Notes on 'Pek' and 'Chote', members of the genus *Vietnamosasa* (Poaceae-Bambusoideae) in Thailand

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ABSTRACT. 'Pek' and 'Chote' refer to two bamboo taxa, found in north and north-eastern Thailand, belonging to the genus *Vietnamosasa* Nguyen, sympodial bamboos found in Vietnam, Cambodia, Laos, and Thailand. 'Pek' is identified as *V. pusilla* (A. Camus & Chevalier) Nguyen, and 'Chote' as *V. ciliata* (A. Camus) Nguyen; 'Pek' is smaller than 'Chote', and young shoots of the former are green, whereas those of the latter are purple or purplish-tinged. They are found growing mainly in dry dipterocarp forests. The morphology, especially of the rhizomes, culms and branches, is presented to show their adaptation to dry climate and annual burning.

INTRODUCTION

When I started examining herbarium specimens of bamboos from Thailand in 1992, I came across two local names 'Pek' and 'Chote' on specimens collected by Kerr and Smitinand. They are small bamboos 0.5–1.5 m tall, with solid culms; all specimens in K bear inflorescences. Holttum (1955) and Hambananda (1961) identified two of the specimens at K, with the local name 'Pek', as *Arundinaria pusilla* A. Camus.

Arundinaria pusilla was described from Vietnam by A. Chevalier & A. Camus in 1921. It is related to *Arundinaria ciliata* A. Camus which was described from Cambodia (A. Camus, 1919); it can be differentiated from *A. ciliata* by its longer spikelet, more nerves in the glume and glabrous flowering culms. Both species possess multi-flowered spikelets and six stamens in the floret. In 1989 Chao & Renvoize transferred these two species to the genus *Racemobambos* Holtt., a genus native in Malesia; they considered that *Racemobambos* and these two taxa have indeterminate inflorescences. Furthermore they considered *A. ciliata* and *A. pusilla* as conspecific. In 1990 Nguyen transferred *A. ciliata* and *A. pusilla* to a newly described genus *Vietnamosasa*, with the type species *V. darlacensis* Nguyen, and maintained their specific status, without referring to Chao & Renvoize's paper (presumably it was not available to the author at the time the paper was submitted for publication). I have supported the inclusion of both species in *Vietnamosasa* with the reservation that the genus should be studied more critically (Dransfield, 1992).

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Chao & Renvoize (1989) misunderstood the nature of the 'indeterminate' and 'determinate' habit in bamboo inflorescences. The presence of small reduced sheaths in the inflorescence of *Racemobambos*, as mentioned in Chao & Renvoize (1989), does not indicate that an inflorescence is indeterminate; such reduced sheaths (bracts) are also present in determinate inflorescences, such as in *Chusquea* Kunth (Clark, 1989) and *Athroostachys* McClure (McClure, 1973) from the New World, *Hickelia* A. Camus, *Valiha* S. Dransf. and *Cathariostachys* S. Dransf. from Madagascar Dransfield (1994, 1998), and *Temburongia* Dransf. & Wong (Dransfield & Wong, 1995) from Brunei. In Dransfield (1983) it was shown that *Racemobambos* has determinate inflorescences, characterised by the absence of a prophyll and buds at the base of the spikelet; the spikelets mature almost simultaneously. In an indeterminate inflorescence, a prophyll and bracts bearing buds are present at the base of the spikelet, and the whole structure is called 'pseudospikelet' (McClure, 1934). The buds at the base of the spikelet will develop into other pseudospikelets, and in this way an inflorescence will produce spikelets almost continuously or indeterminately. In *V. ciliata* and *V. pusilla* a prophyll and a bract bearing a bud are present at the base of the spikelet; thus the pseudospikelet is present in the inflorescence, and this precludes their belonging to the genus *Racemobambos* (Dransfield, 1992). In this paper I maintain them in *Vietnamosasa* and their morphology and taxonomy are presented. Observations are based mainly on herbarium specimens deposited at BKF, K, L, and P. I also made brief observations during fieldwork in 1996 in the Khorat plateau and 1997 in Pha Taem, Phu Phan, Phu Rua and Nam Nao National Parks, Thailand.

HABITAT

In Thailand, 'Pek' and 'Chote' are found mainly in the north-eastern plateau, from Phetchabun in the west to Khong Chiam and along the Mekong River in the east; the plateau is dominated by flat-topped sandstone formations, with a dry season lasting six months (Smitinand, 1988). These bamboos are one of the most important components in dry dipterocarp forest on soils derived from sandstone and on sandy loams; 'Pek' is usually found as undergrowth in more shaded areas, whereas 'Chote' can be found dominating more open areas, or growing here and there in less cultivated or disturbed secondary vegetation; occasionally it is found growing together with 'Pek'. They seem to be able to survive the annual burning during the dry season.

