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K. M. Wong*: **Current and Potential Uses of Bamboo
in Peninsular Malaysia**

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Abstract

In Peninsular Malaysia, the industrial utilization of bamboo is less than in countries with more established industries. Although bamboo has long been an integral part of traditional and rural Malaysian life, it is now little used in rural house construction, for which more durable materials such as wood are preferred. The present industries are mainly at the cottage level, manufacturing incense sticks, vegetable baskets and poultry cages; several concerns manufacture broomsticks, meat skewers and blinds. These, however, are low priced, disposable utility items that chiefly cater to the domestic market. Recent developments include expansion of the already viable export oriented handicraft industry and greater innovation in product development and processing methodology. The disappearing art of using bamboo to plait elaborate motifs into panels has great promise when used in the construction of art craft furniture and indoor fittings. At the same time, there is the possibility of using bamboo to make furniture frames; this has not been fully explored probably because other materials such as wood and rattan are readily available. The present bamboo resource exists almost entirely as unmanaged wild populations. Although apparently adequate for existing utilization, efforts should be made to increase the supply of raw material to match a more intensive and systematic exploitation. The management of existing bamboo areas, improvements in harvesting and the cultivation of marginal land near cottage industries are considered. These represent, in Malaysia, new areas of endeavor for which preliminary trials are essential.

Introduction

In Peninsular Malaysia, the minor forest products – items obtained from the forest other than timber – are varied, but not all are important commercially. Some, like gutta-percha (a gum derived from the latex of nyatoh trees like Taban merah, *Palaquium gutta*, (Hk.f.) Baillon extensively used for the coating of submarine cables in the early part of this century), have declined in importance until no longer significant. Minor forest products include items like animal skins, beeswax and honey, but only the plant products, such as rattan and bamboo, are of commercial importance. In economic terms, minor forest products differ from timber in the much smaller total (bulk and monetary) yield per unit area, and usually also in their higher monetary value per unit weight. Often a comparatively minimal investment is required to organize the harvesting of minor forest products.

Bamboo is second only to rattan in commercial importance as a minor forest product in Malaysia. It has long been associated with the traditional lifestyle in Malaysia, although it has never been as commercially important as in other countries, such as Japan, Taiwan and the Philippines where industries based on bamboo are more established. Much regarded as a weed in Malaysian forestry until the 1970's (Watson & Wyatt-Smith 1961,

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Chin 1977), it was only later that the possible use of bamboo as a raw material resource was given serious thought. Current attention is focussed on how a small, tradition-rich Southeast Asian country such as Malaysia can best exploit its bamboo resources, how mechanical innovation can improve on the economics, scale and quality of utilization, and how value-added products can be competitively manufactured.

The intention of this paper is to explore current trends and imaginative ways of exploiting this resource in Peninsular Malaysia. Four major areas are considered:

1. The availability of bamboo resources.
2. The quality and extent of both traditional and contemporary uses of bamboo.
3. The limitations of bamboo as a raw material compared to other natural materials and synthetics.
4. The appeal of bamboo as a natural material suitable for many uses.

In short, the best use of bamboo depends on its *availability* and its *adaptability* to different end-uses and manufacturing techniques.

Bamboo Resources in Peninsular Malaysia

The extent of bamboo in Peninsular Malaysia is difficult to measure because it does not grow over large contiguous areas. Instead, bamboo is found in patches of varied habitats such as the foothills of the peninsula's Main Range, forest fringes and parts of river courses, and in disturbed areas such as logged-over forests. Local pure stands of bamboo sometimes occur in the northwestern states of Perlis and Kedah, where patches of secondary forest dominated by a mixture of bamboo (mainly *Gigantochloa ligulata* Gamble and the tree *Schima wallichii* (DC.) Korth. are thought to have been encouraged by woodcutting, intermittent cultivation and fires that occur frequently during the annual dry season (Symington 1943). These stands are not contiguous, however, and their extent is extremely difficult to measure. Furthermore, the density of bamboo growth can vary from place to place, according to the site conditions, the extent of disturbance and the species. Even air photos can only discern large disturbed areas where the bamboo grows densely. Past attempts at estimating bamboo resources have, therefore, been largely descriptive; McGrath (1970) merely estimated the acreage in each state where bamboo occurs significantly. Even then, the 50,000 acres (20,250 hectares) that he estimated includes different densities of bamboo growth ("dense, sporadic, widely scattered") as well as species with different characteristics. It is important not to accept the figures given by McGrath (1970) as representative of homogeneous density and generally useful species, as has been done in various reports.

Under such circumstances, estimations of so-called "total" resources is limited in value. It is more applicable to survey the species that are known to be useful or potentially exploitable, and obtain an idea of where these occur in substantial abundance. In considering the feasibility of setting up various bamboo-based industries, such factors as accessibility and productivity should also be considered. McGrath (1970) concluded that there is not enough wild bamboo in Peninsular Malaysia to supply a pulp mill of minimum economic size (running at 150 tons per day). However, bamboo is naturally abundant enough to support several thriving cottage and production-line industries (Wong 1982).

There are 50 species of bamboo known in Peninsular Malaysia, of which 25 are indigenous; the remaining are known only in cultivation. Of the wild species, *Gigantochloa scortechinii* Gamble is the most widespread and useful; it occurs in the foothills of the peninsula's mountain ranges and often spreads into disturbed lowland areas. *G. scortechinii*

is especially common at Ulu Langat, Kanching and Ulu Gombak (Selangor state), the Slim and Grik areas (Perak), the Bentong-Raub and Bukit Tinggi areas (Pahang), and the Nami, Pedu and Baling areas (Kedah). Other indigenous species that are much exploited and abundant include *G. ligulata*, which is common in the northern parts of the peninsula where there is a distinct dry season during the early part of the year, and *G. wrayi* Gamble, which is common in the northern half of the peninsula and generally used in the same way as *G. scortechinii* and *Schizostachyum zollingeri* Steud. Table 1 summarizes the utilization of culms of Peninsular Malaysian bamboos.

The bulk of bamboo extracted from natural areas, as indicated by the royalty collected by the Forestry Department (Table 2), comes from the states of Kedah and Perak. Ground checks of the collection areas and cottage industries based in these states indicated that the bamboos are *Gigantochloa* spp., mainly *G. scortechinii* (Figure 1), and in part *G. wrayi*.



