamboo preservation. This mission was followed by consultancies in about 25 countries, strongly supported by laboratory research. Results were published in about 110 bamboo-related papers and 6 books as author or co-author. The latest publication from 2016 contains chapters on structures, properties and uses of bamboo. At the age of 93 I am still enjoying the discussions with bamboo colleagues worldwide.

Introduction

My first contact with bamboo took place in 1951, when shortage of timber for the coal mining industry in West Germany led to the idea to use bamboo as pit props. Culms were imported from Indonesia, but they failed because the internodes crushed under axial load without emitting any cracking sound, a warning sign for miners to escape (Fig.1, Fig.2). The following year, 1952, I pioneered the use of electron-microscopy at the “Institut für Übermikroskopie”, Düsseldorf, to explore the unknown fine structure of wood. Out of pure curiosity some left over bamboo pieces were also put under the microscope to reveal structural details, (Fig 3).

Fig. 1 Dendrocalamus giganteus, Bogor, Indonesia.

Fig. 2 Culm internode crushed under load.

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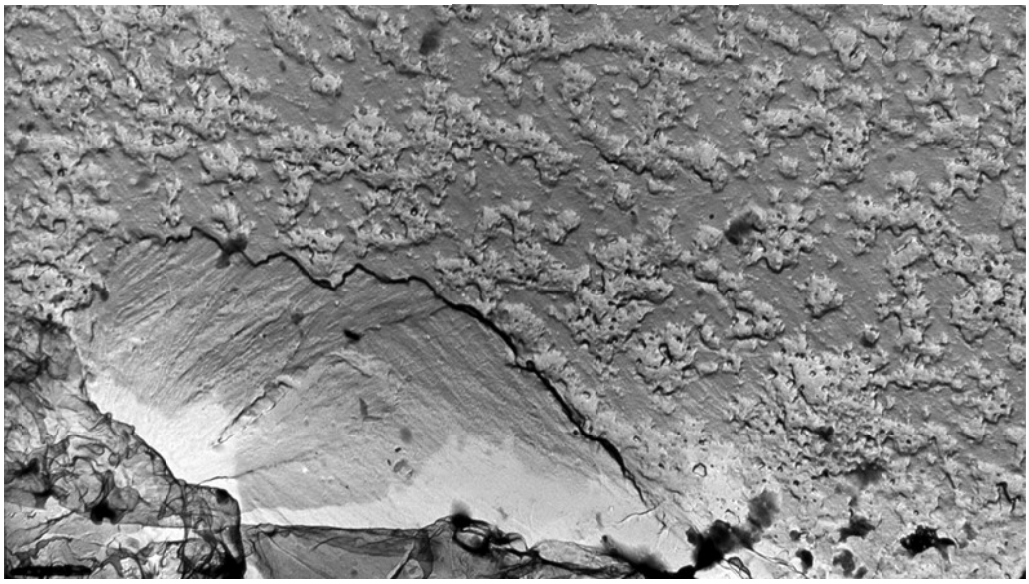

Fig 3 Parenchyma cell wall, Bambusa vulgaris, electronmicrograph,1952.

However, much later these electron-micrographs became very useful, when in 1956 an Indian wood preservation expert on an international factfinding mission paid me a visit at the University of Freiburg to discuss my earlier industrial work on the treatment of spruce. He showed little attention for this work, since his real interest were details on bamboo preservation. Happily, I showed him the slumbering bamboo electron micrographs from 1951/52. He became very excited and indicated a consultancy, since any improved knowledge of bamboo structures might help to treat bamboo culms against deterioration. So, the following year, I went to India as an FAO expert for 4.5 months, at the academically young age of 31 years. For the first time I saw a bamboo plant in its natural habitat. My task was to develop methods for the preservation of bamboo culms against deterioration by fungi and insects. Especially the frequently applied sap-replacement method (Boucherie) should be improved (Fig. 4). This could be achieved by putting an air-sucking cup on the culm end before applying pressure. The results became widely known and initiated numerous consultancies, not only on bamboo, like the one on Wood/Bamboo Preservation in Indonesia the next year and followed by electron-microsocpical work in Melbourne, Australia.

