

Pre-Austronesian dispersal of banana cultivars West from New Guinea: linguistic relics from Eastern Indonesia

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Abstract

Against the backdrop of a comprehensive archaeobotanical review, we present linguistic evidence that allows us to develop a model of the dispersal of bananas westwards from New Guinea. This westward dispersal is a window on pre-Austronesian contact between New Guinea and regions to the west. The linguistically-derived model is compatible with archaeobotanical and botanical data. Our interpretation accords with evidence for maritime interactions from the early Holocene in western New Guinea and eastern Indonesia.

In the first half of this paper the history of banana domestication, which has been partially documented through archaeobotanical, genetic and phytogeographic research, is reviewed. On the basis of this multi-disciplinary and chronological context, the second half of the paper presents a detailed, linguistically-derived interpretation for the westward diffusion of bananas from New Guinea into eastern Indonesia. Apparently cognate terms for ‘banana’ in the modern languages of Melanesia and eastern Indonesia are reviewed and evaluated. The distribution of one particular cognate term correlates with the range of a linguistic substrate identified in western Melanesia and eastern Indonesia, and is argued to be associated with an early, pre-Austronesian diffusion of banana cultivars westward from New Guinea.

Banana domestication

Botanical classification and phytogeography

Bananas (*Musa* spp.) have one of the most complex domestication histories of any major food plant (Carreel *et al.* 2002). The domestication of bananas of *Musa* section is our focus because it includes the most important and widespread banana cultivars today and, presumably, in the past. As De Langhe and De Maret (1999: 378) comment: “the hundreds of banana cultivars form a very heterogeneous group and their phenotypes are the reflection of a ramified pattern of domestication more or less coupled with genome combinations, polyploidization and somatic mutations”.

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The domestication of *Musa* section bananas has been traced to the human management of two subspecies: *Musa acuminata* ssp. *banksii* that grows wild in New Guinea, Manus, northern Australia and some islands of eastern Indonesia and, *Musa acuminata* ssp. *errans*, which grows wild in the Philippines (Carreel *et al.* 2002; also see Kennedy 2008), although not all authors recognise these subspecific classifications (e.g. De Langhe and De Maret 1999). Parthenocarpy, the ability to produce fruit without fertilisation, was fostered in *M. acuminata* ssp. *banksii* first and nearly all food-producing cultivars across the world are descended from at least one of these subspecies (Lebot 1999; Carreel *et al.* 2002). It is likely that a partially domesticated *M. acuminata* ssp. *banksii* subsequently hybridised with *M. acuminata* ssp. *errans* to produce edible AA diploids (Edmond De Langhe 2007, pers. comm.).

The initial phase of the domestication of *M. acuminata* (genome A) subspecies, especially ssp. *banksii*, occurred *in situ* over several thousand years and involved the development of parthenocarpy, the suppression of fertility and subsequent generation of ‘AA’ diploid cultivars (De Langhe and De Maret 1999; Kennedy 2008, in press). Cultivation of AA diploids in the vicinity of other wild *Musa* spp. created intra- and interspecific hybrids. Hybridisation of *banksii*-derived edible AA diploids with other *M. acuminata* subspecies generated a range of edible AA diploids and AAA triploids. Cross-breeding with *M. balbisiana* (genome B) populations, a species considered native to mainland and, potentially, Island Southeast Asia (although wild populations of uncertain origin and antiquity are known in the Philippines and Melanesia; Kennedy 2008: Table 1), generated AB diploids and AAB and ABB triploids (De Langhe and De Maret 1999). *Musa balbisiana* is cultivated for materials, fibres, fodder, cooking and medicine.

Given the domestication sequence and natural ranges of wild populations, genetic and archaeobotanical evidence can shed some light on the generation and dispersal of cultivars in space and through time (see Vrydaghs and De Langhe 2003; Vrydaghs *et al.* 2003; Kennedy and Clarke 2004; Kennedy 2008, in press).

