HORTAX

CULTIVATED PLANT TAXONOMY GROUP

Muddles and misapplications: taxonomic difficulties associated with bamboos in cultivation

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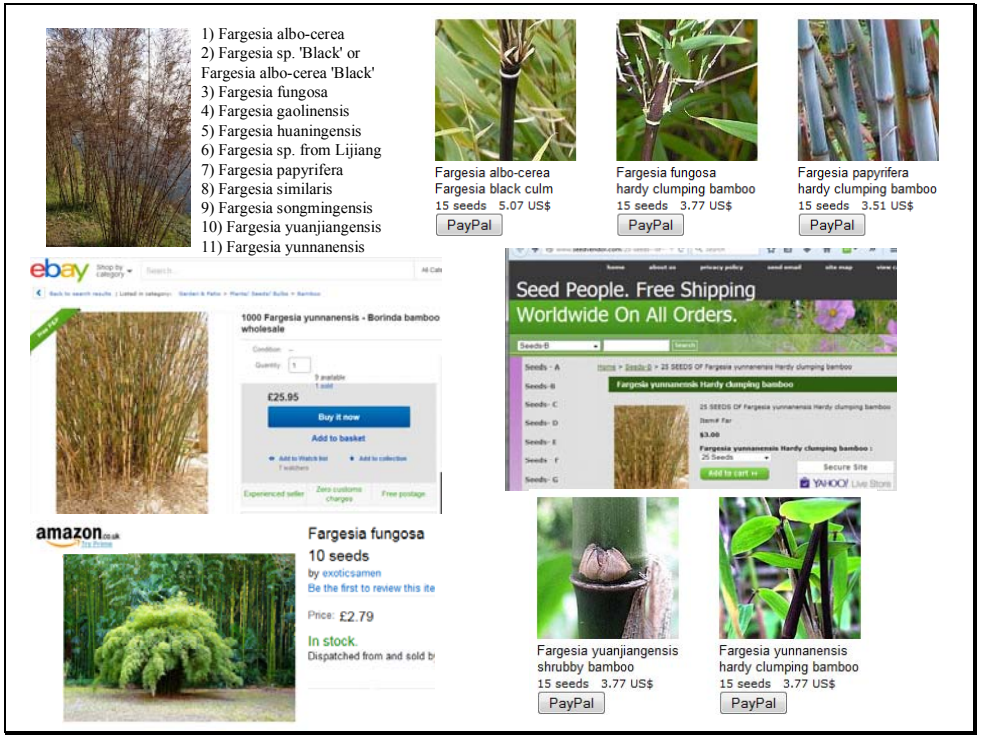
Presentation roughly as given in 2015, updated a little in 2021.

Here I illustrate the problem – multiple names in the UK for the same cultivated plant. Genus, species & cultivar names all varying on displayed and marketed plants. All these are the same species. To decide which name is correct Steve Renvoize & I had to go as far as conserving a species name in the journal Taxon. The genus *Pleioblastus* is considered appropriate on the grounds of morphology and molecular data. In that genus it is now correctly called ***Pleioblastus viridistriatus***, but you will still see these other names around.

Popping in to Tesco's, I saw a nice little bamboo plant on the stands outside. It had an authoritative label, saying Fountain Bamboo. It is not Fountain Bamboo, which is *Fargesia nitida*. On the back it says *Fargesia rufa*, which it also is not. It is actually *Fargesia dracocephala* 'Rufa', Dragon-head Bamboo. It also says it comes from the mountains of western China, while in fact it comes from Central China, but that is not so important as getting the name so wrong. How have we got into this position in Europe? This disinformation would not happen in the US, where we have verified and standardised bamboo names for most of the horticulturally available bamboos.

Stapleton, C. M. A. & Renvoize, S. A. (2001). Proposal to conserve the name *Bambusa viridistriata* Siebold ex André (*Poaceae*, *Bambusoideae*). *Taxon* 50(3): 911–913.



Currently we often cannot identify bamboos collected in the wild, because their taxonomy has not been dealt with adequately. This is what happened when an undescribed *Borinda*-like species started flowering from 2011, only 20 miles outside Kunming in Yunnan Province of China. In the absence of good knowledge of the species in the wild, without any collaborative fieldwork going on, or any checks on the collection and global marketing of plants from the wild in China by Chinese nationals, many kilos of bamboo seed from this flowering species were gathered from a range of seed sources, and sold around the world under no fewer than 11 different names. 6 were misidentifications, and 5 were unpublished names. Suddenly seed of 11 temperate bamboos, apparently including some very desirable species, were available on the internet, all arriving promptly in airmail envelopes for very reasonable prices. The suppliers in Kunming were very happy, and buyers were initially ecstatic, until a few years later when the seedlings all started to look remarkably similar, and nothing like their supposed identities, also all showing substantially less hardiness than claimed.

Names should not be left to fertile imaginations or market forces.

Causes of confusion

1. **Poor separation of taxonomic groups**

We are in a mess. Why? Bamboos are actually quite difficult to classify or identify, because groups are not separated clearly
Two aspects to this fundamental cause of confusion.
1. Bamboo taxonomic groups at all levels have indistinct boundaries with overlapping characters.
2. Knowledge and understanding of the characters has been poor. Morphology had not been studied properly.

This has made it very difficult to define and separate groups, even when substantial differences are apparent.

Temperate bamboos

Temperate - 3 stamens

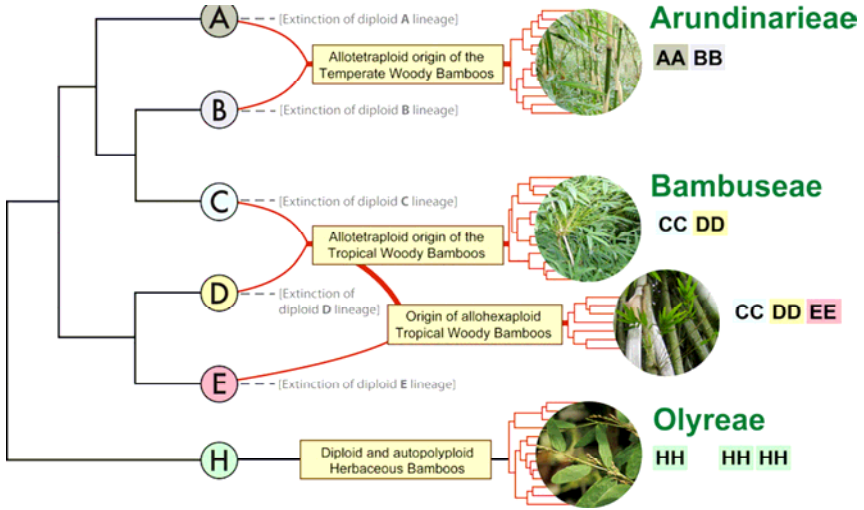
Tropical bamboos

Tropical - 6 stamens

I will now home in on the confusion in names for temperate bamboos as those are most important for horticulture in Europe. These are the bamboos that have evolved from tropical ancestors, out of the windless and mild tropical forest understorey. The main morphological character that they have in common is having 3 rather than 6 stamens. Maybe they do not need to produce so much pollen where there is more wind, but this distinction is clearly a major and important one. Without delving into cytology, anatomy, or sequencing genes there is really no other way of distinguishing them.

Problem!: temperates with 6 stamens, eg *Sasa*

Immediately we have a problem, even at this level. Unfortunately there are some temperate bamboos that have 6 stamens. These are the species found as a very dense low forest understorey, where there is less wind. This highlights a major problem in the bamboos. There are exceptions to every rule. Characters are plastic, often under physiological control. Boundaries become vague, and thus potentially muddled and controversial.



Triplett, J. K., Clark, L. G., Fisher, A. E., Wen, J. (2014). Independent allopolyploidization events preceded speciation in the temperate and tropical woody bamboos. New Phytol. 204 (1): 1469-8137. http://dx.doi.org/10.1111/nph.12988

One reason for such irregularities is rampant hybridisation. Even the major groups of bamboo have originated by hybridisation. Our current polyploid groups apparently arose as hybrids between previous diploid lineages.

Hybridisation has probably obscured distinctions between groups of bamboos ever since they first evolved.