In some parts of Laos these bamboos dominate to form savannah, known as 'Pek savannah', a vegetation useful for grazing (Hacker et al., 1996).

MORPHOLOGY

Generally it is not easy to differentiate 'Pek' and 'Chote' without seeing fresh material. Young shoots of 'Pek' are usually light green, whereas those of 'Chote' are purplish green; 'Pek' often forms diffuse clumps as if it possesses 'running' underground parts (usually the lower portion of culm), whereas 'Chote' generally forms compact clumps (Fig. IIA).

Non-flowering plants of 'Pek' are not more than 50 cm tall, whereas 'Chote' has culms ca. 2 m tall.

Chevalier & Camus (1921) described the rhizome of *Arundinaria pusilla*, in this case 'Pek', as 'repens'. When I collected 'Pek' in Khorat (*Dransfield* SD1248 (BKF, K)), I wrote in my field notes 'sympodial bamboo with long necks'. McClure (1966) described the rhizome as pachymorph with the presence of a metamorph II axis, a long transitional stage intervening between the rhizome proper and the culm proper; it is typically rootless, but it usually has a bud at each node (Fig. 1A). In his observation, McClure (1966) concluded that the rhizome originating below a certain depth will possess a metamorph II axis, whereas the rhizome originating above a certain depth will not. In my opinion this metamorph II axis is, in fact, the lower portion of the culm buried underground, as explained below.

Basically, 'Pek' and 'Chote' have sympodial or pachymorph rhizomes, with short or long necks. The long necks of rhizomes have not been observed in detail, but it seems that they grow downwards, which can be seen in *Hacker* JBH1587 (K) from Vietnam and *Dransfield* SD1459A (BKF, K) from Thailand (Figs 1G & 2C). I believe that the structure of the rhizomes more or less resembles that of *Yushania niitakamayensis* (see Takenouchi's illustrations, McClure, 1966).

In the shaded area of dipterocarp forest, such as in Sakaerat Research Centre, Khorat, the rhizomes of 'Pek' and 'Chote' can be found up to 20 cm deep. In the more open areas with rocky ground the rhizome of 'Chote' can reach 50 cm beneath the soil surface (Hacker et al. 1996; pers. obs.). In the majority of bamboos with sympodial rhizomes, the lower part of the culm is usually above ground level, and the culm is defined as an above ground part of the bamboo plant, whereas the rhizome is the underground part. In 'Pek' and 'Chote' the lower parts of the culms are buried in the soil when the rhizome proper is found deep in the soil, and naturally the culm bases are under the ground. As mentioned above, they grow on sandy soil, derived from sandstone and sandy loam soil. Usually it is not too difficult in herbarium specimens to recognise the culm portions that are buried in the soil, because a small amount of soil can be found on these parts.

New culms, produced by the rhizomes buried deep below ground level, grow either upright or horizontally underground. Those growing horizontally can be mistaken for running rhizomes, as noted in the type specimens of *Arundinaria pusilla* A. Camus ('traçant'), or long necks of the rhizomes, as in the field notes associated with *Dransfield* SD1428 ('necks' of rhizomes have no branch bud at each node). The upright underground portion of culms can be found in both 'Pek' and 'Chote' of which the rhizomes are found deep in the ground (Fig. I). So far I observed the horizontal underground portion only in 'Pek' with rhizomes found underground at shallow depths (Fig. 2B). The culm is solid; the internodes of the underground part are 11–15 mm long, either straight or not, while those of the above ground part are ca. 20 cm long, and always straight.

Upright underground culm portion

The culm has a branch bud at each node from the lowermost node of the underground culm portion upwards; therefore some of the branch buds remain buried

underground. The branch buds found at nodes in the above-ground portion of the culm develop into many branches with the primary branch often dominant. Those below the surface develop differently. I collected various states of the short-necked rhizomes with culms of these two bamboos from various places, but unfortunately I have not had the chance to follow the development of these buried branch buds during their growing season.