Figure 1. Culms of *Gigantochloa scortechinii*, harvested from the Baling area in Kedah state, being loaded onto a lorry for transport to the utilization centres.

At present, no bamboo plantations exist in Malaysia to supply any kind of mechanized industry. At most, market gardeners maintain small areas planted with bamboos (*G. levis* (Blanco) Merr. and *Dendrocalamus asper* (Schult.) Backer ex Heyne) that yield shoots sold in markets. In order to place the supply of bamboo on a more organized and productive basis, effort must now be harnessed towards looking into the following possible areas:

1. Management in the main harvesting areas. Given a free hand, collectors, who have no stake in the areas being worked and who cannot be constantly overseered in the field under the present system, may over-harvest stems leaving insufficient material for continued sustenance of the bamboo clumps, thus damaging future performance and yields. Once the optimal harvesting and regeneration rates are worked out, it may be feasible to centralize harvesting, possibly by contractors who work localities

- on a rotation basis.
2. Improved bamboo output. Natural areas that contain mixed species may be enriched by replacing unwanted clumps with desired species. These areas can also be silviculturally managed for increased production.
 3. Cultivation on a plantation scale. There is strong competition for the lowland from more established crops such as an oil-palm and rubber. Also, the harvesting of any crop on difficult terrain away from lowlands may be economically unattractive. Thus, one should consider establishing bamboo plantations only on marginal land in small plots near cottage industries, which are mainly in rural areas. Bamboos should not be planted on extremely impoverished soils such as tin tailings because this would require a high input of nutrients for satisfactory production.

Current Uses of Bamboo

In rural life, bamboo is acknowledged as one of the most useful of natural materials. As in many Southeast and East Asian countries, bamboo, by virtue of its availability and versatility, is associated with the traditional and rural lifestyles in Malaysia. It is used as a supplementary material in house construction, in the making of numerous home utility items, rafts, bridges, water pipes, musical instruments, kites, blow-pipes, traps and a myriad of other items. Bamboo is also associated with traditional culinary practices, whether as cooking implements or as a delicacy itself, and with ornamental horticulture.

There is presently emphasis to organize the economic exploitation of bamboo. Several cottage industries in Peninsular Malaysia are well established and worthy of note. They mostly make use of *Gigantochloa scortechinii* and *Schizostachyum zollingeri* and are consequently centered in areas where these species are abundant. *Dendrocalamus pendulus* Ridl. and *Schizostachyum grande* Ridl., which are also abundant, are rarely used in these industries, though the reason is not clear. Perhaps it is because they are usually found in hilly terrain where harvesting is difficult; they seldom invade lowland areas like *G. scortechinii* does. Collectors may avoid them because they believe them to be inferior, or it may be that they are just more familiar with *G. scortechinii*.

The industries using mainly *G. scortechinii*, supplemented by *G. wrayi*, manufacture poultry cages at Guar Chempedak in Kedah state (Figure 2), vegetable baskets at Tapah and Telok Intan in Perak state, and incense sticks used in Chinese religious rites at the Ulu Langat district in Selangor state. The culms are either brought as whole lengths trimmed to fit into trucks that transport them to these areas, or are hand sawed to shorter working lengths at the harvesting sites before being transported in smaller trucks, pickups and motor scooters. In making poultry cages and vegetable baskets, the culms are cut, split and further sliced into thin strips using light, movable, electrical machines. Prior to slicing, the nodal diaphragms are manually knocked out of the split lengths. Strips are plaited manually. Each center has from 10 to 20 households engaged in the industry, each using 5 to 10 people who are often members of the same family (Wong & Abdul Rauf 1981; Wong 1982). The manufacture of incense sticks is centered in the Ulu Langat district (Burton 1979) where it is the predominant occupation in several villages, again with individual households as the operating units. The green skin of cut culms, either quartered or still in the round, is manually shaved off with a knife before the remaining part is split into sticks of about 1.5 mm diameter. After drying in the sun, the sticks are smoothed by manually passing them through a comblike series of knives and passing them over a small fire to remove surface fibers. The sticks are then bundled and sent to other factories where they are coated with

fine sawdust mixed with a fragrance and an adhesive. The latter factories are mostly in the greater Kuala Lumpur area but are also found in the states of Penang and Johore. Although some are exported, most incense sticks are kept for domestic use. Imported incense sticks have decreased from M\$260,000 in 1971 to M\$181,000 in 1974 to M\$146,000 in 1978 (Malaysian Industrial Development Authority 1980).



Figure 2. Poultry cages ready for distribution at Guar Chempedak in Kedah state.

Poultry cages and vegetable baskets are manufactured for domestic use. The poultry cages (Figure 2) are mainly supplied to poultry farms in the states of Perak and Penang for shipping fowl to market throughout the country. Most vegetable baskets are made in the towns of Tapah and Telok Anson. They are used in the main vegetable producing area in the Cameron Highlands nearby for shipping produce to the lowland towns (Figure 3).

In the Mata Air district of Perlis, culms of *Schizostachyum zollingeri* harvested from wild populations are used for plaiting baskets used in the northern states for holding vegetables and fish. The species is used in the northern states of Perlis and Kedah because it is abundant there in its large diameter form. This form dies out towards the south where the species has only smaller diameter culms (Wong 1981).

The local handicraft industry, best developed in the states of Kelantan, Kedah and Perak, uses *G. scortechinii* culms from the forest as well as *G. wrayi* cultivated in villages. The wide range of bamboo handicrafts includes place mats, vases, mugs, dish covers, trays, baskets, kites and wall motifs (Figure 4). These are sold locally as well as abroad. The Malaysian Handicraft Corporation plays an active role introducing new products, market testing, providing assistance in marketing and introducing light processing machinery for material preparation in an industry that had been wholly manual.



Figure 3. A lorry fully laden with vegetable produce packed in bamboo baskets, about to make the journey from the vegetable producing area in the Cameron Highlands to towns in the lowlands.