Genetics

Unusually, chloroplast DNA (cpDNA) and mitochondrial DNA (mtDNA) in bananas are inherited through the maternal and paternal lines, respectively (Carreel *et al.*

2002: 680), thereby enabling the contributions of different species and subspecies from different geographical regions to be traced. Of most relevance for the present discussion is the tracking of banana cultivars originating in the New Guinea region westward to Africa, particularly for two major cultivar groupings, AAA (East African) and AAB (West African) (following Carreel *et al.* 2002; Kennedy in press).

East African Highland AAA bananas are descended from *M. acuminata* ssp. *banksii* from the New Guinea region that hybridised with *M. acuminata* ssp. *zebrina*, which is native to Indonesia. West African AAB plantain cultivars are partially descended from AA diploids from New Guinea; indeed they exhibit ‘exactly the same cytotype pattern as some *Musa acuminata* ssp. *banksii* accessions still present in New Guinea’ (Carreel *et al.* 2002: 689). The AA diploids

hybridised with *M. balbisiana* populations, which are ultimately of mainland or insular Southeast Asian origin (Figure 1), most likely in island regions to the west of New Guinea (De Langhe and De Maret 1999). The resulting AAB cultivars are predominantly sterile, although some may produce seed if pollinated, and after a presumed introduction to East Africa dispersed vegetatively, i.e. under cultivation, to West Africa (De Langhe 2007).

The genetic histories of both African cultivar groupings indicate similar trajectories: a westward movement of *M. acuminata* ssp. *banksii* from the New Guinea region; subsequent intraspecific (AAA) and interspecific (AAB) hybridisation with species native to Indonesia and primarily mainland Southeast Asia, respectively; and, dispersal to, and inland from, East Africa. Archaeobotany is beginning to shed an intriguing, albeit partial, light on the time-depth for these processes.

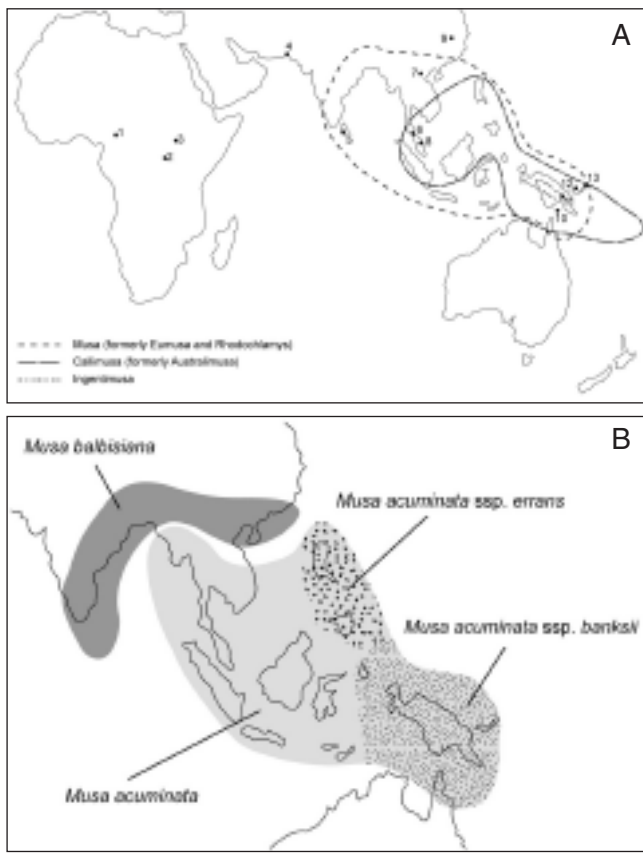


Figure 1. A: The natural ranges of Callimusa, Ingentimusa and Musa section bananas (INIBAP 2006) and numbered locations of sites with archaeological evidence of banana (Table 1). Note that *Musa* spp. have recently been reclassified into three sections: Musa [formerly Eumusa and Rhodochlamys sections], Callimusa [formerly Callimusa and Australimusa sections] and Ingentimusa [unchanged] (after Wong *et al.* 2002). B: The approximate generally accepted and minimal natural ranges of two major Musa section species, *M. acuminata* and *M. balbisiana* (De Langhe and De Maret 1999; Wang *et al.* 2007), and the approximate natural ranges of two important subspecies, *M. acuminata* ssp. *banksii* and *M. acuminata* ssp. *errans* (after Kennedy 2008: Table 5).