Thus, my “bamboo life” had started.

Fig. 4 Treatment of bamboo culms by the sap-replacement method, Dehra Dun, India, 1957/58.

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The following reflections on bamboo activities must necessarily concentrate on some general areas such as culm structures, protection, international co-operation. After several consultancies, a general documentation about "Bamboo-Biology, silvics, properties, utilization" was published 1985 [1]. For another important monocot, the rattan palms, intensive studies about their structures and properties as well as on their fungal degradation and protection were also initiated.

Culm structures

My first studies on the general anatomical structure of bamboo started 1959 in Freiburg with two bamboo culms brought from India. Studies were continued at my following working stations at Munich and Hamburg, intensified by the use of the electron-microscope. Of the many interesting topics, only a few can be mentioned here, like the fine structure of the cell wall, the variability of fibres within a culm, the arrangement of vascular bundles and their significance for classification (Fig. 5), and structural changes during aging (Fig.6). The main tissue types of Bamboo are vascular bundles embedded in parenchyma tissue. Vascular bamboo number and distribution vary along wall thickness, giving the high strength of bamboo. The parenchyma acts as reservoir for water, plant nutrients, sugars and starch.

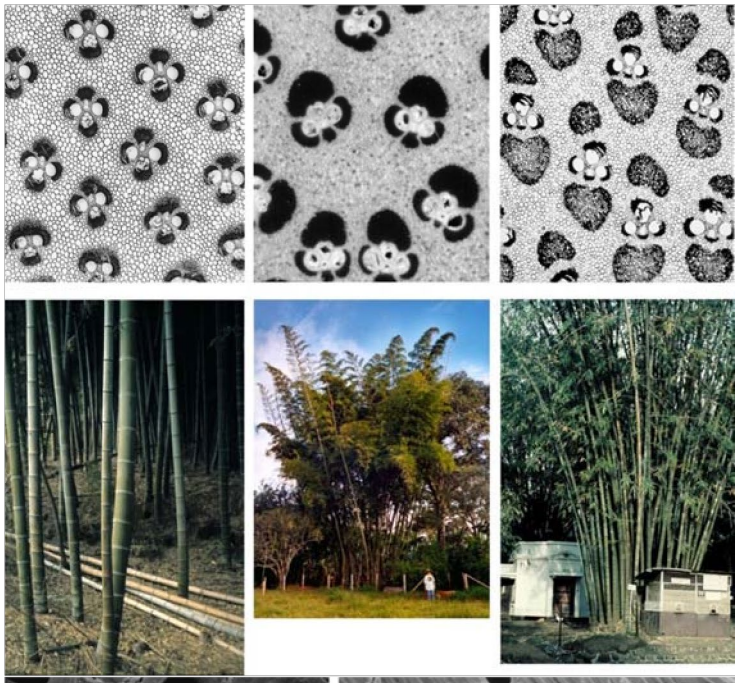

Fig. 5 Growth types of bamboo have different types of vascular bundles.

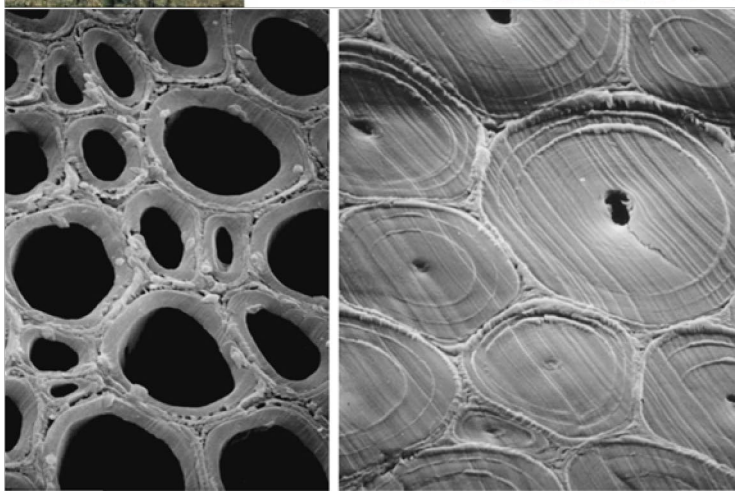

Fig. 6 Cell wall thickening from one year to six years,

Phyllostachys Viridiglaucescens.