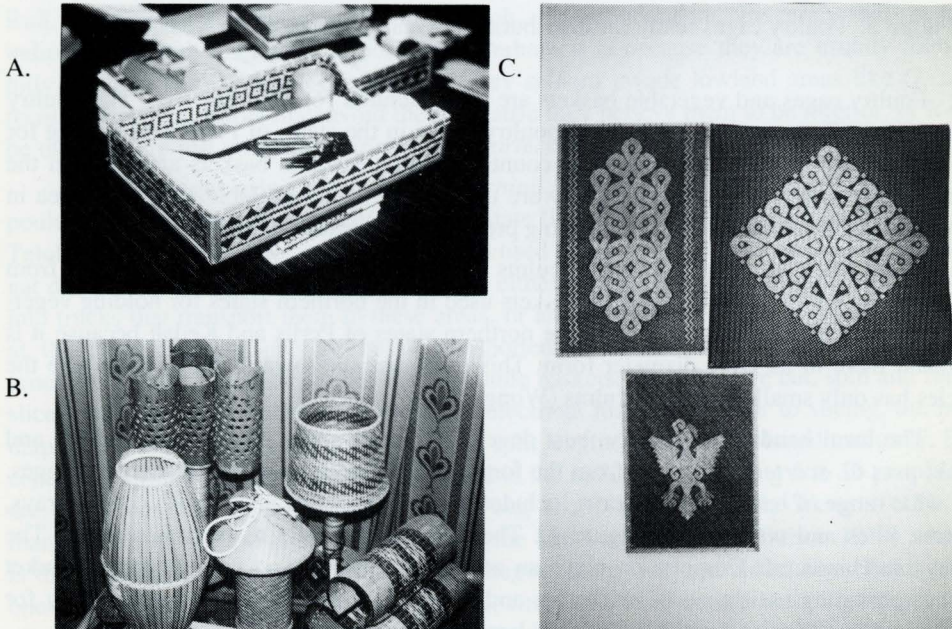


Figure 4. A , Ornamental desk tray. B , Lampshades crafted from bamboo. C , Wall motifs plaited with bamboo, incorporating indigenous designs from the East Malaysian state of Sarawak.

Several makers of poultry cages and vegetable baskets also produce broomsticks and meat skewers using simple splitting and sizing machines. At Naka in Kedah, there is a factory manufacturing bamboo blinds on a limited scale with the use of electrically operated looms that thread thin strips of bamboo together. Other uses, which cannot be properly categorized as industry, include the collection of slender, thick walled culms of *G. ligulata* in Perlis and Kedah for use as poles for drying rubber sheets.

The young shoots of *G. levis* and *Dendrocalamus asper* are relished as a delicacy. They are usually sold in small quantities obtained from cultivated village clumps. I know of only one instance, at Kepong in Selangor state, where there was a bamboo shoot farm of about one hectare cultivated solely with *G. levis*, but the farm is no longer in production. Bamboo shoots cannot form the sole raw material for a profitable canning or dried food industry because the required scale would involve cultivation on very large farms. Moreover, because shoot production is seasonal, shoot collection from natural stands is likely to be inefficient and unpredictable (Wong 1984).

Limitations and Potential of Bamboo as a Raw Material: the Malaysian Context

The appropriate end uses for bamboo need to be properly considered in any plan to increase its exploitation. Bamboo generally has a low natural durability, and it is highly susceptible to attack by wood boring beetles when untreated. It is therefore not favored in situations where more durable materials such as timber and metal are available. Unsplit, it has relatively low flexibility, and the physical attributes such as taper and variation in wall thickness present difficulties in standardization of the material.

Hence, where the aesthetic qualities of the products are not important, such as poultry cages destined for the market and utility trays, plastics are now extensively used instead of bamboo or rattan. Plastic poultry cages cost more but last longer and can be stacked higher during transport because of their strength. By comparison, bamboo cages are cheaper but can be used only once or twice and cannot be stacked as high because they are compressible. In local construction scaffolding, mangrove poles have always been preferred to bamboo poles as they last longer, but the trend is now moving towards the use of metal scaffolding that can be reused many times and can be easily assembled from modular units. Even where aesthetics count, other considerations may render bamboo unacceptable as a raw material. In furniture making, the use of jigs for shaping frames is highly limited with the use of unsplit bamboo, making standardization of parts and quality control in mass production difficult. Moreover, in many cases, simple nailing may cause the material to split.

Other than the numerous *ad hoc* uses associated with the traditional lifestyles of the people, bamboo is now relatively little used in housing construction. In some rural areas, especially in the north, the very strong and straight culms of *Bambusa blumeana* Schult. are sometimes used as beams and supports in houses traditionally built on stilts, and whole walls are sometimes plaited from bamboo strips taken mainly from *Schizostachyum zollingeri* and *Gigantochloa scortechinii*. It may be quaint to live in a house with walls plaited from bamboo, but most people now prefer a more rigid wall when the storms arrive. Even when walls are plaited from bamboo, such house owners normally prefer to use strong timber for the house frame, replacing the wall panels when necessary. Thus, although the rural population in Malaysia may have a lower average income, many strive to build their houses from wood, which is recognized as being stronger and more durable than bamboo.

However, this is not to say that bamboo is an inferior material. Because it is plentiful, it is a cheap raw material, and items made from it can be replaced often at comparatively low cost. It lasts longer with some basic preservative treatment and proper finishing. Small bamboo items, such as handicrafts, lend themselves better to standardization and quality control in mass production. Items such as mugs, vases, hats, baskets, flutes and plaited ornaments can be manufactured with some degree of mechanization in the preliminary stages, especially splitting, sanding and simple weaving.

Not everything should be made by heavily mechanized mass production. Handicrafts from the Far East are popular abroad, and individual local entrepreneurs have good sales responses from overseas (Sulaiman Othman, Pers. comm. 1981) although no figures are available for the export of Malaysian bamboo craft items. Handicrafts are valued as art objects and souvenirs of the traditional skills of a country; they have special appeal when made from indigenous, natural materials. The cottage industries that produce bamboo handicrafts are therefore viable enterprises even in the modern world of mass production. Furthermore, the introduction of more sophisticated craft techniques, such as bamboo lamination, can broaden the product range. Improvements can also be made by adopting the techniques and methods used in countries such as Japan and Taiwan, where the handicraft industry is well developed.