The archaeobotany of ‘wild’, managed and cultivated bananas

Although the archaeobotanical record is spatially and chronologically fragmentary, several general patterns illuminate human-banana domesticatory relationships through time (Figure 1 and Table 1; see Vrydaghs and De Langhe 2003; Vrydaghs *et al.* 2003; Kennedy 2008 and in press for reviews). For regions with natural populations of banana species and subspecies, it is not always possible to clearly differentiate between the presence of wild, managed and cultivated bananas in the past. Interpretative limitations arise in part from a methodological inability to discriminate microfossils of some banana genera, species, subspecies and cultivars (from Wilson 1985 to Ball *et al.* 2006). Other limitations are intrinsic to the domestication process; except for predominantly sterile triploid cultivars, bananas can interbreed with other species, subspecies and cultivars thereby generating a complex array of hybrids. At present, cultivation and domesticatory relationships can be inferred from the archaeobotanical record in two ways: the presence of a *Musa* sp. banana beyond its natural range, e.g. in Africa (Vrydaghs and De Langhe 2003); and, the frequency and archaeological associations of bananas, e.g. with cultivation at Kuk Swamp (Denham *et al.* 2003).

The time-depth of phytogeographic distributions for a few banana species and subspecies is attested in the archaeobotanical record. *Musa acuminata* ssp. *banksii* and *Musa ingens* phytoliths are present at Kuk Swamp in the highlands of New Guinea approximately 10,000 years ago (Denham *et al.* 2003), while *Musa balbisiana* and cf. *Musa acuminata* seeds have been identified in Terminal Pleistocene contexts in Sri Lanka (Kajale 1989). Other Terminal Pleistocene and Early Holocene records of bananas from China (potentially; Zhao and Piperno 2000), Malaysia (Bowdery 1999) and New Guinea (Denham *et al.* 2003) are equivocal in terms of human management (Table 1), since the low frequencies of undifferentiated phytoliths in wetland sediments might just reflect bananas growing wild in the landscape, as opposed to a form of human management. Only the Beli-Lena finds are directly