Arundinarieae - discovery & recognition of genera

Arundinaria 1803 (US endemic) - Inflorescence open, ebracteate

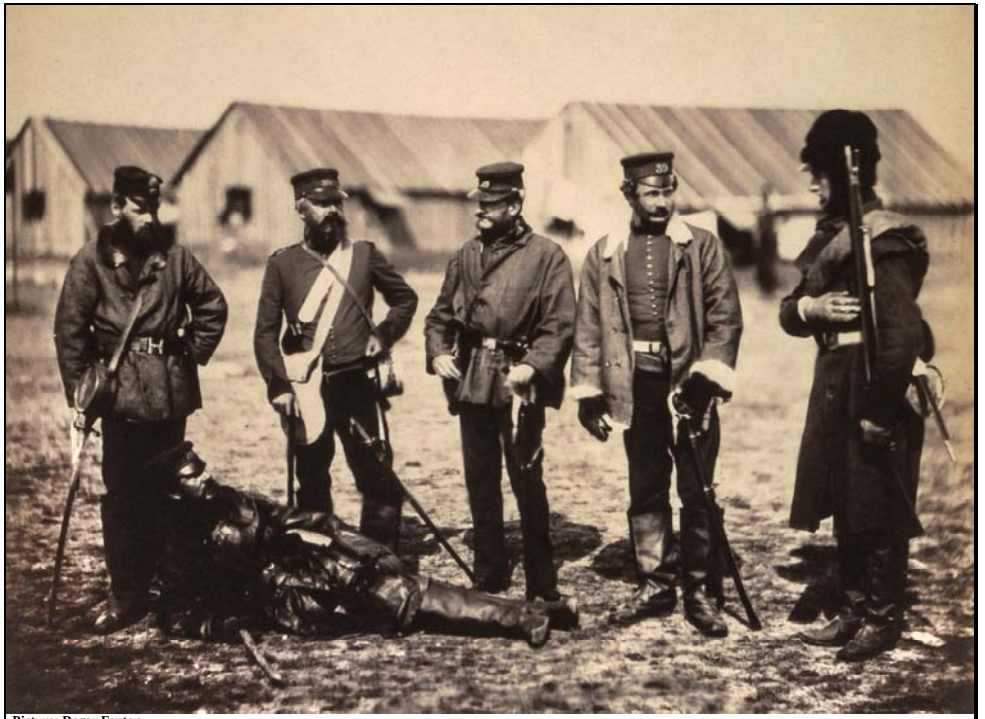
http://www.vaplantatlas.org/index.php?do=plant&plant=381

I want to concentrate now on Tribe Arundinarieae, which contains all the temperate bamboos (except a few temperate bamboos found in S America).
There has clearly been huge confusion at the generic level. I am going to talk about how knowledge of the genera has grown, concentrating on clup-forming genera, and how attitudes to generic recognition have changed.

Arundinaria Michaux 1803, was the first temperate genus described, including clumpers and spreaders. It is the benchmark for temperate bamboos. The inflorescence is open with well separated spikelets, and without basal sheaths or bracts.

After 1803 in came the troops to find some different types of inflorescence. Let's have a look at who was involved in the development of bamboo generic names and classification.

(This is one of the smartest portraits ever of a plant taxonomist)
I consider this man the Father of Bamboo Taxonomy. Lieutenant (eventually General) William Munro in 1844. Fought for a better understanding of grasses, especially bamboos.
Classified and described all 219 bamboos of the world known in 1868 in A monograph of the Bambusaceae, *Trans. Linn. Soc. London* 26: 1–157.
He established several important new bamboo genera, though mostly tropical, and he named many new species. He described 14 plant genera in total, not bad for an amateur taxonomist.



Picture: Roger Fenton

He was a practical man. He established botanic gardens at some of the military stations where he served, and made his soldiers grow their own vegetables.
Here, as Lieutenant-Colonel Munro (2nd from right) in the 39th Dorsetshire Regiment, fighting the Russians in Crimea in 1855, alongside the French.
These guys were pioneers. In this war they developed new military techniques, new medical practices, new military supply systems, and the balaclava hat. No wonder that Munro also dared to look at plants in new ways. Service in India, as well as Canada and the West Indies provided him with the ideal opportunity to collect and study exotic plants.
Photography had only been invented 20 yrs earlier, and the series of photos of the Crimean War by Roger Fenton were as ground-breaking and influential as the military developments and Munro's botany.
Excellent botany and taxonomy have often been undertaken in association with (and thus funded by) other activities, by those without formal training in the subject.

Open, ebracteate

Staying in *Arundinaria*
(*Yushania, Sarocalamus, Borinda*)

Compressed, bracteate

new - *Thamnocalamus* Munro

But I digress. So - what sorts of bamboo inflorescence was Munro likely to encounter in British India?
Within the temperate Asian bamboos we have plenty of variation.
There are differences in compression of the inflorescence, as discovered by Munro, and in the presence of spathes.
He saw open ones like those on the left here, in *Yushania maling and Sarocalamus racemosus.* They are very similar to those of *Arundinaria* which we saw before. He also saw the more compressed inflorescences of *Thamnocalamus spathiflorus* in the Himalayas. These were all placed in *Arundinaria* at that time, but Munro separated out those with compressed inflorescences into his new genus *Thamnocalamus.*

Open, but bunched

Drepanostachyum

Compressed, bracteate, & unilateral

Fargesia

They can also vary in other ways.
Open inflorescences with bunching (fasciculation) at the nodes could have been seen by Munro in *Drepanostachyum falcatum*, known then as *Arundinaria falcata* in the western Himalayas.
Even denser inflorescences than those of *Thamnocalamus* are seen in *Fargesia nitida*, known then as *Arundinaria nitida,* as a result of extreme compression and confinement. These dense toothbrush-like flowers are found in C China where Munro did not go.

Open, ebracteate, pedicels short

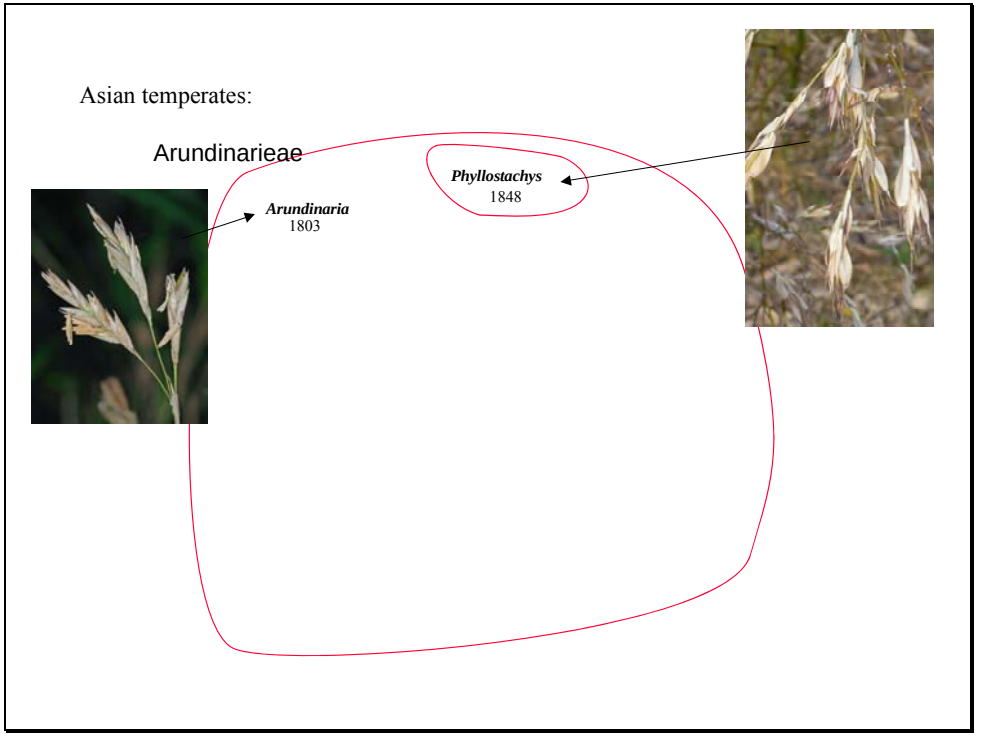
Indocalamus

Compressed, bracteate, leafy

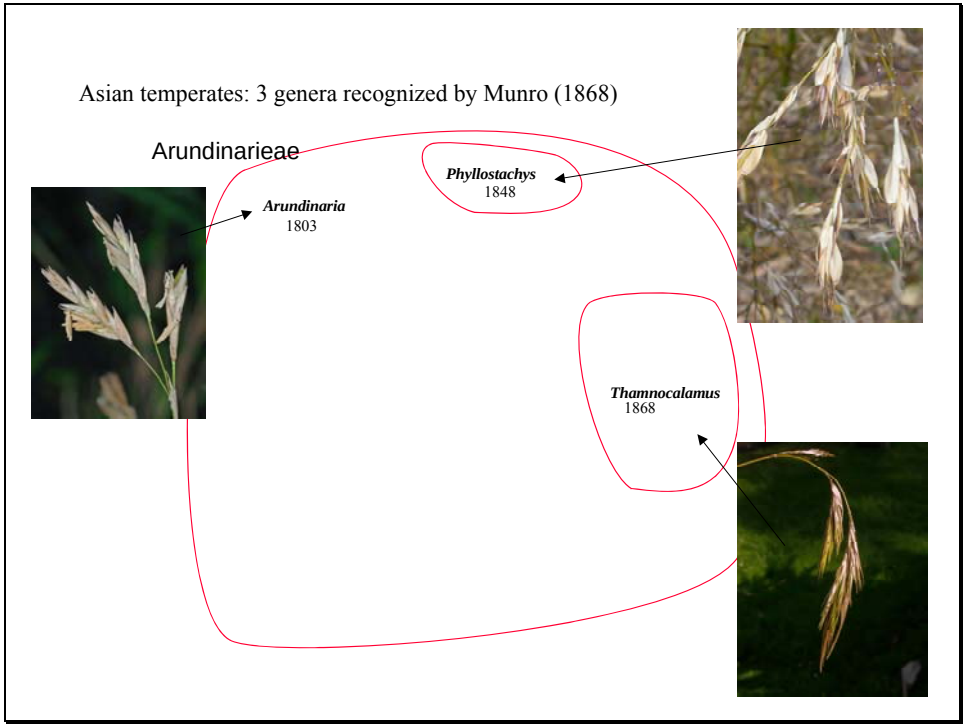
Phyllostachys

Other characters can also be found in Chinese & Japanese bamboo genera, eg short pedicels with long spikelets, or very leafy spathes around inflorescences.