In some tropical Asiatic bamboos, such as the climbing bamboos belonging to the genus *Dinochloa* and *Maclurochloa montana* (Ridl.) Wong, the primary branch buds may be dormant or stimulated to develop reiteratively when the apex of the main culm is damaged (Dransfield, 1983 Wong, 1995). *Dinochloa* species are found in primary tropical rain forest, but can survive in severely logged forest, partly because the reiterative primary branches have the ability to develop further behaving like the main culm. This phenomenon is an adaptation to growing in humid conditions in disturbed and undisturbed forest. In extreme conditions, such as a prolonged dry season and annual burning, many perennial plants possess tubers, thick corky bark and rhizomes, allowing them to survive. In 'Pek' and 'Chote' the branch buds occurring in the underground portion of the culm can be interpreted as an adaptation to such conditions. These buds remain dormant most of the time. Some of them will develop reiteratively in two different ways at the beginning of the rainy season after the above-ground part of the culm is destroyed or burnt completely by fire. The buds occurring just below the surface (usually at the first two nodes) break dormancy and develop upright into a bunch of short branches bearing leaf-blades, with the primary branch slightly larger, and these branches emerge above ground resembling a perennial grass sprouting after the first rain appears (Fig. III & Fig. 1B). One or more branch buds below it will also reiterate but produce a single large branch, slightly smaller or as large as the main culm, or a dominant primary branch with smaller secondary branches, both growing upright (Fig. 1C & D). It is not known whether the upper bush-like branches develop first then followed by the lower single one, or they both develop simultaneously. The bush-like branches emerging from the ground have been observed and recorded in *Actinocladum verticillatum*, a fire-adapted bamboo found growing in the Brazilian cerrado (Soderstrom, 1981).

The single branch will continue to develop above ground replacing and behaving like the main culm. Below or underground, its base often develops into a rhizome-like swelling bearing roots; one of its lowermost branch buds often develops too and replaces it when its above-ground portion is damaged by fire. This phenomenon was also observed in other bamboos, but the process happens above ground level. In *Dinochloa* some of the buds at the culm nodes develop into solitary branches resembling and serving the function of culms themselves. Some of these form new root-bearing rhizomes (Wong, 1995). Branches forming rhizome-like basal portions after the distal part of the culm has been cut have been noted in *Schizostachyum latifolium* in Brunei (Wong, 1991), and in several species of *Bambusa* in Bangladesh (Banik, 1980). A clump of a bamboo growing in the Palm House at Kew, identified as *Olmeca recta* Soderstr., has produced at the lower nodes above ground level branches bearing rhizomes and roots, perhaps as a result of the upper part of the culm having been cut; one of these branches has produced another branch from its rhizome-like basal