Even though bamboo may not be preferred as the sole material for making furniture, it is certainly suitable when combined with wood, rattan or other natural materials that are aesthetically and functionally compatible. Besides sophisticated hand crafted furniture, bamboo could be used in other types of furniture. The slender, thick walled culms like those of the indigenous *Gigantochloa ligulata* or the exotic *Thyrsostachys siamensis* Gamble can be used for back frames of chairs and in framing tables and screens. Such uses have probably not been implemented because both wood and rattan have been readily available to the furniture industry for these purposes. The fear that bamboo is highly susceptible to the powder-post beetle (mainly *Dinoderus* spp.) may be unfounded since material like rubberwood, which is naturally susceptible to both bluestain fungi and powder-post beetles (Tho, pers. comm. 1985), is becoming popular as furniture material. In such cases, durability can be much improved by proper drying and finishing, rather than being just a function of preservative chemical treatment. Some bamboo species may be naturally more resistant than others to beetle attack and decay. In Mata Air Village in the state of Perlis, I saw an old house raised on stilts made from *Bambusa blumeana* culms which remained in good condition after more than 10 years without any preservative treatment.

An exciting potential use of bamboo for indoor fittings arises from the art of plaiting bamboo strips into entire walls of houses, a highly skilled practice used in several villages in the northern state of Perlis (Wong 1982). The simple cross-plaiting of bamboo strips in wall panels in the huts of poorer people in villages throughout Peninsular Malaysia (Figure 5) does not require the highly skilled techniques used for plaiting the ornate and elaborate motifs on wall panels of some houses in Perlis (Figure 6). The art was more widespread during the early part of the century (Noone 1948) but is fast disappearing as rural people begin to rely more on planks and nails, which require less effort in building a wall. At the villages of Ngulang and Mata Air in Perlis, where this art still exists, the few elderly artisans whom I interviewed in 1981 and 1985 lamented over the general lack of interest among young people in traditional skills. According to them, most rural youths prefer to look for urban employment, leaving behind the many fine skills associated with the traditional lifestyle.

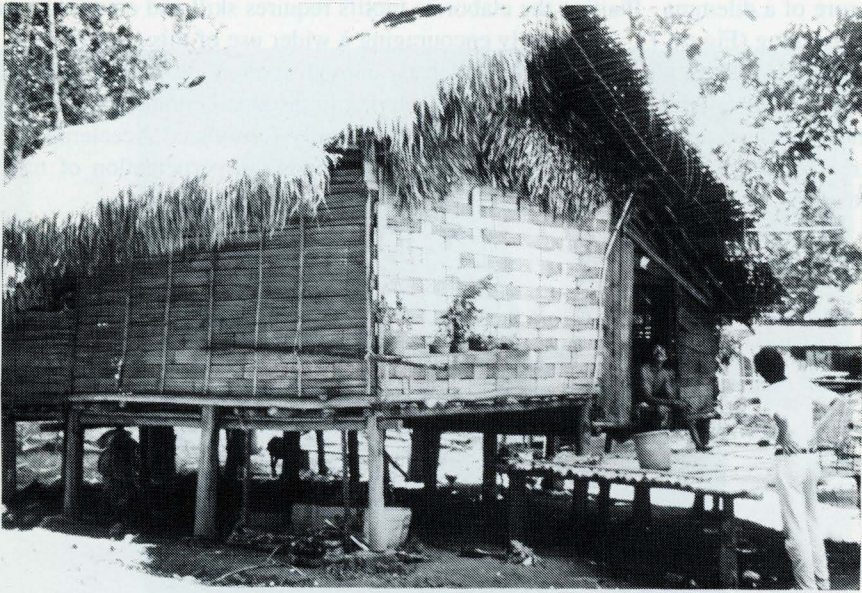


Figure 5. Simply plaited bamboo walls are part of the houses of poorer people in some villages. In this case, the culms used are those of *Gigantochloa scortechinii*.

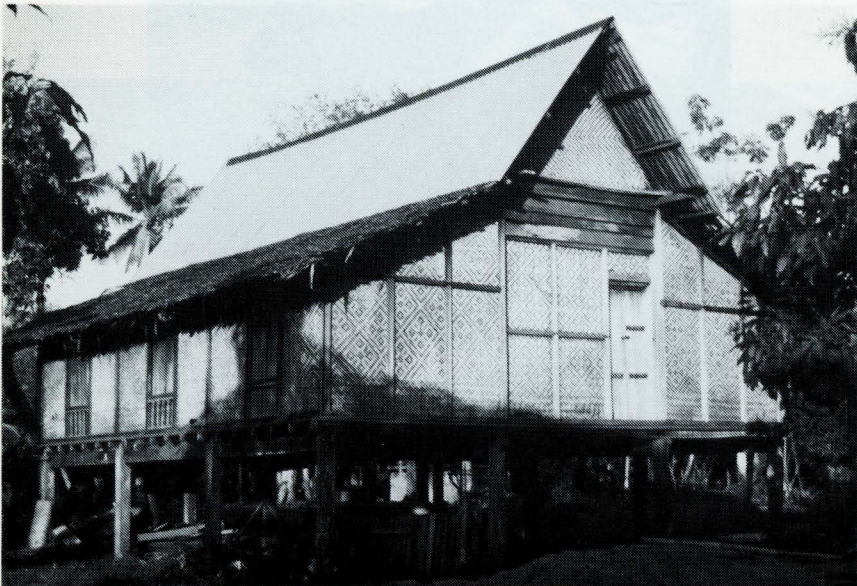


Figure 6. A traditional house in Perlis state, with walls made from bamboo strips plaited into ornamental motifs. The bamboo used is *Schizostachyum zollingeri*.

With the knowledge that an art form can barely exist when it is not popular, we arrive at the core of a dilemma. Plaiting the elaborate motifs requires skill and creativity, and it is time consuming (Figure 7). Yet merely encouraging a wider use of this craft in rural house building (Figure 8) is not a practical and strong enough motivation for keeping the skill alive. We might say that this tradition is barely living in the small community of craftspeople who still construct such panels. The nation's recently formulated Accelerated Village Industry Development program, part of which encourages the perpetuation of traditional crafts through its many rural skill training centers, also helps.



Figure 7. An elderly artisan masterfully incorporates yet another bamboo strip into the plaited panel that is made only with painstaking skill.



Figure 8A. An entire house-wall constructed from elaborately plaited bamboo panels.



Figure 8B. Even the eaves of some village houses in Perlis state are panelled with this form of highly ornate bamboo plaiting.

The popular appeal of plaited panels (Figure 9) is evident from their use on walls and ceilings in several prestigious hotels in the city of Kuala Lumpur. Even here, the potential of this art form is not exploited to the fullest. In addition to wall panelling, the plaiting can be used to make light screens and movable indoor partitions. The elaborately plaited motifs are enhanced in aesthetic quality when inlaid into tabletops and encased in glass. Such innovations, suitably framed and provided with proper and attractive finishing, represent art craft furniture and indoor fittings infused with an indigenous Malaysian and Far Eastern flavor. At the present average price of M\$10 to M\$15 per square foot, the panels may not be affordable to most people; still, the commercial success of such items will have to consider that art craft furniture and fittings are often exclusive and command their own market.