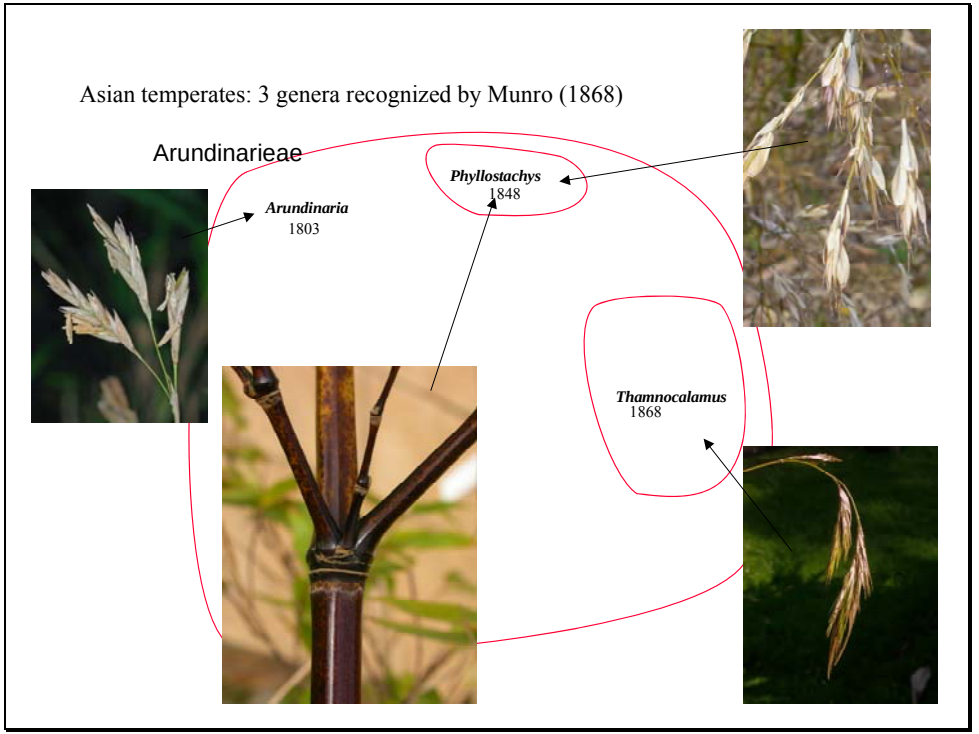
There is a lot of variation within the inflorescences of temperate bamboos, as noticed by Munro.



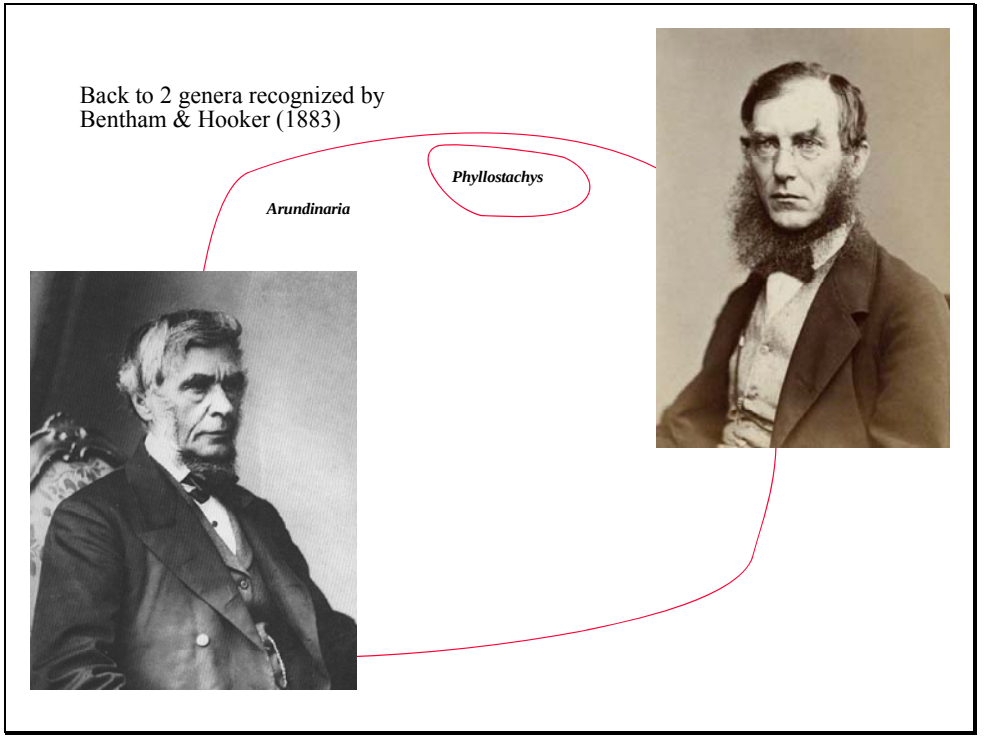
So how did the classification of these temperate bamboos develop?
Here the red loop signifies the whole tribe Arundinarieae. Before Munro *Arundinaria* & *Phyllostachys* were the only 2 genera in it, with *Phyllostachys* only distinguished in 1848 by its almost leafy spathed flowers.



Munro described *Thamnocalamus* for species with dense compressed inflorescences in 1868.



Munro also distinguished *Phyllostachys* by a vegetative character, its distinctive semi-flattened internodes. This was pioneering. He was daring to look at vegetative characters at the generic level in grasses.



Munro's work did not go down well. A more conservative approach was favoured by institutional grass taxonomists in 1883, when bamboos were included in the next major grass classification, putting the clock back. Munro's *Thamnocalamus* was not recognised, back to 2 genera.

Different perspectives on bamboo genera are nothing new. Also, when experts try to cover too broad a group of plants they run the risk of being out of touch.

Adrien René Franchet

***Fargesia* 1893**

Père Paul Farges

Moving on, and into the 20th Century. More botanists came along, looking at more bamboos in much more depth, and describing more genera from a wider range of characters.
Adrien René Franchet was a French botanist, based at the Paris Muséum national d'Histoire naturelle.
He is noted for his extensive work describing the flora of China and Japan, based on the collections made by French Catholic missionaries in China, including Paul Guillaume Farges, after whom he described the genus *Fargesia*, which includes several of our horticulturally important species.

Adrien René Franchet

Fargesia 1893

Takenoshin Nakai

***Sinarundinaria* 1935**
(*+ 8 leptomorph genera*)

Nakai was a Japanese botanist looking at bamboos in the (temporarily) expanding Japanese Empire of the 1930s, who gave us many bamboo genera, including the ill-fated *Sinarundinaria.* When he was in charge of the Botanic Garden at Bogor in occupied Indonesia, he protected the trees from the Japanese army who wanted to cut them down for timber. The acceptable face of Japanese occupation. Looking at 2 Chinese species sent to Japan, he distinguished his new *Sinarundinaria* from *Arundinaria* on vegetatative characters alone, persistence of culm sheaths, smoothness of oral setae, and number of branches. This was revolutionary. Only 160 years later when nitida flowered was it confirmed that *Sinarundinaria* is a synonym of *Fargesia*, as its type species *Sinarundinaria nitida* has dense inflorescences just like those of *Fargesia*. Poor correlation between classifications based on bamboo flowers and those based on their vegetative characters have been a source of confusion for a very long time.

Adrien René Franchet

Fargesia 1893

Takenoshin Nakai

Sinarundinaria 1935
(*+ 8 leptomorph genera*)

FloydAlonzo McClure (another missionary in China)

***Indosasa* 1940** (leptomorph, + 7 S American genera later)

Floyd Alonzo McClure was an American missionary. His main job was professor of botany in Canton University. He was driven out of China by the invading Japanese, and then kept out by the Chinese Communists, but he gained first-hand understanding of bamboo morphology, unprecedented for a westerner. His insights into the characters used to classify bamboos were probably his greatest contribution to Asian bamboo taxonomy.