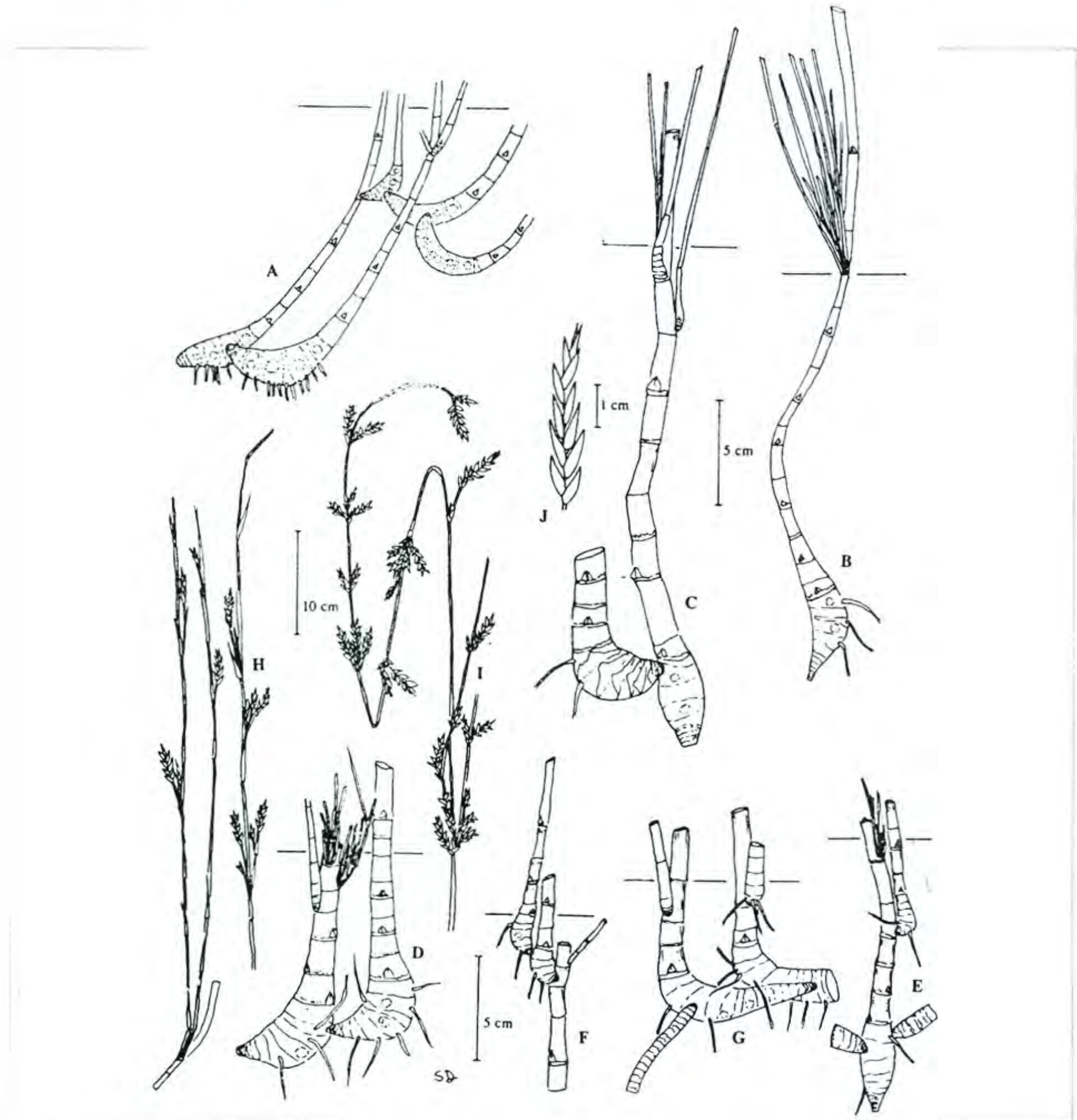

Fig. 1. A. Sketch of rhizomes of *Vietnamosasa* from McClure, 1966, showing McClure's term of metamorph II axis; B–J. *Vietnamosasa ciliata*: B. underground upright culm portions, collected after the first rains from a leafless culm showing a dormant branch bud at each node, and fresh leafy branches emerging at ground level (see also Figs 3 & 5B); C. undamaged but leafless main culm in the dry season (see also Figs 3 & 5B), with one of the branch buds of the underground portion developed into a dominant primary branch with dormant secondary branch buds, the other one distal to it also developed into a dominant primary branch and several short and smaller secondary branches - these dominant branches do not produce rhizome bases, (see Fig. 1A); D. damaged main culm, with one of the branch buds of the underground portion developed into single dominant branch without producing rhizome base, two branch buds distal to it developed into short branches emerging above ground; E. branch turned into rhizome producing another rhizome base after apex damaged (see Fig. 2A); F. development of a culm branch of the underground portion into a rhizome base producing culm emerging above ground, after main culm damaged, branch buds nodes distal to it developed into many branches emerging above ground (see Fig. 2A); G. rhizome neck emerging from another rhizome, x lower part of long neck with very short internodes and lacking branch buds; H. & I. flowering branches; J. spikelet. B–F. from *Dransfield* SD1427, C. & D. from *Dransfield* SD1459, G. from *Hacker* JBH1587, H. from *Maxwell* 76-221 (K), I. from *Smitinand* 2553 (K), J. from *Maxwell* 76-221. Drawn by the author.

portion (pers. obs.). The formation of such a portion could be reactivated partly by the moist conditions surrounding the lower part of the plant or clump. The soils in which Pek' and 'Chote' grow are dry and hard in the dry season, but become wet and soft during the rainy season; these conditions, together with annual burning, could stimulate the development of the rhizome-like basal portion of the single underground branch.

Which of the underground branch buds is reactivated to produce a swollen base, depends on the depth of the rhizomes and the length of the culm portion buried in the soil. In a shallow position, the single branch with rhizome-like swollen base emerges from the third node from the culm base, and the node(s) above it bears bush-like branches emerging above ground (Fig. 1D). This feature can be seen in other bamboo species, but is found above ground, such as in *Olmeca recta* (pers. obs.). In a deep position, the single branch (or two branches) emerges from one or two nodes below the bush-like branches, and consequently there is a long lower portion of culm below bearing a dormant branch bud at each node (Fig. 1B). McClure (1966) described this portion as a metamorph II axis in a pachymorph rhizome. In my opinion, this portion is part of the culm, because the length of it (i.e. corresponding to the numbers of the internodes), and the position of developing branch vary depending on the position of the rhizomes proper. When the above-ground portion of the culm is not burnt or damaged, branch buds of the underground culm portion usually remain dormant. However, when the above ground culm portion is leafless during the dry season (but again not burnt), the bush-like branches may develop (upright in this case) at the beginning of the rainy season, and may be followed by the development of the single branch from the node below it. Here the base of this single branch does not produce either a rhizome-like swelling or roots (Fig. 1C). In this case the ecological and/or climatic factors play an important role.