In the meantime, there is much to be done in the experimentation with construction, design and finishing. More importantly, the skill of plaiting the many available motifs with bamboo must be even more extensively disseminated among craftspeople whose attention should be directed toward the new potentials of traditional skills. The ornamental wall panels of Perlis are made from *Schizostachyum zollingeri*. Substantial natural stands of this species were discovered in Perlis and Kedah only as recently as 1981 (Wong 1981). The suitability of other bamboo species for plaiting panels and screens should also be investigated.

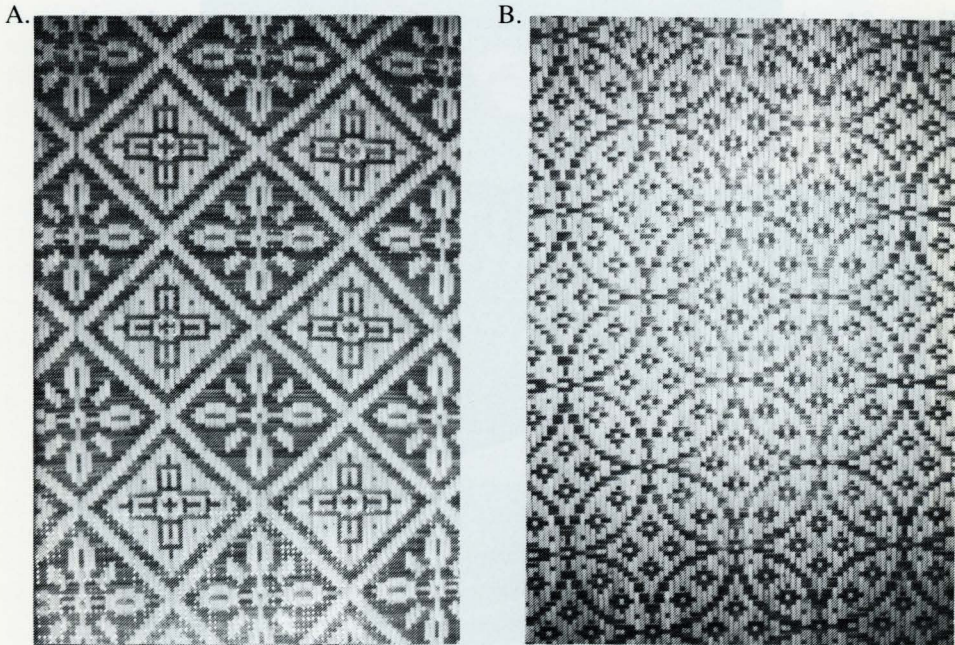


Figure 9. A & B, Two different motifs plaited from bamboo strips taken from *Schizostachyum zollingeri*, a species abundant in the northern states of Perlis and Kedah.

Table 1. The Uses of Peninsular Malaysian Bamboos.

| Type of Use | Culm Diameter | | |
|---|---|---|---|
| | Large 5-10 cm or more | Medium 2.5-5 cm | Small 1-3 cm |
| A. Indigenous Species | | | |
| Commercial | *G. scortechinii *G. wrayi *S. zollingeri | *G. ligulata (typical form) | |
| Ad hoc | D. pendulus *G. ligulata (large form) | G. latifolia | B. wrayi |
| Unused though available or even abundant in some areas | B. "burmanica" D. hirtellus S. grande | | D. dumosus D. elegans S. gracile S. latifolium |
| Unused because rare or unknown | D. sinuatus G. holttumiana | | B. klossii B. magica B. montana B. ridleyi Dn. scandens R. setifera S. aciculare S. insulare S. terminale |
| B. Cultivated Species | | | |
| Commercial | | *B. heterostachya | |
| Ad hoc | *B. blumeana B. vulgaris *D. asper *G. levis *G. "maxima" *S. brachycladum | | B. aff. textilis S. jaculans |
| Ornamentals or scientific specimens | *B. arundinacea *D. giganteus *G. ridleyi | D. strictus *G. apus G. "hasskarliana" *T. siamensis | B. glaucescens B. ventricosa G. rostrata S. iraten |

* Species worth consideration for greater exploitation.

B. = Bambusa, D. = Dendrocalamus, Dn. = Dinochloa, G. = Gigantochloa,
R. = Racemobambos, S. = Schizostachyum, T. = Thyrsostachys

Table 2. Revenue in units of one thousand Malaysian dollars collected by the Forestry Department from bamboo taxation royalty in 1981-1982 compared with the royalty from rattan and other minor forest products, as an indication of bamboo output from the various states in Peninsular Malaysia.

| State | Bamboo | | Rattan | | Others | | Total | |
|-----------------|--------|-------|--------|-------|--------|-------|--------|-------|
| | 1981 | 1982 | 1982 | 1982 | 1981 | 1982 | 1981 | 1982 |
| Kedah | 50.6 | 37.5 | 29.2 | 12.8 | 56.5 | 23.9 | 136.4 | 74.2 |
| Perlis | 2.5 | 1.6 | 0.3 | 0.9 | 233.6 | 284.7 | 236.4 | 287.2 |
| Kelantan | 0.2 | 0.3 | 15.0 | 3.6 | 1.3 | 0.3 | 16.5 | 4.2 |
| Perak | 35.0 | 42.3 | 42.6 | 48.6 | 882.9 | 42.4 | 960.4 | 133.3 |
| Pulau Pinang | — | — | — | — | 1.2 | 5.2 | 1.2 | 5.2 |
| Trengganu | 0.3 | 0.1 | 5.4 | 5.1 | 53.9 | 16.4 | 59.7 | 21.6 |
| Pahang | 0.6 | 1.7 | 73.3 | 45.4 | 26.1 | 13.0 | 100.0 | 60.1 |
| Selangor | 4.6 | 6.1 | 3.0 | 1.5 | 33.5 | 20.2 | 41.1 | 27.8 |
| Negeri Sembilan | — | 0.1 | 5.1 | 5.4 | 10.7 | 2.9 | 15.9 | 8.5 |
| Melaka | 0.2 | 0.3 | — | 0.1 | 0.7 | 1.1 | 0.9 | 1.4 |
| Johore | 7.2 | 7.5 | 5.5 | 8.2 | 106.6 | 202.5 | 119.3 | 218.2 |
| Total | 101.2 | 97.5 | 179.4 | 131.6 | 1407.0 | 612.6 | 1687.8 | 841.7 |
| | 6.0% | 11.5% | 10.6% | 15.6% | | | | |

Source: Annual Reports of the Forestry Department, Peninsular Malaysia. 1981 and 1982. M\$2.6 is equivalent to US\$1 at time of writing.