1. Adrien René Franchet

Fargesia 1893

2. Takenoshin Nakai

Sinarundinaria 1935
(*+ 8 leptomorph genera*)

3. Floyd Alonzo McClure

Indosasa 1957 (leptomorph, + 7 S American genera)

4. Keng Pai-Chieh
耿伯介
(Geng Bojie)

Yushania **1957**
Drepanostachyum **1983**
Himalayacalamus **1983**

(*+ 2 leptomorph genera*)

5. Xue Ji-Ru & Yi Tong-Pei

Chimonocalamus **1979**

6. S.L. Chen, T. H. Wen & G.Y. Sheng

Ampelocalamus **1981**

Later in the 20th Century Chinese botanists from several universities described useful generic names, before and after the Cultural Revolution of the 1960s and 1970s. Some are synonymous, but 5 have stood the test of time:
3 names for Chinese genera: *Yushania* with long rhizomes like *Arundinaria* but pachymorph, *Chimonocalamus* with thorns like *Chimonobambusa* but clump-forming, *Ampelocalamus* for temperate bamboos with a climbing tendency
2 names for bamboos of India: *Drepanostachyum* with open flowers like *Arundinaria* but bunched, *Himalayacalamus* with small racemes instead.

1. Adrien René Franchet

Fargesia 1893

2. Takenoshin Nakai

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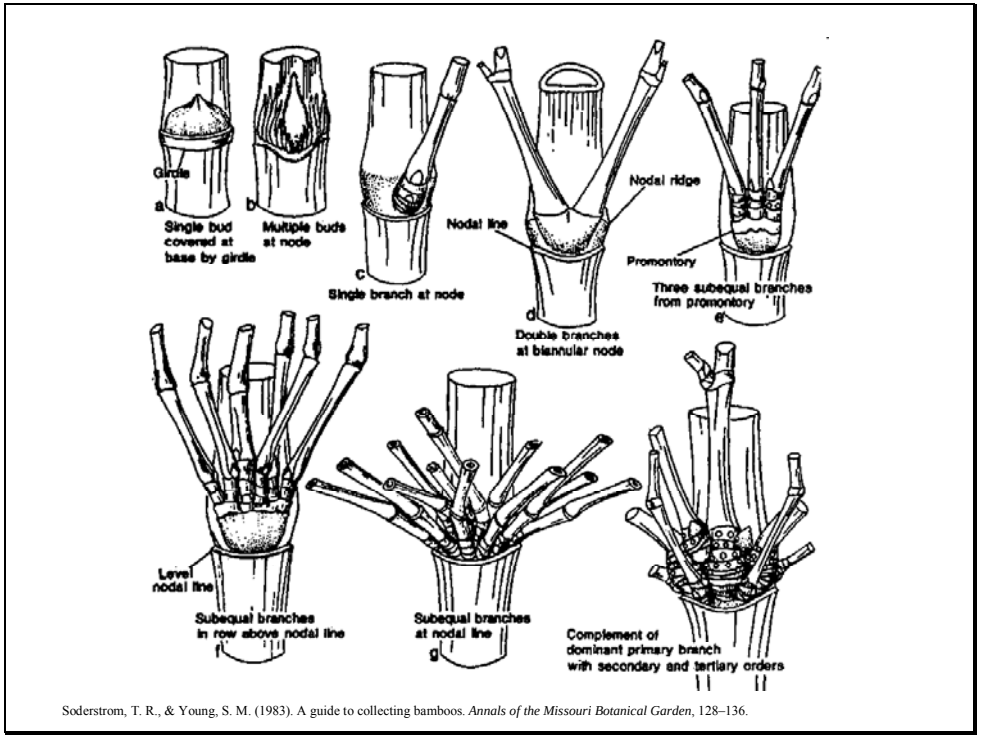
Ampelocalamus **1981**

7. Cleofé Calderón & T. Soderstrom

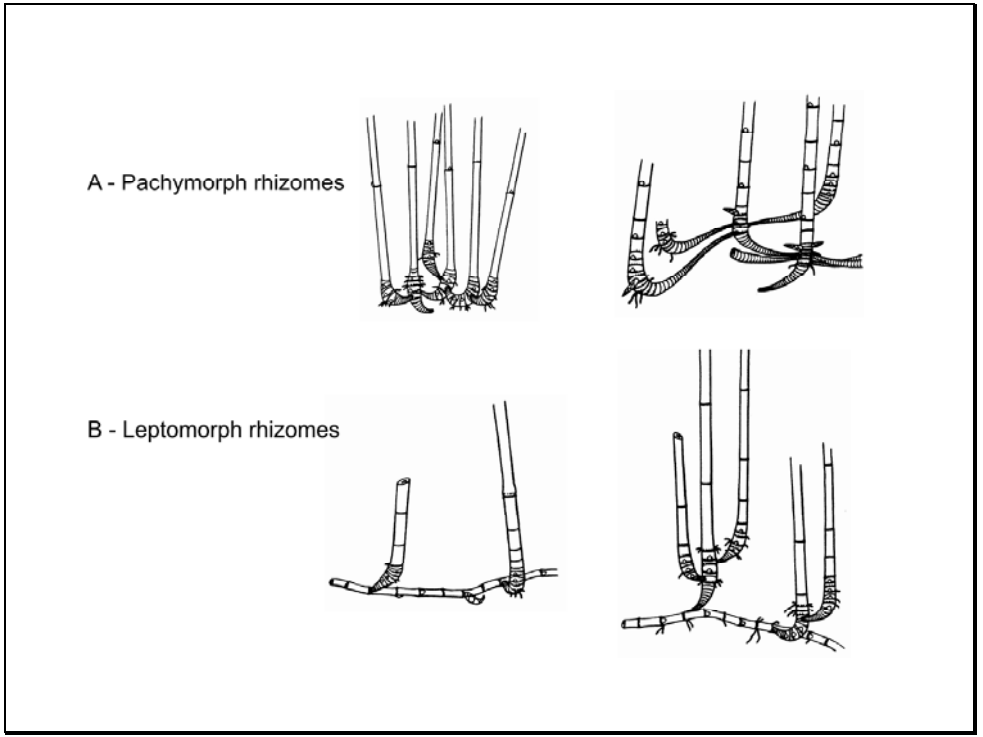
Otatea 1980

The Smithsonian Institution in Washington arranged extensive work and collaboration on bamboos, especially the herbaceous ones, by Tom Soderstrom, continuing McClure's work on bamboos of S America. One temperate genus was described, *Otatea,* in collaboration with Cleofé Calderón of Argentina, for slightly spreading temperate species similar to *Yushania* with pachymorph rhizomes.



Soderstrom, T. R., & Young, S. M. (1983). A guide to collecting bamboos. *Annals of the Missouri Botanical Garden*, 128–136.

More characters were studied. More understanding of morphology was gained.
Branching patterns show great variability in the temperate bamboos. Several characters are involved.
Improvements in our understanding of branch variability has been ongoing from the first studies by **Usui (1957)** in Japan, expanded by **McClure (1966, 1973), and Soderstrom (1983)** and still continuing



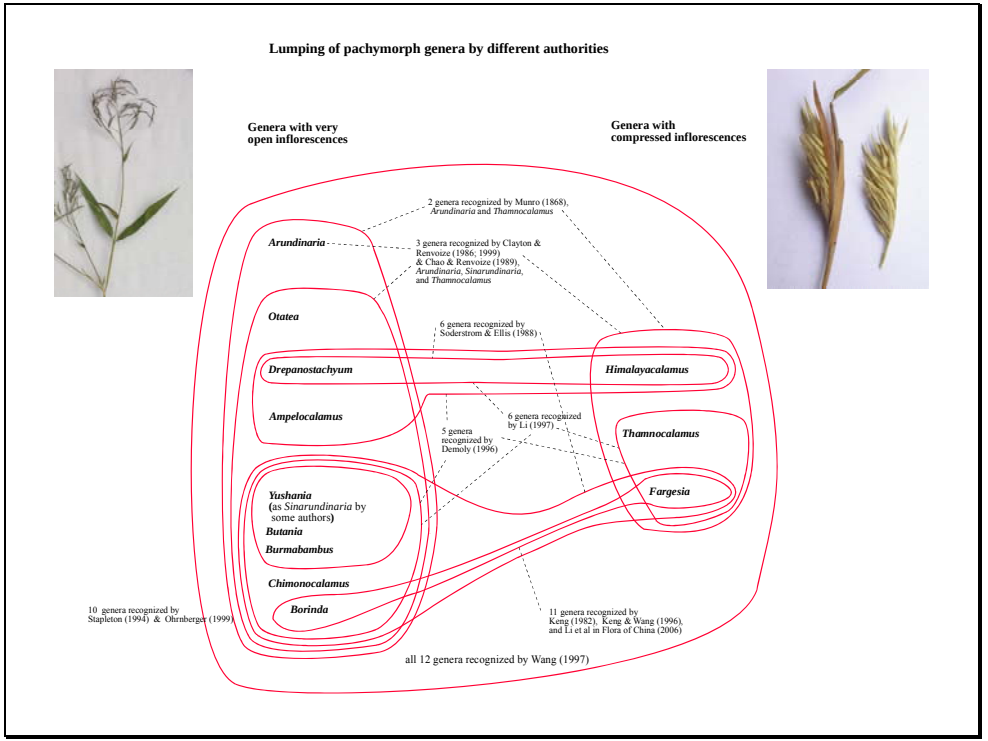
Rhizomes were looked at in more detail. **Charles Marie Rivière & Marie Auguste Rivière in 1878** had described the major difference between pachymorph rhizomes and leptomorph rhizomes. **Takenouchi in Japan (1926)** distinguished four patterns. **Floyd Alonzo McClure (1966)** revisited these distinction in greater detail, and thus it was only in 1966 that these 4 different patterns of rhizome form were properly distinguished in the west. They lead to rather different forms of clump or stand of bamboo culms, but can only be determined properly by excavation. This clear illustration was published in Hong Kong Bamboos, **But et al. (1985).**

In the temperate bamboos there is plenty of variation in vegetative morphology as well as inflorescences.