| Site | Country | Map Ref. | Earliest/ Associated date (cal. BP) | Banana type | Evidence | Reference | Comments ¹ |
|-----------------------------|------------------|----------|-------------------------------------|---|----------------------|---|--|
| Nkang | Cameroon | 1 | c. 2500 | <i>Musa</i> sp. | Phytoliths | Mbida <i>et al.</i> 2000, 2001 | Discrimination of <i>Musa</i> sp. from <i>Ensete</i> sp. Inferred cultivation of sterile triploids |
| Bunyakiri | D.R. Congo | 2 | post 200? | <i>Musa</i> sp. | Phytoliths | Runge 2001 | Recent origin based on chronostratigraphy |
| Munsa | Uganda | 3 | pre 5400–5000 | <i>Musa</i> sp. <i>Ensete</i> sp. | Phytoliths | Lejju <i>et al.</i> 2006 | Problematic chronostratigraphy Discrimination between <i>Musa</i> , <i>Ensete</i> and undifferentiated Inferred cultivation of <i>Musa</i> sp. cultivars |
| Kot Diji | Pakistan | 4 | c. 4000 (in Kennedy in press) | <i>Musa</i> sp. (AB hybrid?) | Phytoliths | Fuller and Madella 2001 | Uncertain identification If hybrid confirmed, introduced cultivar |
| Beli-Lena | Sri Lanka | 5 | c.11,500–13,500 | <i>M. balbisiana</i> <i>M. cf. acuminata</i> | Seeds | Kajale 1989 tentative | <i>M. balbisiana</i> , <i>M. acuminata</i> Exploitation of wild populations |
| Nong Thalee | Thailand | 6 | c. 5000 | <i>Musa</i> sp. | Phytolith | Kealhofer 2003 | No subgenus discrimination |
| Song Hong | Laos | 7 | c. 2500–1500 | <i>Musa</i> sp. | Phytoliths | Bowdery 1999; Vrydaghs and De Langhe 2003 | No subgenus discrimination |
| Lao Pako Plain of Jars | | | | | | | |
| Gua Chawas | Malaysia | 8 | c. 10,700 | Musaceae | Phytoliths | Bowdery 1999 | No subgenus discrimination Dating uncertain in Bowdery 1999 |
| Poyang Lake | China | 9 | post c.11,500? post c. 4000 | <i>Musa</i> -type | Phytoliths | Zhao and Piperno 2000 | ' <i>Musa</i> -type' Problematic chronostratigraphy pre-4000 cal BP, after which increased frequencies <i>Musa</i> -type |
| Ormi, Dauar Island | Australia | 10 | c. 2200-1900 | <i>Musa</i> sp. | Phytoliths | Parr and Carter 2003 | Also note <i>Musa</i> sp. at another site on Dauar, Sokoli, at 1600–1400 BP. Inferred to represent introduced cultivars, although possibly introduced plant parts (i.e. via trade). |
| Yuku | Papua New Guinea | 11 | c. 5200 | <i>Musa</i> sp. | Phytoliths Pollen | Horrocks <i>et al.</i> 2008 | Problematic chronostratigraphy Inferred to represent suite of exploited plants, although potentially present in the landscape |
| Kuk | Papua New Guinea | 11 | c. 10,000 | Musaceae <i>M. acuminata</i> ssp. <i>banksii</i> <i>M. ingens</i> <i>Ensete glaucum</i> | Phytoliths | Wilson 1985; Bowdery 1999; Denham <i>et al.</i> 2003 | Discrimination of species, sections and subspecies using phytoliths from seeds and other plant parts Inferred cultivation of <i>Musa</i> at 7000/6500 |
| Garua Island | Papua New Guinea | 12 | post 1100 BP | <i>Musa</i> sp. | Phytolith | Kealhofer <i>et al.</i> 1999; Parr <i>et al.</i> 2001 | No subgenus discrimination, extracted from artefact Identified in sediments associated with settlement |
| Reber-Rakival, Watom Island | Papua New Guinea | 13 | c. 2400-1350 | <i>Musa</i> spp. | Phytoliths | Lentfer and Green 2004 | Discrimination of <i>Eumusa</i> section bananas Tentative interpretation of human introduction of cultivars, although uncertain |

Table 1. Summary table of archaeobotanical evidence for bananas from New Guinea to Africa (cf. Figure 1). The list is not exhaustive and focuses on archaeobotanical finds in New Guinea and regions to the west (see previous reviews in Vrydaghs and De Langhe 2003; Vrydaghs *et al.* 2003; Kennedy 2008, in press), rather than Pacific regions to the east (included in Kennedy in press)

Notes: 1 'Inferred' indicates interpretation in original article, whereas comments following 'although' represent the views of the current authors. 2 Pasveer (2004: 191) mentions the identification of banana seeds at cave sites on the Bird's Head Peninsula of West Papua, Indonesia; however, they are excluded from the table as no further information on identification, age, site or cultural association is provided.

associated with human exploitation (Kajale 1989), although the use of the fruits or seeds there is uncertain.

The earliest evidence for banana cultivation derives from Kuk Swamp at 7000/6500 years ago in highland New Guinea (Denham *et al.* 2003). High Musaceae phytolith frequencies are recorded in feature fills associated with mound cultivation in an anthropic landscape along the wetland margin. The archaeobotanical evidence at Kuk circumstantially corroborates genetic and phytogeographic interpretations for the early cultivation and domestication of *Musa acuminata* ssp. *banksii* in the New Guinea region.