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Richard W. Pohl*: **Method for Obtaining Vegetative Chromosome Counts of Bamboos**

In a recent publication, Soderstrom (1986) has indicated the desirability of obtaining chromosome counts of bamboos from vegetative tissues. We have been able to obtain both meiotic and vegetative counts from *Chusquea deflexa* L.G. Clark, and the meiotic count confirmed the vegetative one (Davidse and Pohl, 1972). The method of preparation was to peel the culm leaves from actively growing young canes and retrieve the apical meristem, which was cut into small pieces and placed in ice water or in saturated aqueous paradichlorobenzene solution to shrink the chromosomes. The vials of material were stored in a refrigerator at ca. 4 degrees C. for 18 hours and then fixed in Newcomer's solution (Newcomer, 1953). After fixation, the meristem segments were stained in Fielgen stain and squashed by standard cytological methods.

Chromosomes of *Chusquea* species are readily visualized without preshrinking by use of standard cytological stains such as aceto-orcein or proprio-carmin, but unfortunately the chromosomes are so long and intertangled that counting is impossible.

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Gary Mitchell*: **Notes on Bamboo Survivability in the Pahrump Valley**

The Pahrump Valley is an ancient drylake about 30 miles long and 10 miles wide, very flat and flanked on both sides by steep mountain ranges. The elevation is about 2600 feet. Agriculturally, the best crops are alfalfa and cotton. The weather is tough and unpredictable. Rain will range from 1 to 9 inches annually. Most rain comes in December, January, February and March, if at all. There will be months at a time without a cloud, usually May, June and July and again in October and November.

Temperatures are as unpredictable as the rains. Winter lows will range from 15 - 28° F. with about 3 days from 0 - 5° F. Winter highs range from 30 - 55° F. Commonly, there will be about 2 weeks in January that will warm up to 70° F., creating a budding situation with deciduous trees, shrubs and some bamboo. *P. vivax* is particularly susceptible. Then, when the cold returns there is usually some damage. In 1986, this occurred and was followed by at least 10 days in February with lows of 10 - 15° F., and dry North winds. Cold damage was as follows: *P. vivax* lost most of its youngest culms and most of its leaves. *P. viridi-glaucescens*, 75% leaf kill and some young culms killed to the ground. *P. viridis* and *P. viridis* cv. Robert Young, some culms froze half way down with some leaf loss. *P. nigra* cv. Bory, 75% leaf damage. *P. aurea* var. *flavens-inversa*, 90% leaf damage, most culms froze. *P. aurea*, 30% leaf damage. *P. purpurata* cv. Straight Stem, froze to the ground. Unseasonal lows can occur also in the fall or even late summer. It has frozen to 30 - 28° F., in September, only to return to 95° F. plus the next day or so. These out of place cold snaps invariably damage some bamboo even though the overall lows may not be that cold. Summer temperatures aren't too bad. Average highs range from 90 - 105° F. with occasional days to 110° F. The lows average 66 - 80° F. These temperatures run from June to mid September normally. Humidity runs 10 - 30% year round, except during storms.

Like most of the desert, the winds in the spring can be bad from March to June; sometimes 2 days a week at 30 - 45 mph, from the south. Early culming bamboos take a beating unless they have some protection. The most wind resistant bamboo is *P. makinoi*, no damage. *P. viridis* and Robert Young, no damage. *P. viridi-glaucescens*, little damage. *P. purpurata* cv. Solid Stem, no damage. The most commonly damaged are *P. aureosulcata*, broken culms. *P. vivax*, some culms tip over. *P. nigra*, culms break badly.

Perhaps most of this problem will go away as the stands become large enough to protect themselves from the wind, but it is a problem for the first 4 to 5 years.

The soil is pure clay. It is made up of decomposed limestone, holds water well and nutrients don't leach away rapidly. Unfortunately, the salts don't either. The pH runs between 8 to 9. Soluble salts run typically 3000 - 25,000 ppm. Consequently, chlorosis, salt toxicity, zinc deficiency and a host of other problems are common.

Up to a year ago, these problems were combatted by heavy leaching, using soil amendments, such as sulphur, gypsum, and adding organic materials and iron sulfates, plus a variety of fertilizers, mostly 21-0-0 and 16-20-0, to the soil. Although the bamboos grew, they could have grown and looked much better. Since that time, with the help of Alan Hinman, of Lubin Fertilizer and Equipment Corp., there have been some dramatic changes in

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the way the bamboos look and grow.

There is not a well planned feeding procedure but things are working nevertheless. Starting in August of 1986, an organic penetrant was used in conjunction with urea 32-0-0, in liquid form plus a Lubin product called Nutraplex-iron with sulphur. Later, thru the fall and early winter, until soil temperatures fell below 50° at a 4 inch depth, the same penetrant was used, with 15-0-0 and 16-4-4. Feeding resumed in the spring when the soil temperatures came back up to 50° feeding plants every 2 weeks or so with the same fall formula. Soil analysis showed a lack of zinc and the state pathologist suggested many of the fruit trees were also zinc deficient, so a Lubin zinc product is being added. This zinc supplement is not yet on a well planned program but soon will be. Experimentation continues with the application, rates, etc., to determine what methods to use.

Two of the bamboos which were almost given up on were *P. nigra* cv. Bory and *P. viridis*. These plants would not green up at all. Even though they are still "yellow", some of their new culms have good green leaves and are looking better all the time. In general these bamboos probably will never achieve the stature that they have when grown under more favorable conditions. The size will be approximately half of what they would normally achieve.

Without extensive efforts to provide good drainage, reduce pH levels, protect from sun and wind when young and provide water all the time, bamboos just do not do well in the desert.

The following is a list of bamboos which have been tried and how they did or are doing:

P. arcana: Started from 1 gal. plant. It did poorly from the start, but late summer and winter was it's undoing. It lived for two years. Probably should try it again in a more sheltered place.