Causes of confusion

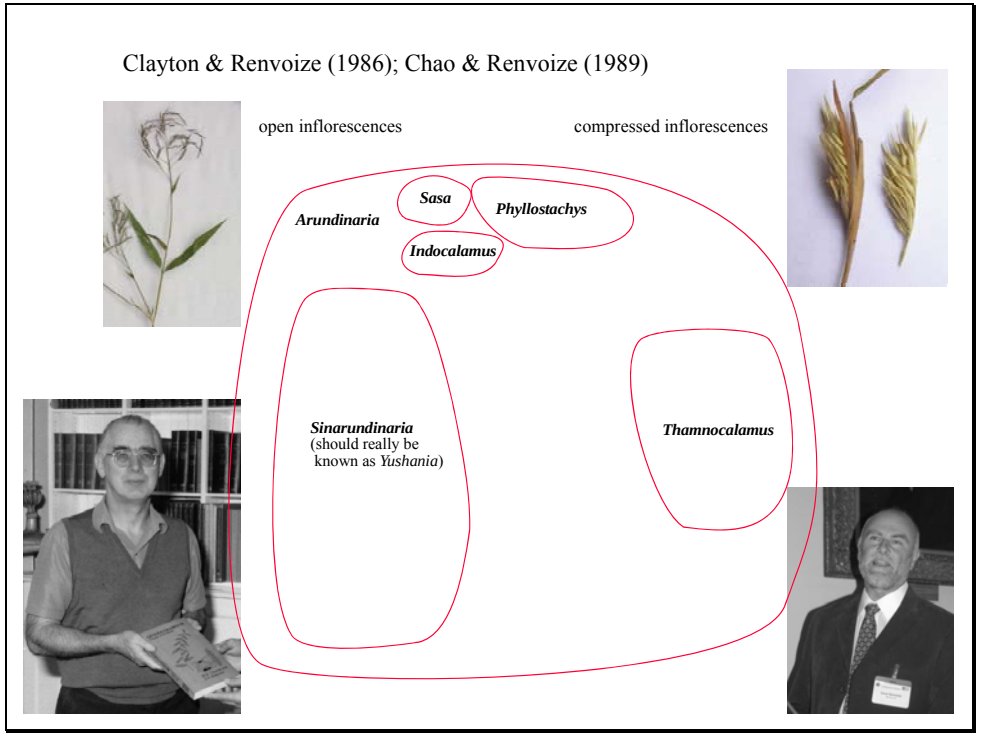
1. Poor separation of taxonomic groups
2. **Different opinions on importance of characters**

So we have a lot of characters, but which ones are important, or most important?



By the mid 1990s 11 genera had been described in the pachymorph-rhizomed temperate bamboos. These met with varying receptions. Lumping of the genera has been common, but with different authorities prioritising different characters and lumping either according to the inflorescence – either open or compressed (vertical), or by using other characters that cut across this distinction (horizontal).
Essentially a conflict was starting between those who favoured floral characters, especially grass taxonomists and their followers, and those who favoured vegetative characters.
Also – some lumping appears justified when the genera seem to merge into each other without clear blue water – no-one wants to be labelled a splitter.

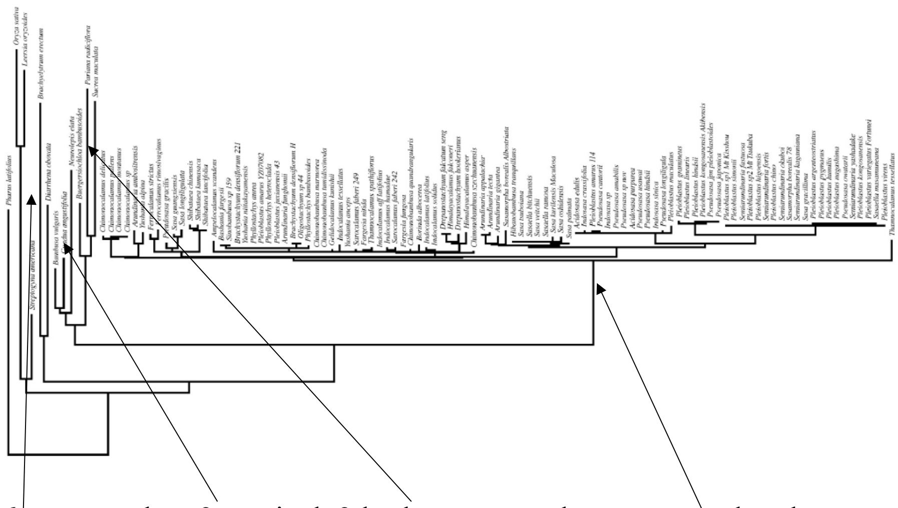
Lumping on different characters causes conflicts, boundaries don't become less vague, just different, and still controversial.



Again, as in 1883, the new bamboo genera did not go down well with institutional grass taxonomists, who again favoured a more conservative approach. This is the grass taxonomists' classification, as applied in Genera Graminum, Grasses of the World, and applied to cultivated UK bamboos. It prioritises flowers and ignores many vegetative characters.

Pachymorph-rhizomed clump-forming temperate bamboos were simply divided into 2 large groups based on whether the inflorescence was open (*Sinarundinaria*) or compressed (*Thamnocalamus*). As in 1883 it was deemed highly authoritative because of Kew's standing, and was widely followed. It was finally just being abandoned in India in 2015.

So is this all just a classic lumpers vs splitters conflict? Only if the large groupings are natural. Bring on the molecular phylogenetics, but unfortunately it did not seem very informative in bamboos.



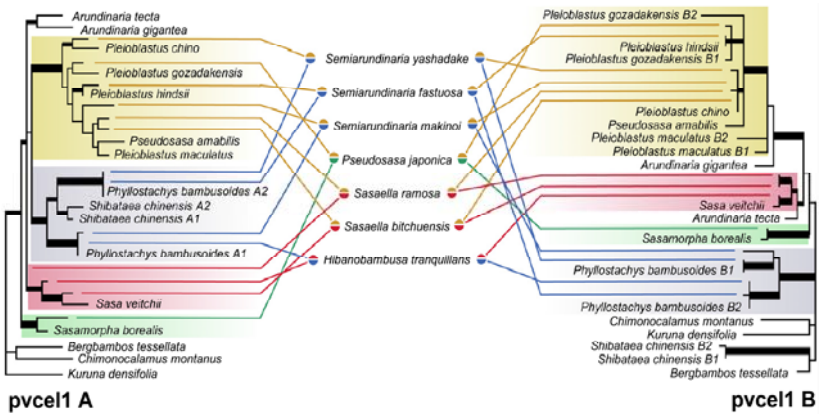
6 grasses, then 3 tropical, 3 herbaceous vs the temperate bamboos

NJ tree showing relative differences between chloroplast DNA by Jimmy Triplett, see PhD thesis &:

Triplett, J.K. and L.G. Clark. 2010. Phylogeny of the temperate bamboos (Poaceae: Bambusoideae) with an emphasis on *Arundinaria* and allies. *Systematic Botany* 35(1): 102–120.

So why are the groups hard to separate with vague boundaries, and why did molecular data not help?
This neighbour joining tree shows great disparity in resolution between the other grasses, tropical bamboos, herbaceous bamboos, and the temperate bamboos.
High similarity in DNA is evident despite all the morphological variation we have seen.

Temperate bamboos are all genetically very similar.