Claims for later banana cultivation in the New Guinea region are of variable significance and certainty. Finds in Island Melanesia and the Torres Strait have been interpreted to represent cultivation (Parr and Carter 2003; Lentfer and Green 2004), but other explanations are equally plausible, including dispersal of wild populations and human introduction of plant parts, i.e. fruit for consumption and leaves as food wrapping or lining for cooking. Of relevance, 'wild' populations of *Musa* section bananas occur in northern Australia (Pollefeys *et al.* 2004). Similarly, the 5000 year-old Musaceae phytoliths at Yuku rockshelter in highland New Guinea may only represent bananas growing, as opposed to being cultivated, in the landscape (cf. Horrocks *et al.* 2008).

Evidence for banana cultivation and cultivar diffusion for the vast Southeast Asian region between New Guinea and Africa is largely indeterminate. There is no published archaeobotanical evidence of bananas in Island Southeast Asia, which reflects a lack of research rather than the distribution of the species, given the natural range of *Musa* bananas (Pollefeys *et al.* 2004) and the inferred domestication and diffusion of cultivars (De Langhe and De Maret 1999). On mainland Southeast Asia, most finds occur within the natural range of some banana species (e.g. Kealhofer 2003) and are late (e.g. Laotian finds in Bowdery 1999), but others are suggestive of human agency. Could the higher and more persistent frequencies of *Musa*-type phytoliths at Poyang Lake in the Middle Yangtze River Valley between c. 4000 and 1200 years ago represent cultivation? Although originally interpreted as reflecting vegetation movements concomitant with climatic changes during the middle and late Holocene in the catchment, the *Musa*-type phytolith signal could potentially represent the northward anthropic expansion of *M. balbisiana* beyond its natural range. Poyang Lake is currently 200 km north of the lowland evergreen tropical rainforest to which *M. balbisiana* is native (Zhao and Piperno 2000: 205; Wang *et al.* 2007). Of similar potential significance is the phytolith-based evidence for *Musa* sp. at Kot Diji, which represents the anthropic diffusion of unknown bananas to Pakistan by 4000 cal BP (Fuller and Madella 2001; Kennedy in press). These two continental Eurasian cases are tantalising because both sites are beyond the imprecisely known margins of the natural range of wild *Musa* bananas (Figure 1; Pollefeys *et al.* 2004) and both potentially represent the mid-Holocene diffusion and cultivation of *Musa* populations beyond their natural range.

Of major significance are records from Africa. African *Musa* cultivars are triploids, vegetatively propagated and beyond the natural range of the genus. Assuming that the genus-level discrimination of phytoliths between *Musa* and *Ensete* is correct, *Musa* phytoliths are indicative of cultivation – whether for food, fibre or fodder – and can be used to track agriculture across the continent (Vrydaghs and De Langhe 2003; Vrydaghs *et al.* 2003). Significantly, the Nkang finds represent the diffusion of AAB cultivars, which are descended in part from New Guinea, to Cameroon by at least 2500 years ago (Mbida *et al.* 2000, 2001). These are the only known *Musa* bananas in the region and must have dispersed under cultivation from a presumed point of introduction in eastern Africa (De Langhe 2007).

More recently, putatively earlier evidence of banana cultivation dates to c. 5000 years ago at Munsu in Uganda (Lejju *et al.* 2006). The security of these findings is problematic; there is a 3000 year-old hiatus near the base of the core and radiocarbon dates are derived from bulk sediment organic carbon from the same contexts containing banana phytoliths. Taken critically with respect to orthodox arguments for the introduction of bananas to Africa from 600 AD (e.g. Vansina 2003; cf. Mbida *et al.* 2004, 2005), the Munsu evidence on its own is not definitive. However, taken contextually with respect to the Nkang (2500 cal BP), Pakistani (c. 4000 cal BP), and New Guinean (c. 7000/6500 cal BP) evidence, a much longer chronology for banana domestication and dispersal is emerging. Thus, despite shortcomings, the claims for the Munsu evidence are unsurprising.