P. aurea: This one is tough by any standard. Does well under almost any conditions. It is a rampant runner, responds well to feed (lots of it), and looks good most of the time. It never tends to be very dark green, but is pretty nevertheless. Spring budding takes place in late February and early March. New culms start in late March and last thru April. The new culms are reasonably wind tolerant. The tallest here is about 20 feet, but may get significantly taller.

P. aurea var. *flavens-inversa*: It was very slow to start and was damaged badly the first year by cold, (winter of '86), 10° in February. The plant since that time has become very vigorous and looks very good. The plant has put up many fall culms in October and November, one of them being its tallest culm at about 7 feet.

P. aureosulcata: Completely hardy, but is usually damaged in spring by wind when culming. Budding starts in late February, culming in early March thru mid May. There has been no fall culming. The plant has grown to about 8-9' in 6 years. The plant is a rampant spreader and likes much water.

P. bambusoides: Results are inconclusive. Planted 2 of them this spring. One died, the other looks great. The summer did not bother the one that lived at all, and it still has a very good color.

P. decora: One of the best bamboos. It looks good anytime of the year. It is very green with very little chlorosis. It is a rampant runner, but slow to get very tall, 5 to 6 feet in 6 years. It is a small but pretty bamboo. Budding is in March and culming is in late March and early April. The plant is more drought tolerant than most of the other bamboos and never shows signs of stress from the heat, drought or cold.

P. elegans: Planted in spring and has done fairly well until late October. Then it started looking bad. Its losing most of its leaves. On November 12, it started blooming.

P. makinoi: Another star performer. The plants general impression is one of great vigor. Most of its leaves are a very dark green with a few being chlorotic. So far it has shown no signs of stress from heat or cold. It has looked better in the winter than any of the other bamboos. The plant has so far spread very little, but has doubled in height and tripled in number of culms each year. It is to 8 feet in two complete growing seasons. Culming is different than other *Phyllostachys*. Culming starts slowly around mid May and the culms grow slowly taking two or three weeks to reach full size. The plant only puts up two or three at a time, allowing each one to reach nearly full size, then puts up two or three more. This process slows down in the heat of summer, but picks up again as the weather cools, towards the end of September. The plant has actually puts up more culms in October and November, than in the spring, although being somewhat smaller. The wind has not damaged any of the new culms. Water requirements seem average, and it is a heavy feeder.

P. meyeri: These plants were seedlings that were raised in a 60% shade house for two years. None of them ever did look very good and grew very slowly. Each one died as they were moved outdoors - within a few days.

P. nigra: Several have been tried. It doesn't like winter, summer, wind, salt or sun. Might do fair as a container plant in a very sheltered area. Very susceptible to wind.

P. nigra cv. Bory: Very slow growing, chlorotic, doesn't like summer, but it lives. It seems to be responding to massive nitrogen doses, approximately 10 lbs. of N per 1000 sq. feet and fed 6-8 times from March to October. Budding season begins in March. Culming season in early April. Height at end of 7 years is about 9 feet. So far not hardy at all.

P. nigra cv. Henon: Two very healthy, pretty plants have been tried and both of them shocked and died immediately. Deserves another try.

P. nidularia cv. Smooth Sheath: Has been fairly fast to spread, but very slow to gain height, being only about 3 feet in four years. It was damaged badly in '86, (10° freeze), and took all next year to recover. It is currently looking better than it ever has, with with good color and very little chlorosis. Budding begins in early May and starts culming in early June.

P. nuda: Started with a one gallon plant with 1 culm, two years ago. Now its a one gallon plant with three culms. Its very slow and color is so-so.

P. purpurata cv. Solid Stem: Extremely chlorotic, but otherwise vigorous. It is spreading fearfully, at least doubling in area each season. It has grown to about 4-5 feet tall but has approximately forty culms in only two seasons. Budding season begins mid-March,

culming in mid-April. Chlorosis persists. Possibly as it gets older, it will improve.

P. purpurata cv. Straight stem: Dies to ground every winter, but recovers by end of the summer to look surprising good, although small. It will be moved this winter to try to change its environment. It is currently very shaded and protected from wind by many trees.

P. viridis: This one so far is doing fair, in four years, it has grown to 15 feet. It is very chlorotic, but is responding to treatment slowly. Budding starts in April and culming in early June. It is wind resistant. It needs a lot of water and food. One point of interest, its rhizomes run very deep - at about 20 inches.

P. viridis cv. Robert Young: Same as above, but not quite as big and less cold hardy.

P. vivax: Has mixed performance, has good and bad years. It has taken 0° with no damage, but lost half its growth with 5° - 10° in other years. It needs a lot of food and water to look good, and tends to be chlorotic late in winter and early spring. In summer and fall however, it is pretty and impressive. Its rhizomes run very shallow, some at 2-3 inches, therefore making it susceptible to wind damage. In four years, it has grown to 20 feet tall and covers an area about 12 x 30 feet and is spreading rapidly. Budding season is in April and it starts culming in late May.

P. pubescens: Two of the seedlings from Quail in 1985, did not survive the first summer, even though they protected from the sun and wind.

Semiarundinaria fastuosa: A one gallon plant was started this spring and so far it has done very well. It has very good color and even put up two culms, the largest being about 7' tall.

The following small bamboos have been tried and do fairly well in 60 % shade with much water:

S. pygmaea, *A. argenteo-striata*, *S. tessellata*: All these survived winter lows to 4° with little damage, but none have looked very good. Only *A. pygmaea* has survived outdoors in the shade of trees and shrubbery.

Arundinaria tecta and *A. gigantea*: Both do remarkably well, although they are deciduous here. They will look much better with lots of water, but will do surprisingly well on very little. Both are unaffected by any amount of salt, wind or heat. They never need fertilization and neither can be killed. *A. gigantea* will reach almost full size in the first season, if planted early (March) and looks a little more robust than *A. tecta*. For best appearance, old culms (3-4 years) should be removed.

Bamboo that have been observed growing in Las Vegas, that have done reasonably well are:

Pseudosasa japonica (Sheltered from afternoon sun.)