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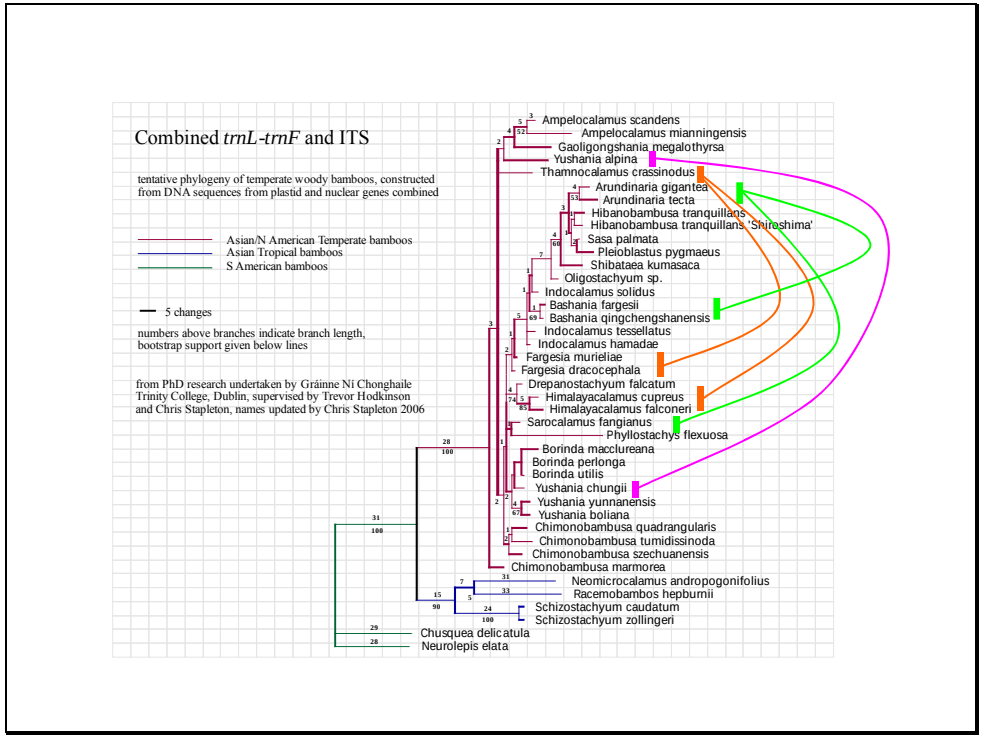
Why is the DNA so similar? remember the hybridisation between the higher groups of bamboos? Intergeneric hybridisation has also been demonstrated in several bamboos, confirmed here by findings from 2 different genes.
Hybridisation is, and always has been common in these bamboos. It continues at the species level, with detailed investigations revealing hybrid swarms in sympatric species.

Also – relatively recent, rapid colonisation and diversification into and within new temperate habitats, especially in E Asia, has been an important factor. Also - long generation times, with flowering occurring only every 100 years or more in many species. The DNA has not consolidated (lineage sorting), still containing strong signals from earlier generations with different morphologies.

DNA was not the hoped-for silver bullet for bamboo taxonomy.



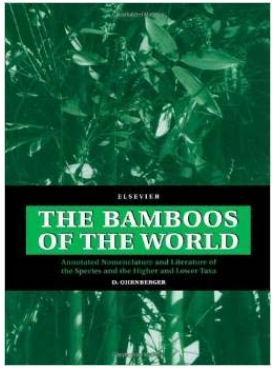
Nevertheless, early molecular data was very useful, even if only in a negative sense, showing what relationships did **not** exist rather than revealing ones that do exist. Ni Chonghaile's (2002) results were used to test some broad groupings in morphological phenetic classifications. They demonstrated the polyphyletic nature of large groupings – artificial lumping.

It highlighted groups with similar morphology from geographically distinct areas – showing them to be unrelated. *Yushania alpina* from Africa has now became *Oldeania alpina*. *Sarocalamus* from the Himalayas to Sichuan was described for *Bashania fangiana,* and could no longer be included with other *Bashania* species or with the N American genus *Arundinaria*, despite looking very similar indeed.

Thamnocalamus was a large lump including *Himalayacalamus* and *Fargesia*, shown here to be less closely related to *Thamnocalamus* than several other bamboos.
The broad genera in Genera Graminum were shown to be very polyphyletic indeed. This was not just lumping groups that were closely related.

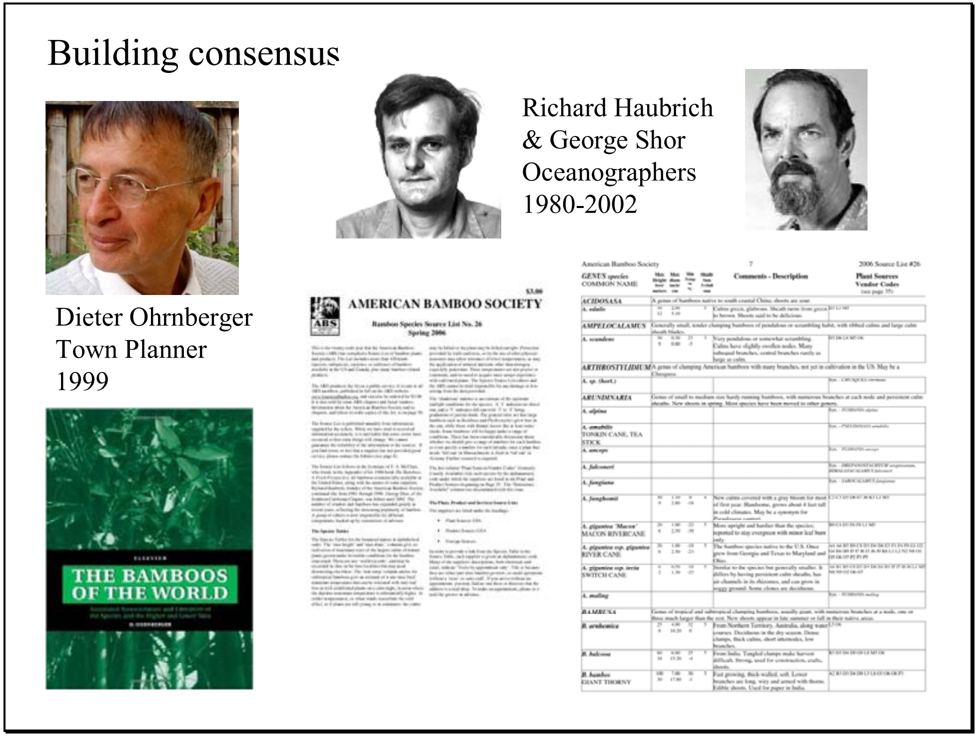
Thus the molecular data could reinforce the phenetic classification, and it was applied this way in the collaborative Flora of China bamboo account in 2006.
This approach is now called 'Integrative taxonomy'. It used to simply be the normal scientific procedure of considering all available evidence to make decisions.

Building Consensus



Dieter Ohrnberger
Town Planner
1999

Like Munro's global treatment of 1868, another independent mind was needed to consolidate local accounts into a global classification.
Disparate views on bamboo names were reconciled on the basis of global consensus opinions in this colossal collection of all published bamboo names, refined over 15 yrs for each genus, then compiled in 1999 by Dieter Ohrnberger in Germany. The scope and comprehensiveness of this painstaking work was breathtaking. It was a quantum leap in knowledge of names at a time when Kew jealously guarded and sold the contents of Index Kewensis, and online versions of Tropicos & IPNI were still a long way off.
Undertaken after taking advice from all experts around the world and arriving at a consensus treatment of names for each genus, it avoided getting bogged down in descriptions, but became a benchmark reference work for others to build from, and started to create a sense of confidence in stability of bamboo nomenclature.



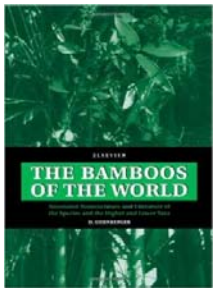
Also deserving credit is The Bamboo Species & Sources List of the American Bamboo Society, which lists bamboos for sale and sources (suppliers) for each bamboo. It is like the RHS Bamboo Plant Finder for the US.

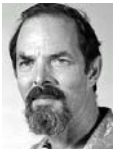
Expanded in 1981 from a brief list of bamboo suppliers included in McClure's textbook of 1966, it was developed greatly under Californian oceanographers from the Scripps Institute Richard Haubrich & George Shor to 2002. It carries on and now has nearly 500 entries. Each year there are a handful of carefully considered additions. Growers can post and compare photos of their plants on a dedicated site and discuss names in a forum. The names are carefully screened and only included after the editors are happy that the plant is distinct with a reasonably reliable name. Combining advice on taxonomy and nomenclature from bamboo specialists around the world with information from horticulturalists, it has standardised names of bamboos in cultivation across the US, and its influence has spread around the world, not least because the ABS, like several originally American horticultural societies, has members in many different countries. You could almost call it an informal register of cultivated bamboo names, which has been running quietly for 34 years. However, it has no accreditation or formal status and the official bamboo ICRA is now in China https://www.ishs.org/sci/icralist/93.htm http://www.bamboo2013.org

This list is recognised in the American horticultural trade as an effective means of reassuring buyers about the real identity and characteristics of plants they are purchasing, and improving customer confidence is always good for sales. I had dreamt that the RHS Plant Finder might expand in coverage to become a European equivalent of the ABS source list. This would have been a fantastic boost to stability of bamboo names in Europe.