In sum, the timing and nature of dispersal accords with scenarios of initial domestication of some species and subspecies in the New Guinea region with subsequent complex processes of hybridisation and dispersal westward reaching Africa potentially via the Indian subcontinent during the mid-Holocene. This timeframe suggests that the dispersal of bananas from New Guinea to Island Southeast Asia predates Austronesian influence (see Denham 2004; Denham *et al.* 2004; Kennedy and Clarke 2004; Kennedy 2008, in press), given that Austronesian speakers arrived in the New Guinea region around c. 4000 cal BP, and had only limited influence on the island of New Guinea until after c. 3000 cal BP (Bellwood 1996). As mentioned above, however, there is a major gap in the archaeobotanical record from Island Southeast Asia, which can now in part be addressed by linguistic evidence for the pre-Austronesian dispersal of bananas westward from New Guinea.

Linguistic evidence for a Melanesian source

Several strands of linguistic evidence bear on the question of the dispersal of bananas and its approximate date. Although by themselves they are more suggestive than definitive, taken together with the macrohistory of the region and the history of banana domestication they comprise a compelling argument for the early anthropic dispersal of bananas west from New Guinea. We examine

attested terms for bananas, within the context of the linguistic ecology of New Guinea and eastern Indonesia.

In this region we currently find languages that are discussed as two entities: the Austronesian languages, relatively recent arrivals in the area sharing a common ancestor in Taiwan; and the languages referred to as ‘Papuan’, a term that does not imply relatedness but simply designates a language not belonging to the Austronesian family that is spoken in the vicinity of New Guinea. While Papuan languages are geographically restricted, Austronesian languages are found as far away as Madagascar, Formosa, Easter Island and Hawai’i.

The Papuan linguistic sphere

Today, Papuan-speaking populations extend as far west as the Timor area, although they may have been formerly more extensive given that humans inhabited the archipelago for tens of millennia before the arrival of Austronesian language-speakers. For example, to the west, Sumbawa was home to the trading kingdom of Tambora until the catastrophic eruption of Mt. Tambora in 1815 (Oppenheimer 2003), and there is good evidence that the language there was Papuan (Donohue 2007a). Given the survival into historical times of at least one socially prominent Papuan population with a reported maritime tradition, and the significantly changed character of the Austronesian languages east of Sumbawa, it is almost certain that other, now vanished, Papuan languages were present in more of the islands west of New Guinea than is the case today, and

that these populations were socially significant during the period in which Austronesian language-speakers arrived in the region. We shall argue that these Papuan-speaking peoples were responsible for the dispersal of banana cultivars west from New Guinea before the arrival of Austronesian languages in the region.

Evidence for these now-vanished Papuan populations is found in the structure and distribution of contemporary Austronesian languages of eastern Indonesia, with particular reference to the western border of the so-called Central-Eastern Malayo-Polynesian languages (Figures 2 and 3), a grouping that has been proposed as a major subgroup within the Austronesian family (Blust 1993). A number of structural changes have been cited to support this division, including: (a) subject agreement prefixes on verbs; (b) a distinction in possessive marking, typically distinguishing body parts and family from the rest of the natural world; (c) a couple of verbal suffixes of ill-defined function; and, (d) three irregular morphological developments in the words for ‘four’, ‘yawn’ and ‘shy’ (Blust 1982, 1983/1984, 1993). However, these morphological developments are not found in all of the languages of the eastern region, and various of them are found in some of the more westerly languages in Indonesia that are not claimed to be part of this subgroup. This makes their value as innovations that define a Central-Eastern Malayo-Polynesian subgroup problematic. The verbal suffixes, point (c), have antecedents further west and, crucially, they are not present in their eastern Indonesian form further east in the Pacific. This implies they represent multiple local innovations, rather than developments of