P. nigra (Sheltered from sun and wind.)

P. aurea

P. bambusoides

P. bambusoides cv. Castillon

B. multiplex

B. multiplex cv. Alphonse Karr - (some winter damage to leaves at 15° F., but not severely damaged down to 12°.)

B. multiplex cv. Fernleaf

B. multiplex (Hort. variety Golden Goddess)

Chimonobambusa marmorea

The weather in Las Vegas consists of long hot summers, rather short mild winters. Summer highs range from 100 - 115° F. with an occasional 117° F. Winter lows range between 68 - 80° F. The hot season starts in early June and lasts thru September. Winter is December, January and February. Typical lows are 30 - 40° F. with an occasional cold snap down to 10 - 15° F.. Daytime highs range between 45 - 75° F.

Spring winds can be bad for spring culming bamboo. The winds are commonly from the south in April, May and can be quite violent, 40 - 60 miles an hour.

The soil in Las Vegas for the most part is limestone, gravely with caliche in layers of a few inches to many feet thick, poor at best. Other areas consist of blow sand or silt and all of the soils are alkaline.

The water is either Lake Mead, or well water. Both are high in dissolved solids, about 1000 ppm or more. Solids consist of sodium, magnesium, and manganese salts and calcium carbonates.

Rain consists of a few winter storms and an occasional thunder storm in August, September. Total precipitation ranges from 3 to 9 inches.

Elevation in Las Vegas ranges from 2200 - 3100 feet.

Once the placement of the divisions was approved by the Architect, and the tubs had been cut away from the divisions, the planters were backfilled to the level required by the Architect. The new soil was placed on top of the rootballs burying all culms from 2 to 5 inches (up to four internodes) deeper than the original soil levels. A ground cover, probably *Sagina subulata* (Swartz) K. Presl cv. Aurea, "Scotch Moss," is to be planted as sod on top of the soil, further burying the culms up to 2 inches deeper. The entire planting process consumed four and one half hours (Figure 7).

Following the planting, the up till now unwatered planters were each hand watered for periods varying from 15 to 24 minutes, until the planters were apparently soaked. As the Architect objected to the appearance of an irrigation system, and since he did not want to take the chance that the granite paving might get wet, no irrigation system was provided for the planters. The nearest water source is located some 165 feet away at an exterior quick coupling valve. There were no plans as of the date of installation for maintenance, although the Architect expects that this will be left to the interior maintenance forces.

The completed installation of bamboo (Figure 8) as of March, 1987, gives a delicate appearance to an otherwise cold and sterile office building atrium. It has proved popular with the tenants, and with the work force which continues to put the finishing touches on the building. The Contractor is said to be replacing the one division that "died" during acclimatization, which will fill in an evident blank spot in one of the planter areas.

The long-term survivability of the Moso, however, is in some doubt. There is no plan for watering the bamboo. At the present time, the Contractor regularly dumps large quantities of water on the clumps, but has been provided no contractual guidance for maintaining them. The ventilating system may prove problematic, as the tops of the taller culms visibly sway in the air currents it delivers, raising questions as to the influence of dry indoor air on the bamboo. The Architect's "plan" to turn the bamboo over to the interior maintenance forces may leave something to be desired: immediately after installation, interior maintenance was observed to be sweeping dirt from the granite floors into the planters. Let us hope that they introduce nothing toxic into the planters. The potential problem for the culms being planted deeply is to be partly ameliorated. The Architect has directed that the soil level be lowered, in an effort to prevent the grout between the granite pavers from wicking water up, possibly hurting the granite. No mention of or provision for fertilization or pest control has been put forward.

It is, of course, profoundly to be hoped that this interior installation of Moso will be successful. The Owner is aware of the potential problems, but has no competent resources to draw on to ensure the bamboo's health. In the meantime, readers of this *Journal* are encouraged to visit the site and experience the beauty of this most graceful bamboo.

NOTES

1. O'Brien, Michael, 1985. Bamboo Indoors [Letters to ABS], *American Bamboo Society Newsletter VI(3): 1*.
2. As is typical in such cases, the Landscape Architect had no knowledge of any other parts of the specification while those for the landscape (including bamboos) were being prepared. Both he and the author have no knowledge of whether or not these specifications were used, in whole or in part, by either the Architect or the Contractor. In any event, the Architect had the authority to modify, amplify, or completely ignore, any part of the prepared

specifications.

3. The taxonomic status of the Indian Laurel Fig is quite confused. However, this species is too well known, at least in Southern California, to merit any concern over its exact botanical identity.



Figure 1. Growing in the nursery.



Figure 2. The Moso on site prior to installation.



Figure 3. The planters before the planting work began.



Figure 4. The plants were moved in with a hand truck.



Figure 5. Positioning the plants.



Figure 6. Removing the containers.

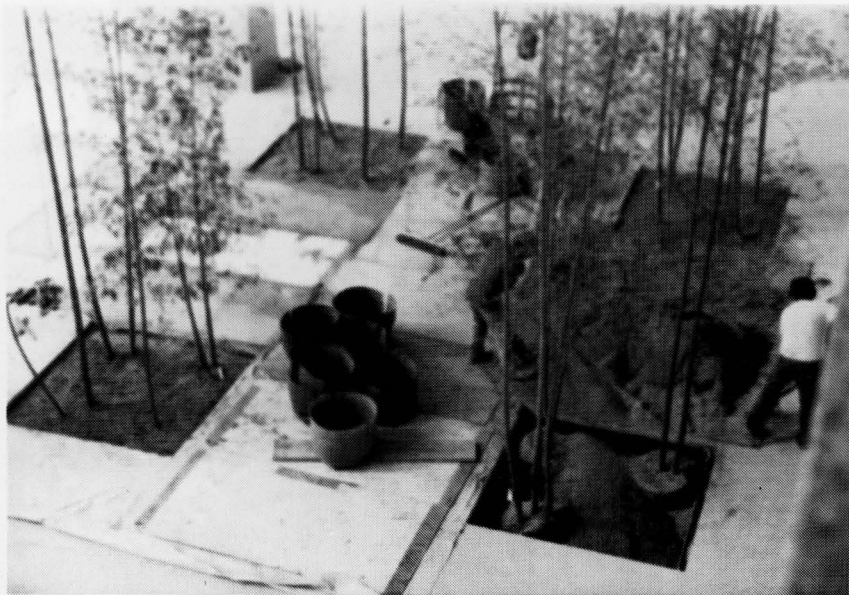


Figure 7. Filling the planters with soil after positioning the plants.

Figure 8. The planters before the plants were placed.



Figure 8. The final installation.