Building consensus

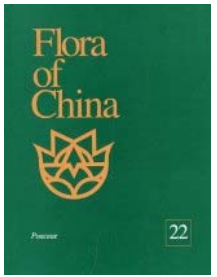
Dieter Ohrnberger
Town Planner
1999





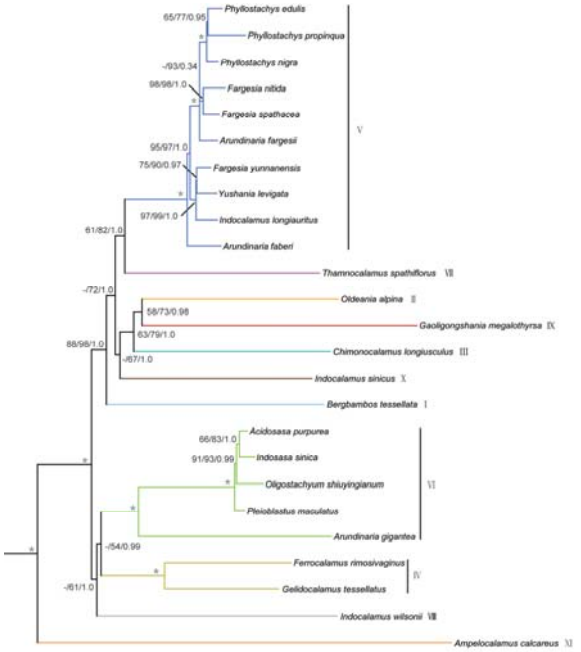
Haubrich & Shor
Oceanographers
1997-2002

Li De-Zhu
Forester 2006



An important milestone in consensus was the English language version of the Flora of China. Bringing together more than 25 Chinese bamboo taxonomists to compile an English language version of the Flora of China, De-Zhu Li, now Director of the Kunming Institute of Botany managed to reconcile radically different approaches to genera and species concepts within China, applying an evidence-based approach in collaboration with other bamboo taxonomists from around the world, using new molecular information gained in the UK, Ireland the US and China. The project was undertaken under the initiative of Professor Peter Raven and his team at Missouri Botanical Garden.

Consensus on recognition of botanical names should include all stakeholders, including all the users of plant names.



Ma PF, Zhang YX, Zeng CX, Guo ZH, Li DZ (2014). Chloroplast phylogenomic analyses resolve deep-level relationships of an intractable bamboo tribe Arundinarieae (Poaceae). *Syst Biol.* 63(6): 933–950.

The pursuit of a reliable classification from molecular phylogenetics was continued by the Bamboo Phylogeny Group, led by Lynn Clark of ISU, which published a treatment in 2012, but it could not really claim to be firmly based on sound phylogenetic data.

The consensual treatment was maturing by 2014, but still on shaky ground. Strict recognition of only monophyletic groups would have led to 12 genera in the Arundinarieae from sequencing of chloroplast and nuclear genes. But how would that change as molecular techniques changed? Note inclusion of *Phyllostachys* and *Fargesia* together in Group V. Would we want *Fargesia* species to be included in *Phyllostachys*?
Is this molecular lumping any better than lumping on phenetic characters? Does it provide a useable classification that helps identification and conservation? Is the monophyly criterion just another opinion on the importance of a particular character?

Strict interpretation and recognition of only monophyletic groups can make identification much more difficult. Is integrative taxonomy the way forward for bamboos?

Causes of confusion

1. Poor separation of taxonomic groups
2. Different opinions on importance of characters
3. **Use of hybrid generic names**

Conventional name	**Nothogenus name**	**Putative parents**
Hibanobambusa	×*Phyllosasa* & combinations	*Phyllostachys* *Sasa*
Sasaella	×*Sasinaria* & combinations	*Sasa* *Pleioblastus*
Semiarundinaria	×*Pleiomorpha* ?? & combinations	*Pleioblastus* *Sasamorpha*
Pseudosasa	×*Pleiostachys* ?? & combinations	*Pleioblastus* *Phyllostachys*
more waiting in the wings ??	?? & combinations	all bamboo genera??

Another bone of contention is whether we should use intergeneric hybrid nothogenus names for bamboos?
Some nothogenus names are published already, but the problem is we don't know about the timing of hybridisation, and many bamboo taxa have arisen through hybridisation.
What about changes in recognition of names of parents as knowledge improves, as in ×*Sasinaria* which many authorities would now consider should be ×*Sasablastus* instead, applying *Arundinaria* in a stricter sense.
How recent does a hybridisation event have to be to use a nothogenus name anyway?

Causes of confusion

1. Poor separation of taxonomic groups
2. Different opinions on importance of characters
3. Use of hybrid generic names
4. **Poor typification**

Names need to be tied down to avoid confusion. Basically if a name has no type or standard it is effectively meaningless as it is open to different interpretation and application.
Bamboo type specimens in herbaria are often poor quality and hard to identify. Sometimes it is not clear which specimen the type should be, and therefore different authorities may assume that names belong to different species or to different genera.

on entering the grounds will not fail, if he be an arboriculturist, to admire the fine specimen Bamboos

bium Dalhousieanum was noted remarkable for the size and substance of its growths, which are many—

house a healthy batch of Pinguicula caudata was observed. Passing along into a Peach-house is a

FIG. 33.—ARUNDINARIA NITIDA IN THE BAMBOO GARDEN AT KEW. (SEE P. 186.)

(not the least affected by the severe frosts of last winter), the massive Gunneras, several fine plants of

some of them measuring more than 7 feet in length, the young stems now growing freely, indicate that

remarkable specimen of Iris Robinsoniana in the best of health, but Mr. Cornish has not yet succeeded in flowering the plant.

The name *Arundinaria nitida* was described from a plant of Fountain Bamboo growing at Kew in 1895. Some people wanted the name to apply to a different, spreading species not known in cultivation at all. That would allow the name *Sinarundinaria* to be used instead of *Yushania*, but it would mean a name change for the Fountain Bamboo, which would have had to be given a completely new name altogether.

After about 20 years of trying to sort this problem out, it was finally laid to rest in the journal *Taxon*. Above is the original picture of *Arundinaria nitida* at Kew, accompanying its description in 1895 in the Gardeners' Chronicle. Like most people I did not take the publication of the name above very seriously, and in 1995 had typified a later publication of the name. Unfortunately the publication above has been considered valid so the name needed typification all over again.

This is a clump of our widely cultivated ‘Fountain Bamboo’ at Kew in what I am sure is the same location in front of a slanting oak tree, making it the same clump in all likelihood. This was 1999, just before it started to flower.

Typification of the name *Arundinaria nitida* with a type specimen from this clump fixes the name *Arundinaria nitida* (and thus *Fargesia nitida*) to the Fountain Bamboo, as its author originally intended, which ensures that *Yushania* is used rather than *Sinarundinaria*, which we hope is finally confirmed as a synonym of *Fargesia,* 29 years after Chao, Clayton & Renvoize started to apply it widely in the wrong context because of poor typification.

collection in 1895 - neotype

collection in 1999 - epitype

Here is a collection made in 1895, most likely to have come from the actual clump photographed for Gardeners' Chronicle.
And a collection of its flowers 105 years later.
Naming of the species properly published, sorted out and typified by 2015, 129 years after seed collection and introduction to horticulture in 1886.

The reason for this particular exercise in typification was principally stabilisation of generic names. Typification is also required for very many species names where the application of the name is in doubt. Note here we are adding flowers to a vegetative type. This is more frequently the other way round – vegetative collections need to be added to flowers collected on their own. This takes us on to species level confusion.

Bamboo species misidentifications

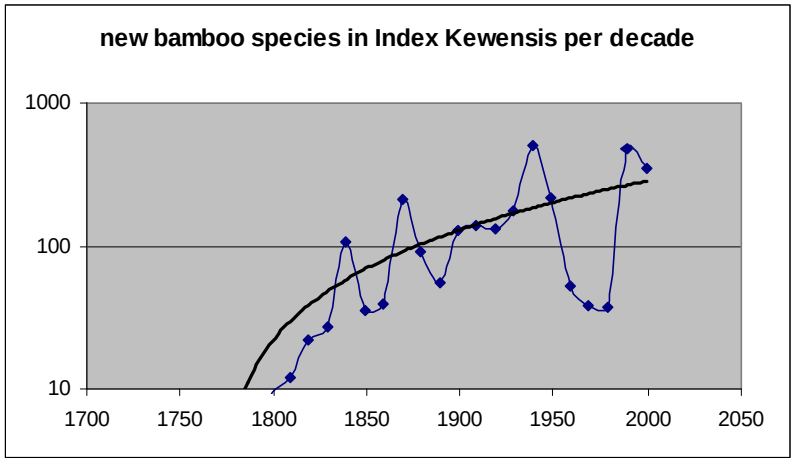
(more causes of confusion, #5-10)

5. bamboo alpha taxonomy started relatively late
6. α taxonomy & revisions largely abandoned while taxonomists chased molecular results
7. collaborative fieldwork was reduced drastically after Convention on Biological Diversity
8. taxonomy curtailed by funding cuts and job losses
9. horticultural introductions accelerated without accompanying fieldwork and taxonomy
10. indiscriminate use of wrong names as marketing tools to diversify product

So much for taxonomic difficulties in bamboo genera. Moving on the species there are yet more causes of confusion.