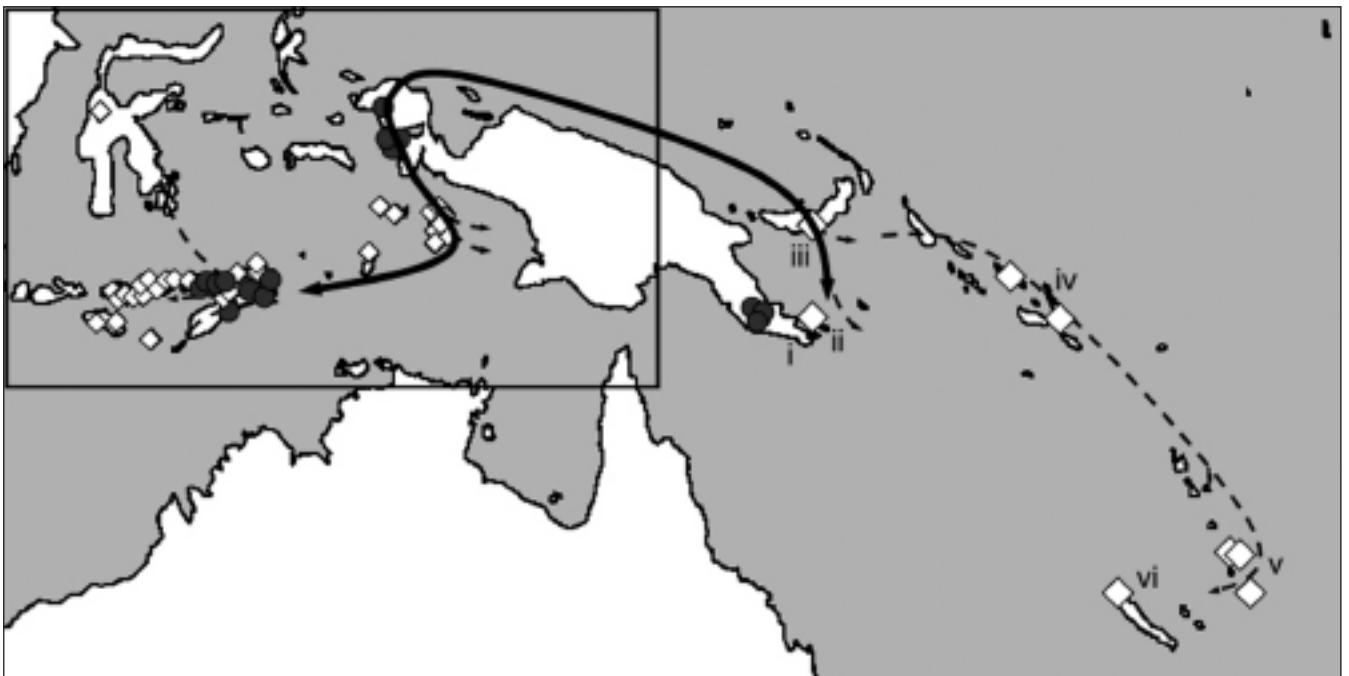


Figure 2. The distribution of *muku terms in the south-west Pacific. The area enclosed in the box in the north-west corner is expanded in Figure 3. Lower case roman numerals refer to languages appearing in Table 2. Papuan languages in which *muku appears are shown with shaded circles, and Austronesian languages with this term appear as white diamonds. The arrows show the inferred direction of dispersal for the *muku term. Due to the lack of ready materials for much of mainland New Guinea, sampling in this area has not been exhaustive.