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The state of knowledge on “the anatomy of BAMBOO CULMS” 1998 was documented in the INBAR Technical Report No. 18, [2].

Bamboo, rattan and palms, all belonging to the monocotyledons, show many similarities in structural aspects defined by vascular bundles and parenchyma. This results in typical property variation of the tissue according to the vascular bundle density and number as well as the age of parenchyma. Looking at the literature on bamboo, rattan and palms one can learn from each other. My college Johannes Welling will have a presentation on the comparison of bamboo and palms.

Preservation

Bamboo culms are easily attacked by insects, especially termites, moulds, blue-stain fungi, white-, brown-and soft fungi, as well as bacteria under suitable conditions. A number of laboratory experiments dealt with the basic factors of degradation of bamboo and the effects of physiological and chemical conditions for protection. In field tests at various locations the natural durability in soil contact was tested as well.

The good results with the sap-replacement treatment in India became widely known and led to a number of consultancies. Thus, a wider spectrum of applied treatment methods could be critically reviewed. These are the non-chemical methods, like storage conditions, clump curing, water storage, boiling, lime washing, traditional smoking and heat treatment. Great attention was paid to the various chemical treatment methods, like brushing, spraying, dipping and especially the ones for longer sustainability, as sap-displacement and the pressure methods. While being on site, a number of methods could be applied. Of special significance was the further improvement of the sap replacement method by inventing a special cap on the culm end for removing the air before the preservative is pushed in (Fig. 7).

Fig. 7 The sap-replacement method requires an air suction/pressure cap at the culm end.

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In cooperation with the Environmental Foundation in Bali, the Vertical Soak Diffusion System (VSD) was developed. For its application all diaphragms of a fresh culm are punched through, except the lowest one. The culms are then placed vertically in a basin and filled with the preservative up to the top. The preservative diffuses into the wall tissue for a given period of time after which the lowest internode is punched through as well, so that the preservative can flow out and can be used for the next treatment after adjusting the concentration (Fig 8).

The "Bamboo Preservation Compendium" from 2003 presents a comprehensive overview (Fig. 9). 1992 a general documentation on "Wood Protection in Tropical countries was provided as background knowledge [3].

Fig. 8 The Vertical Soak System, Environmental Bamboo Foundation, Bali.

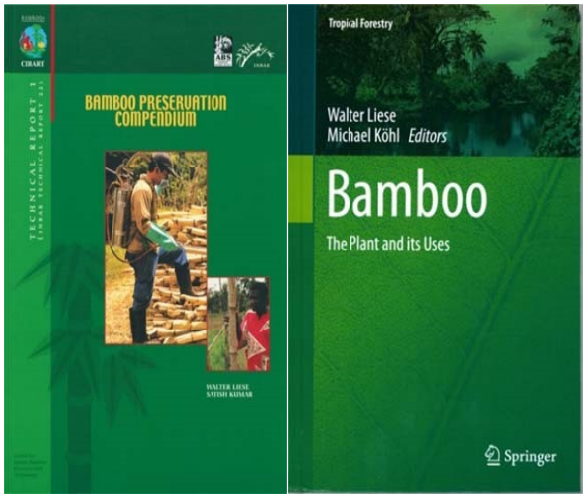

Fig. 9 Bamboo Preservation Compendium, 2003. *Fig. 10 Bamboo. The Plant and its Uses, 2015.*

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Our activities on preservation methods became widely known, resulting in a number of foreign guests to our institute in Hamburg, travelling from countries like India, Indonesia, Thailand, Iran, Ghana, Nigeria, Tanzania, South Africa, USA, Canada Costa Rica, Cuba, Mexico, Chile, Colombia, Brasilia and Chile. They all came to learn and cooperate, taking home with them knowledge, international contacts and personal memories.