As mentioned above, McClure (1966) also stated that the metamorph II axis does not occur in rhizomes originating above a certain depth, because the terminal bud produces a culm directly. The statement of 'certain depth', is not clear, because all specimens I examined, with rhizomes buried at various depths (1–20 cm), possess lower portions of the culms below ground, comprising 3–12 or more internodes, bearing a bud at each node; these underground portions are identical, except for the lengths that are different. Therefore, the underground lower portion is always present and is part of the culm. In most pachymorph or sympodial bamboos, the lower internodes are usually shorter than the upper, as it is in the case of the short internodes of the underground culm portion in *Vietnamosasa*. I suggest that it is not necessary to give a formal term for this underground portion.

Horizontal underground culm portion (Fig. 2 A–D)

It is not known why in 'Pek' the culms growing from the rhizomes often develop horizontally underground, before they emerge above ground level in a form of branches at upper nodes. This underground portion originates from a sympodial rhizome, and resembles the underground portion of upright new growth described above. It differs from a leptomorph rhizome in the solid internodes without the presence of air canal and endodermis in the cortex, and the absence of roots at each node; it differs from the rhizome

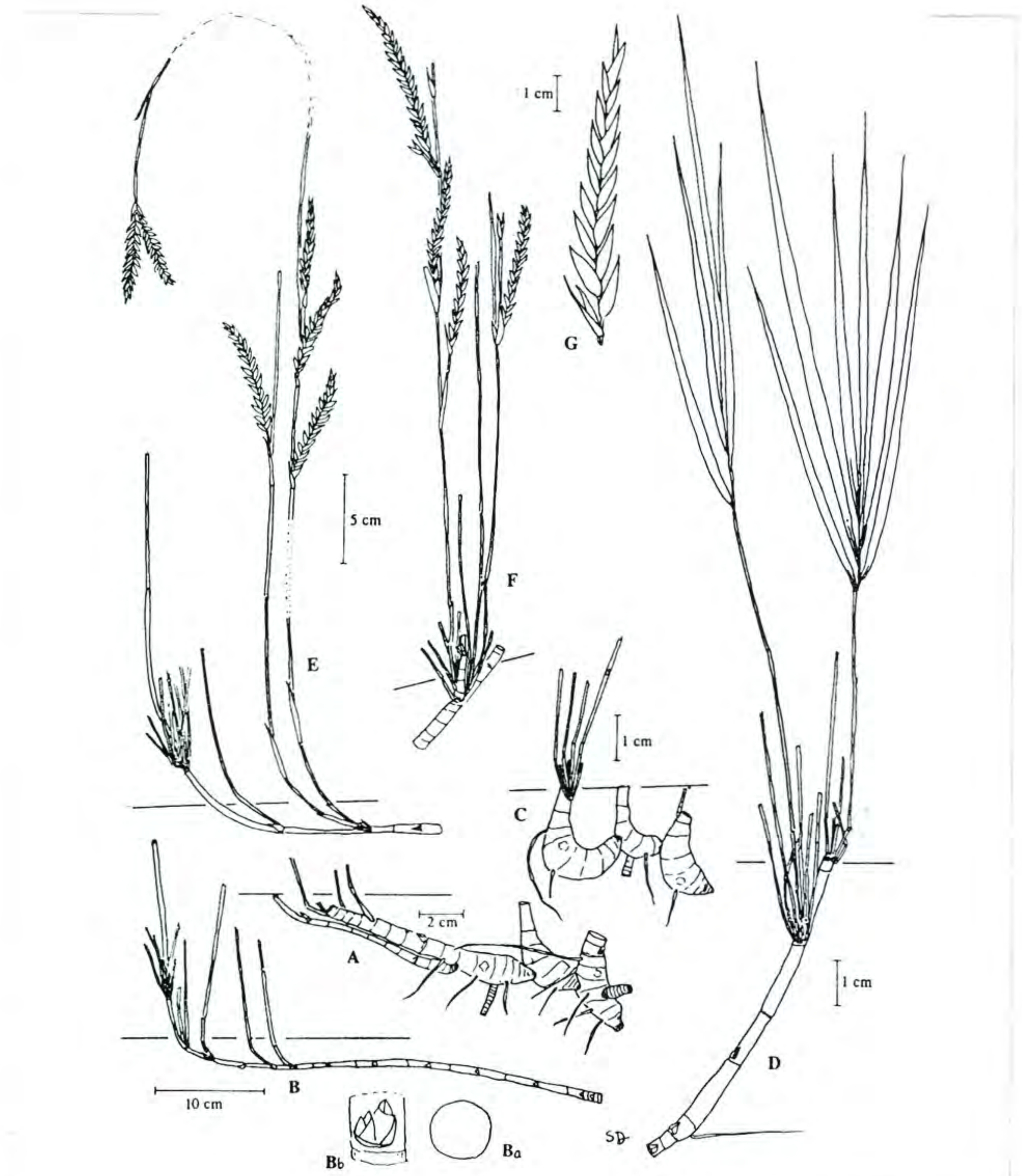

Fig. 2. *Vietnamosasa pusilla*: A. underground portions of culms growing horizontally below ground, producing another culm underground from its rhizome, branches growing upright emerging above ground; B. upper part of the portion, showing dormant bud at each node, and apex emerging above ground, some of the buds below ground developing upright into branches also emerging above ground; the lower portion can be mistaken as a leptomorph rhizome, but it differs from the latter for the absence of roots at each node, its solid internodes with the absence of the cortex (Ba), and branches not solitary (Bb); C underground branch bud developed into a single branch, producing rhizome base, distal to it developed into small branches, x lower part of a long rhizome neck, branch buds (rhizome or culm) absent in the nodes; D. underground culm portion with buds developed into small equal branches; E. & F. flowering branches; G. spikelet. A from *Kerr* 5680 (K), B from *Dransfield* SD1466 (K), C from *Dransfield* SD 1459a, D from *Dransfield* SD1459a, E & G from *Maxwell* 75-227 (L), F from *Dransfield* SD1467 (K). Drawn by the author.

neck in having longer internodes and a bud at each node. There are several branches at each node of the same length, bearing leaf-blades. Occasionally, some of these branches bear flowers. Superficially these flowering branches emerge from the ground as if they develop directly from the rhizomes.

Inflorescences (Figs. 1 H–I, 2 E & F)

