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By: Stefan Anitei, Science Editor

Bamboo plantation
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The Amazing Bamboo

A miracle material

In the world of the building materials, bamboo could compete successfully against steel, concrete, wood and glass. Because of its exceptional mechanical qualities, low price and design, bamboo could turn into one of the preferred building materials of the future. Even if it looks like a tree, the bamboo is just a woody perennial evergreen grass, related to cereals like wheat, corn or rice. For more than 2,000 years, the bamboo has been used for building suspended bridges, houses, scaffolds, but also for making home products, furniture, pirogues, and musical instruments. The Chinese employed it in making a wide range of tools, from surgical needles (pieces with widths of tenths of millimeters, used for sewing nerves) to pipe lines, even during the 4th century BC. They used bamboo pipe lines to transport the brine from the salt mines of Tsu-Liu-Ching (Sichuan province). Some bamboo construction resisted over the millennia. The suspended bamboo bridge at An-Lan (over the Min River), built during the 3rd century AD (!), 320 m (1,066 ft) long, still stands (but it requires two maintenance sessions annually). The bridge is sustained by 15 bamboo cables, each having 5 cm (2 in) in diameter, whose resistance is four times higher than that of hemp ropes. In 1905, China still had drilling stations made entirely of bamboo. They were 75 m (250 ft) tall and worked from 220 AD (!). Tabashir, a siliceous resin secreted by some bamboo species, was used as chemical catalytic agent. In southeastern Asia, tabashir was used against asthma, coughing and even as an aphrodisiac. From heated bamboo, people extracted a wax used for lighting. The first light bulb made in 1880 by Thomas Edison used a fiber of calcined bamboo as filament. The Chinese also made a type of universal measurement standard based on bamboo. A bamboo rod was used as the length standard and when the distance between two knots made it possible, a bamboo rod was used as pipe. The hundredth part of this length was considered the size of a seed or grain, and the volume of the cylinder comprising 1,200 seeds was the standard for capacity. The weight of the 1,200 seeds gave the standard for weight. The Japanese build spectacular bamboo kites. The largest were those of the Shikoku Island: they could be 24 m (80 ft) in diameter and weighed up to 4 tons, requiring the effort of 200 persons who had to hold the 1 km (3,300 ft) long cable. The last kite of this size was built in 1914. Modern kites are up to 19 m (63 ft) wide, 13 m (43 ft) tall and weigh 80 kg (200 pounds), being raised in groups of two during a May festival. **Records and qualities of the bamboo**The bamboo is the plant with the fastest growth rhythm: 2-3 cm per hour. The record is detained by a Japanese species: 1.2 m (4 ft) in 24 hours. In 5-6 weeks, a bamboo reaches the adult height of 18-20 m (60-66 ft). For short periods, the bamboo can reach maximal growth speeds of 40 inches (1 m) per hour. The largest bamboos grow in Brazil: up to 40 m (133 ft) tall, with a diameter of 33 cm (1.1 ft). If for cutting a timber tree you have to wait 20 to 70 years (respecting its natural cycles), the bamboo can be harvested in 3-5 years, when its stem is strong enough. Thus, the efficiency of a bamboo plantation is much higher than that of a forest. Another advantage of the bamboo: if you pull out a stem, another one grows instead. The bamboo has an underground net of rhizomes and roots that naturally generates other aerial stems at a distance of 6 m (20 ft) from the central stem. On a hectare of bamboo plantation, there may be 187 rhizomes, whose fertility maintains for a decade. The bamboo rhizomes are very effective against soil erosion, land slides and even earthquakes, stretching the soil in a very dense knit. Like in the case of wood, the bamboo stem cells have a cell wall made of very dense layers of cellulose, embedded in a matrix of lignin (from "lignus", wood in Latin) which confer an extraordinary resistance to bamboo stems. French researchers checked traction, flexion and compressing resistance of the bamboo, finding it to be 2.5 times higher

than that of the oak wood. Bamboo production costs 8 times less than that of the steel and, during earthquakes, the concrete cracks easier than the bamboo. Still, this material is rather used artisanally in southeastern Asia, Africa and Latin America. The 91 genera and about 1,000 species of bamboo are associated with tropical climate, because they miss from Europe and most of North America. But in the mountains of China, Korea and Japan, they can stand -24o C. Bamboo can be found up to 5,000 m (16,660 ft) in altitude and, in East Asia, up to 50°N latitude. In Argentina and Chile, they are found at 47°S latitude.

[img=2]The main bamboo producer countries are India, Pakistan, Bangladesh, Thailand, Malaysia, Indonesia, China, Philippines, Sri Lanka, Tanzania, Kenya, Costa Rica and Brazil. The annual bamboo production is estimated to 10 million tons. A weak point of the bamboo is its blossoming. The bamboo flowers just once in its lifespan and the effect is the exhaustion of the roots and the rhizomes. Even if some bamboos flower annually, most species flower infrequently, at intervals of 10, 30, 60 or 120 years. This is called mast flowering (gregarious flowering), with all bamboos in an area flowering at the same time. After flowering, bamboos die in mass, and this compels the cultivators to renew the plantations soon after the flowering periods. Another undesired trait of the bamboo is its variable height and diameter, varying from one stem to another, depending on the soil quality, climate and species. Assembling the pieces, too, is complicated. Traditionally, the stems are joined with complicated knots like those used by the sailors. Industrial solutions like glues, nails and bolts are investigated. The French Michel Abadie built Flyboo, a bamboo airplane, 6 m (20 ft) long and 8 m (26 ft) wide. Only the joining elements, engine and landing gear were made of another material. The flying machine can reach 50-120 km (30-75 mi) per hour and develops 49.6 H.P. **Bamboo, rats and panda** The mass fruiting of the bamboo comes with many unexpected consequences. The enormous amount of available seeds induces a boom in rat populations. As the rats turn increasingly numerous, they start attacking crops, causing famine in local human populations. This happened in 1954-1955 with the *Melocanna bambusoides* population from northeastern India, which has a mass flowering period of 30-35 years. The rats can also spread deadly diseases like typhus, typhoid, and bubonic plague. 5.99 % of the panda bear's diet is made of bamboo. An individual ingests 38 kg (90 pounds) of bamboo (shoots, stems and leaves) daily (an activity that takes around 14 hours) and eating bamboo requires some adaptations. Pandas have wide molars and premolars (grinder teeth) and highly developed zygomatic arches (bones where chewing muscles are inserted) correlated to highly developed chewing muscles, adaptations for grinding tough bamboo stuff. They have a sixth "thumb", a bony projection of the fore paw which enables them to grip bamboo stems while eating. The esophagus is folded by a keratin layer so that it is not scratched by bamboo shafts. As it is so dependent on bamboo, the invasions of the bamboo Chinese rat (*Rhizomys sinensis*) - a large subterranean rodent (40 cm (1.3 ft) long and 1 kg (2.2 pounds) heavy) - represent a huge challenge for the panda.