There are often very simple reasons for more and more muddles, misidentifications & taxonomic problems, but there are underlying problems that need to be addressed.

The program of work for the future should address these issues as well as working on symptomatic treatment. Otherwise there will be an endless stream of problems in the future.



Data from IK that I plotted in 1999 to show that bamboo taxonomy started relatively late and the trend was not showing signs of decline, although the funding at Kew was being stopped. Raw IK data no longer available to me for number crunching since 1999, but subjectively I'm not seeing the new species in great numbers, and that is not because there aren't any to describe, but because taxonomic work is being neglected. I'm just seeing horticultural introductions that cannot be identified instead.

Plenty of new species yet to be discovered. New introductions from remote areas quite probably have not been included in a sound local taxonomic treatment.

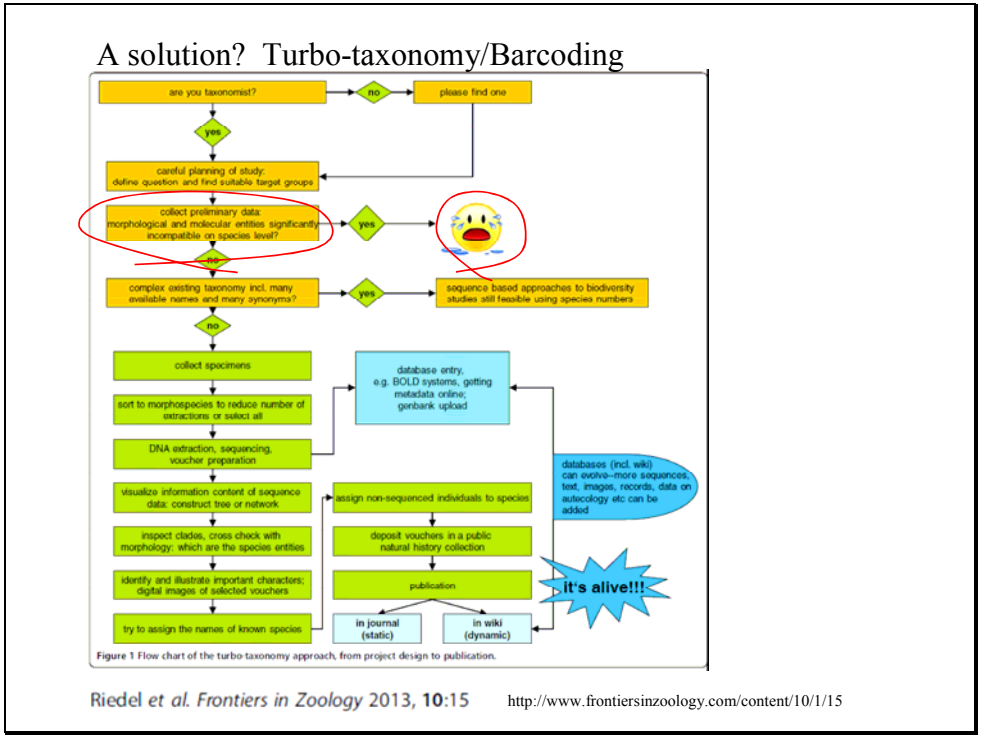
	Collection #	Origin	Locality
1	2304	Vietnam	Fan Si Pan
2	2994	Vietnam	Fan Si Pan
3	3032	Vietnam	Fan Si Pan
4	6321	Tibet	Bago
5	6323	Tibet	Bago
6	3968	Yunnan	ZBS
7	4059	Yunnan	Cang Shan
8	4060	Yunnan	Cang Shan
9	4175	Yunnan	nr Yangtse
10	4206	Yunnan	Yulong Shan
11	4558	Vietnam	Fan Si Pan
12	6356	Tibet	Bago
13	6357	Tibet	Bago
14	6775	Tibet	Bagu
15	6791	Tibet	Bagu
16	6795	Tibet	Bagu
17	5177	Tibet	Gyala
18	5185	Tibet	Gyala
19	3633	Tibet	Gyala to Tripe
20	6715	Tibet	Gyamda Chu
21	6717	Tibet	Gyamda Chu
22	5287	Tibet	Kyikar
23	5870	Nepal	Kathmandu gdn
24	5288	Tibet	Kyikar
25	5786	Tibet	Nyingshi
26	5913	Tibet	Nyingshi
27	5914	Tibet	Nyingshi
28	5917	Tibet	Nyingshi
29	5918	Tibet	Nyingshi
30	6721	Tibet	Nyingshi
31	6900	Tibet	Nyingshi
32	6243	Tibet	Showa La
33	6437	Tibet	Pasum Tso
34	6438	Tibet	Pasum Tso
35	6439	Tibet	Pasum Tso
36	6441	Tibet	Pasum Tso
37	6322	Tibet	Bago
38	6443	Tibet	Pasum Tso
39	5050	Tibet	Pe
40	5051	Tibet	Pe
41	6370	?	?
42	5074	Tibet	Pe
43	3425	Tibet	Pe to Doshong La
44	5600	Tibet	Pome
45	5602	Tibet	Pome
46	5756	Tibet	Pome
47	5950	Tibet	Rong Chu
48	5952	Tibet	Rong Chu
49	5980	Tibet	Rong Chu
50	6745	Tibet	Rong Chu
51	6890	Tibet	Rong Chu
52	6209	Tibet	Showa La
53	6270	Tibet	Showa La
54	6271	Tibet	Showa La
55	6317	Tibet	Tongkyuk
56	6916	Tibet	
57	6937	Nepal	Shivapuri
58	6938	Nepal	Shivapuri
59	6939	Nepal	Shivapuri
60	6980	Tibet	
61	7346	Vietnam	Fan Si Pan
62	7430	Vietnam	Sapa
63	7592	Yunnan	Tian Tang
64	7613	Yunnan	ZBS
65	7614	Yunnan	
66	7615	Yunnan	ZBS
67	7662	Yunnan	ZBS
68	7698	Yunnan	near ZBS
69	7701	Yunnan	Cang Shan
70	7966	Vietnam	Tam Dao
71	Ness s.n	Tibet	
72	8118		
73	8309		
74	8335		
75	8623	Arunachal Pradesh	Nagagigi 3200m

Bamboos keep arriving into cultivation, and are rarely easy to identify.

Here is a list of 75 recent bamboo collections known to be in cultivation in Europe, all collected by just one very active private plant collector since 1992. Many of these 75 collections involved several different plants, more for seedlings.

These all need documentation and taxonomic consideration. Fieldwork is necessary to look at variation in the wild and to compare these to published bamboo species in their type localities, all undertaken collaboratively with local taxonomists to give legitimacy to horticultural introduction in accordance with the CBD.

The loss of funding for institutional collaborative botany associated with horticultural collections has created a vacuum. Collaborative fieldwork on bamboos has largely stopped. Local taxonomic investigations have not filled the gap. Bamboos are still being transferred from the wild. Someone will go out and collect them, whether a national for sale on the internet, or a foreign enthusiast , but they now cannot be identified. Meanwhile habitats and species are being lost.



The future? – barcoding is not an option for bamboos, only a stop-gap measure, just avoiding the issue and kicking the ball down the road.
We should focus on the real problems and address them head-on instead of following this red herring.

Similarly conserving seed for future studies and reintroductions is not an option for bamboo, as the seed, while orthodox, cannot be stored for more than a few years even under ideal seed bank conditions. All rhetoric on effectiveness of that conservation initiative is hollow when applied to bamboos.

There are no shortcuts to good taxonomy

#	Cause of confusion	Solutions
1	Poor separation of taxonomic groups	Continue morphological studies.
2	Different opinions on importance of characters	**Integrative taxonomy**. Work towards consensus. Standardise names for cultivated plants. Europe as well as US please.
3	Use of nothogenus names	Avoid nothogenus names altogether.
4	Poor typification	Improve typification.
5	Bamboo alpha taxonomy started relatively late	Prioritise bamboos above better-known groups of plants.
6	Less α taxonomy & revisions than molecular study	Redress balance through change in incentives & yardsticks, promotion should not require molecular publications.
7	Collaborative fieldwork reduced after CBD	Streamline procedures. **Network & collaborate, outside the usual institutions if necessary**.
8	Taxonomy curtailed by funding cuts and job losses	Retarget botanical & especially new conservation resources towards taxonomy.
9	Horticultural introductions without taxonomy	Re-establish collaborative fieldwork. Enforce quarantine. **Document and study introductions. Share information.**
10	Indiscriminate use of wrong names as marketing tools	Provide better identification information to make this ineffective – e.g. my website! **www.bamboo-identification.co.uk**

To summarise these are the main causes of muddles and misidentifications in bamboos, and these are the solutions.

More botanical funding needs to be targeted back on old-fashioned 'boring' taxonomy. Neglected groups such as bamboo should be prioritised. Less red tape is required for fieldwork, along with more collaboration, especially outside conventional institution to institution teams, as expertise and personnel in taxonomic institutions are simply lacking. Novel ways of channelling resources to suitable investigators are required in order to tackle these problems.