The inflorescences in 'Chote' are arranged in a fascicle at each node of a leafless erect culm. This leafless flowering culm develops either from the rhizomes or originates from an elongate primary branch borne from the node of the underground culm portion that grows upright. It can reach up to 2 m tall. The spikelet is not more than 4 cm long consisting of 5–7 florets. In 'Pek' the inflorescences are borne terminating leafless branches that emerge from the soil/underground. These leafless branches, 10–50 cm tall, originate in fact from a branch bud of the underground culm portion that grows horizontally. Usually there are no more than ten spikelets in each branch with one or two spikelets at each node. The spikelet is ca. 8 cm long, consisting of 8–16 florets. Most of the collections show the burnt parts distal to these flowering branches, except in *Dransfield* SD1467 (BKF, K) collected from Phu Phan National Park in November 1997, which I was told is 'Pek'. However, it is not known, whether the development of the flowers in 'Pek' was or has been usually initiated by the fire during the annual burning.

TAXONOMY

Based on the morphology of flowering specimens, the bamboo called 'Pek', found restricted to shaded mixed dipterocarp forests in Thailand, resembles the type of *A. pusilla* (*Chevalier* 40506 (holotype P)) collected from Vietnam, now called *Vietnamosasa pusilla* (Chevalier & A. Camus) Nguyen. The type specimens are mounted on three sheets, with five underground portions bearing flowering branches, and several loose flowering branches; the underground portions bear damaged or burnt upper parts of the culms. Each of these flowering branches bears one or a few spikelets. Camus described this as 'culmus floriferus erectus, solidus, cylindricus'. The lower part of the sheath in the flowering branch is usually glabrous; the spikelets are 3–8 cm long, consisting of 8–16 florets.

The bamboo called 'Chote' resembles one of the sheets of the type of *A. ciliata* (*Pierre* 6659 (holotype P)) from Cambodia, which is now called *Vietnamosasa ciliata* (A. Camus) Nguyen. The type specimens are mounted on five sheets, on which there are several leafy and flowering branches, and four portions of the culm, three bearing many short young leafy branches (of the same size) at each node. The culm portions seem to be collected from different culms. Three of them are 40–50 cm long, consisting of four to five short internodes, and are probably from the upper parts of erect culms about 1 (or more) m tall, or from the young growth produced after the annual burning (see above). The other consists of a node from a burnt culm, bearing several long leafy branches. The other leafy branches are mounted individually and are similar to those of the latter. Flowering branches seem to be borne on leafless, branched

culms 70–100 cm tall above ground, each node of the culm and branches bearing a fascicle of spikelets. Apart from these flowering culms, there are a number of long slender flowering branches, bearing or terminated by a few spikelets. These originate from a node of an underground portion (of the culm) which produces flowering branches, as represented in one of the sheets. Here this portion shows the burnt upper portion (see above). Camus (1921) did not mention the above descriptions.

CONCLUSIONS AND SUGGESTIONS

1. Based on the discussions above, *Vietnamosasa pusilla* is different from, but is closely related to, *V. ciliata*. The full descriptions of 'Pek' (*V. pusilla*) and 'Chote' (*V. ciliata*) will be presented in the taxonomic account of the genus.

So far there is no written record of the utilisation of these two bamboo species. They are, however, some of the most important components in the dry dipterocarp forest, and in Laos they form savannahs (Pek savannahs), a useful vegetation for grazing. Therefore, a study on their natural history is needed, as explained below.