International co-operation

The first mission in India was followed by many consultancies in about 25 countries for national and international organizations, as GTZ, FAO, INBAR, ITTO, EU, SES, Kolping and others. Since a number of projects were arranged by the GTZ, an overview report no.180 on "Bamboo-biology, silvics, properties, utilization" was published 1985 [1]. My last projects were conducted 2009 in Thailand, 2010 in Korea and 2012 for a key lecture at the XVIIth World Bamboo Congress, Antwerp, Belgium.

The international activities were strongly supported by intensive laboratory research in collaboration with colleagues, thesis students and guests from various countries. About 110 bamboo-related scientific papers and six books were published as author or co-author. The last book in 2015 "Bamboo. The Plant and its Uses" contains chapters on structures, properties and uses of bamboo (Fig.10) [4].

Since I was engaged in various international organizations, two examples must suffice. I was instrumental in getting the International Development Research Centre (IDRC) of Canada interested in bamboo for the creation of the International Network for Bamboo and Rattan, INBAR, consisting now of 43 Member States countries. I am sometimes referred to as the "Grandfather of INBAR". A similar welcome as "The Father of Bamboo" was offered to me at a consultancy in 1999 at the Kolping Society of the Philippines (Fig.11). During my presidency of the International Union of Forest Research Organizations IUFRO 1978-1981 the activities for bamboo were much strengthened. A special highlight was the XVII IUFRO World Congress in Kyoto, Japan 1981, where at a memorial ceremony *Phyllostachys pubescens var.aureosulcata* was planted by the Prince and Princess of Japan (Fig.12).

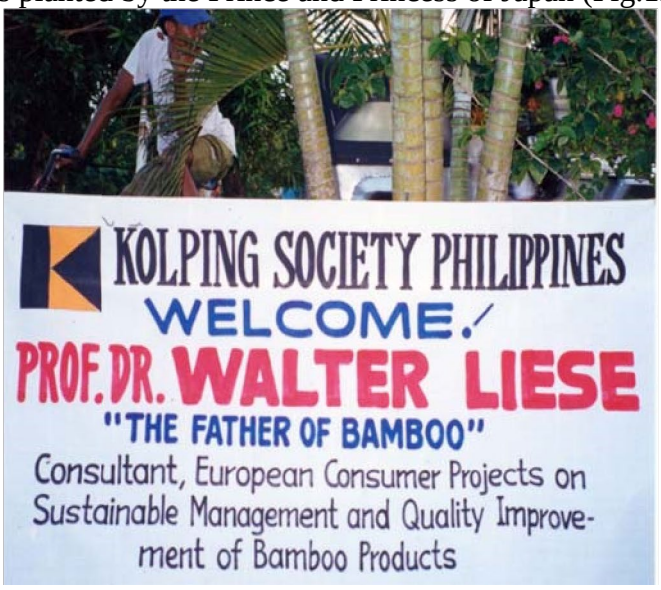

Fig. 11 Visit of a bamboo project led by the Kolping Society, Phillipines, 1999.
Fig. 12 Royal Prince and Princess planting bamboo at the IUFRO Congress, Kyoto, 1981.

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At the age of 92 my passion for bamboo continues with enjoying the international contacts and discussions (Fig.13).

Fig. 13 Walter Liese in his bamboo garden, 2018.

References

[1] Liese W., Bamboos-Biology, silvics, properties, utilization, GTZ Schriftenreihe, Eschborn, 180 (1985).

[2] Liese W., The anatomy of BAMBOO CULMS, Technical report 18, INBAR, Beijing, 1998.

[3] Willeitner H., Liese W., Wood Protection in Tropical Countries, GTZ Schriftenreihe Eschborn, 227 (1992).

[4] Liese W. and Satish Kumar, Bamboo Preservation Compendium, New Delhi, 2003.

[5] Liese W., Köhl M. (eds), Bamboo - The Plant and its Uses, Springer, Heidelberg, 2015, Chapters 8,9,10: pp. 227-364