2. The data on rhizome morphology in 'Pek' and 'Chote' are not complete, and more observations are needed, such as the presence of long necks in the rhizomes as stated elsewhere (i.e. resembling the rhizome structure in *Yushania niitakayamensis*, a bamboo native in Taiwan). This observation may be useful in explaining the way the bamboos spread in large areas.

3. The ability to survive the effects of a seasonally dry climate and annual burning is uncommon in bamboos (although it is common in other grasses). Moreover, the branch buds seen in 'Pek' and 'Chote' that occur in the underground portion of the culm as an adaptation to such extreme conditions is rare. The information given above is the result of short observations from two different localities (Khorat Plateau and Pha Taem National Park) during two different seasons (the beginning of the rainy season in April and the beginning of the dry season in November). The following longer term observations should be conducted: (a) follow the development of branch buds in the underground portion of the culm during the growing season, after the above-ground parts are burnt or dried; (b) observe the growing behaviour of both underground and above-ground portions of the culms in 'Pek' and 'Chote' growing in areas where the dry season is not so pronounced and the plants do not shed their leaves completely, and (c) carry out experimental planting of 'Pek' and/or 'Chote' outside their natural habitats, to determine whether the growth habit is the same as described above. These and other observations should be conducted by those who are permanently in residence, such as local foresters, biologists or students.

4. 'Pek' and 'Chote' seem to produce flowers regularly, towards the end of the rainy season. However, the flowering habit of these two bamboos remains little known. It would be important to observe it regularly, and to note seed production. It was reported that in Vietnam sparrows eat all the seeds/grains before the seeds/grains fall off (Camus, 1921). Again, such observations need to be carried out by local foresters, biologists or students.

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REFERENCES

Banik, R.L. 1980. Propagation of bamboos by clonal methods and by seed. In: Lessard, G. & Chouinard, A. (eds), Bamboo Research in Asia: 139–150. International Development Research Centre, Ottawa.

Camus, A. 1919. Espèces et variétés nouvelles de Graminées de l'Asie Orientale. Bull. Mus. Hist. Nat. Paris 25: 669–672.

Chao, C.S. & Renvoize, S.R. 1989. A revision of the species described under *Arundinaria* (*Gramineae*) in Southeast Asia and Africa. Kew Bull. 44: 364–365.

Chevalier, M.A. & Camus, A. 1921. Deux bambous nouveaux de l'Annam. Bull. Mus. Hist. Nat. Paris 27: 450–454.

Clark, L.G. 1989. Systematics of *Chusquea* Section *Swallenochloa*, Section *Verticillatae*, Section *Serpentes*, and Section *Longifoliae* (Poaceae-Bambusoideae). Syst. Bot. Monogr. 27: 1–127.

Dransfield, S. 1992. A new species of *Racemobambos* (Gramineae-Bambusoideae) from Sulawesi with notes on generic delimitation. Kew Bull. 47: 707–711.

Dransfield, S. 1994. The genus *Hickelia* (Gramineae-Bambusoideae). Kew Bull. 49: 429–443.

Dransfield, S. 1996. Report on the field trip to Southern Thailand, 2 to 29 April 1996. Thai For. Bull. (Bot.) 24: 66–71.

Dransfield, S. 1997. Report on fieldwork collecting bamboos in Thailand, October–November 1997. Thai For. Bull. (Bot.) 26: 35–39.

Dransfield, S. 1998. *Valiha* and *Cathariostachys*, two new bamboo genera (Gramineae-Bambusoideae) from Madagascar. Kew. Bull. 53: 375–397.

Dransfield, S. & Wong, K.M. 1996. *Temburongia*, a new genus of bamboo (Gramineae-Bambusoideae) from Brunei. Sandakania 7: 49–58.

Hacker, J.B., Simon, B. & Phengvichin 1996. The pek savannas of the Lao People's Democratic Republic. Ecology and floristics. Genet. Res. Comm. 23: 1–38.

McClure, F.A. 1934. The inflorescence in *Schizostachyum* Nees. J. Wash. Acad. Sci. 24: 541–548.

McClure, F.A. 1966. The Bamboos. A Fresh Perspective. Harvard University Press, Cambridge Massachusetts.

McClure, F.A. 1973. Genera of bamboos native to the New World (Gramineae-Bambusoideae). Smithson. Contrib. Bot. 9: 1–148.

Nguyen, T.Q. 1990. New taxa of bamboos (Poaceae-Bambusoideae) from Vietnam. Bot. Zhurn. 75: 221–225.

Smitinand, T. 1988. Thailand. In: Campbell, D.G. & Hammond, H.D. (eds), Floristic inventory of tropical countries: 63–82. New York Botanical Garden, New York.

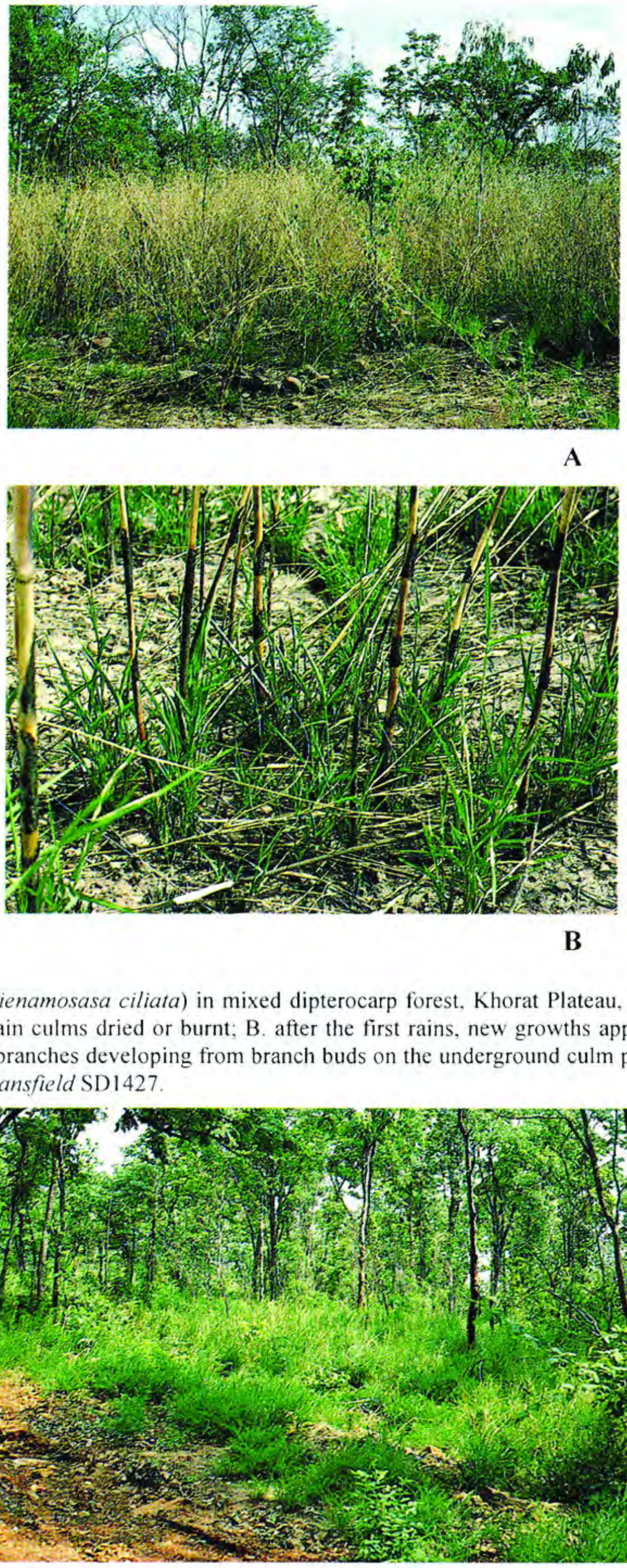
Soderstrom, T.R. 1981. Observation on a fire-adapted bamboo of the Brazilian cerrado. *Actinocladum verticillatum* (Poaceae-Bambusoideae). Amer. J. Bot. 68: 1200–1211.

Wong, K.M. (1991). The growth architecture and ecology of some tropical bamboos. J. Amer. Bamboo Soc. 8: 31–46.

Wong, K.M. (1995). The morphology, anatomy, biology and classification of Peninsular Malaysia bamboos. University of Malaya Botanical Monograph no.1. University of Malaya, Kuala Lumpur.

Fig. 3. Pachymorph or sympodial rhizomes and underground culm portions of 'Chote' (*Vietnamosasa ciliata*); note the branches developing below ground level (see also Figs 1B & 1C). From *Dransfield* SD1459.

Fig. 4. 'Chote' (*Vietnamosasa ciliata*) growing on open grassland, east of Khao Yai National Park. From *Dransfield* SD1427.



A

B

Fig. 5. A. 'Chote' (*Vienamosasa ciliata*) in mixed dipterocarp forest, Khorat Plateau, at the end of the dry season, all main culms dried or burnt; B. after the first rains, new growths appearing above ground compressing branches developing from branch buds on the underground culm portions (see also Fig. 1B). From *Dransfield* SD1427.

Fig. 6. 'Pek' (*Vietnamosasa pusilla*) in Sakaerat Research Centre, Khorat.