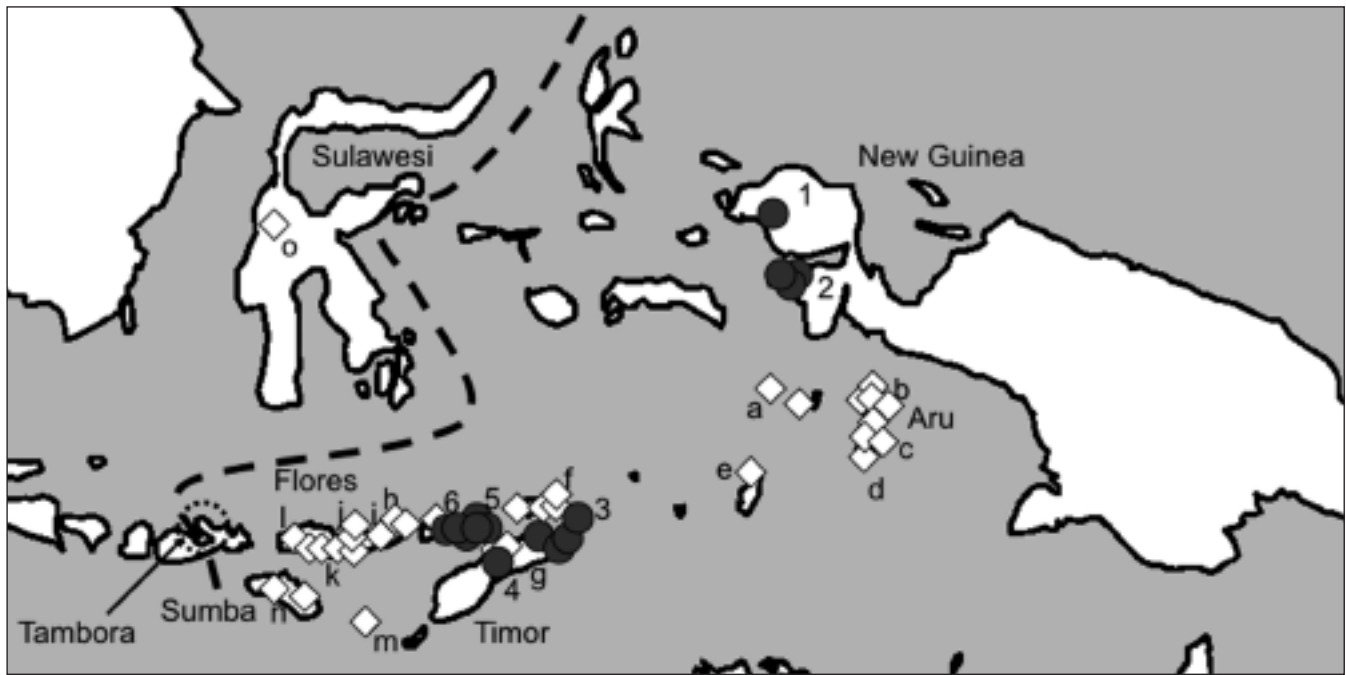


Figure 3. The distribution of *muku terms and the linguistic ecology of eastern Indonesia. Numbers and letters refer to languages appearing in Table 3. The thick dashed line marks the western border of the Central-Eastern Malayo-Polynesian area, east of which significant degrees of Papuan influence are observed in the modern Austronesian languages. The location of Tambora is marked with a finely dashed circle. Other attested Papuan languages are found on the mainland of New Guinea and in north Halmahera.

great antiquity. Points (a) and (b) are more robust, although problematically their distribution extends significantly west of the line generally accepted as the border of the subgroup. Importantly, prefixal agreement is also found in the languages of Sumatra, where ancient contact with now vanished Austro-Asiatic languages must be suspected for other reasons (e.g. Sidwell 2004). Since prefixal agreement and alienability contrasts are also features of the island Papuan languages of this region, and since Papuan influence is independently required to explain a number of additional traits of these eastern Austronesian languages (Reesink 2002; Donohue 2004, 2005, 2007b; Arka 2007; Mbetse 2007), the simplest explanation is that Papuan influence has shaped the construction of an internal division in the Austronesian family tree, and that the ‘Central-Eastern Malayo-Polynesian’ label represents those languages that display a strong Papuan substrate rather than a linguistic split.

Furthermore, given new evidence of a more western extent for this Papuan substrate (Donohue 2007b) than has previously been assumed (Capell 1975), the border of the so-called Central-Eastern Malayo-Polynesian languages matches exactly the past distribution of Papuan languages, providing strong support for the idea that there was, until relatively recently, a significant seafaring Papuan presence across eastern Indonesia. In addition to these structural features, there is some lexical evidence for a maritime population in the Sulu Sea–eastern Indonesia area, a population that Mahdi (1994a) refers to as ‘Australoid’ Austronesians that acted as a substrate to, and preceded, the ‘main’ Austronesian dispersal. In addition to Tambora we

note the persistence of prominent Papuan language-speaking maritime communities into modern times; for example, the Sultanates of Ternate and Tidore from North Halmahera were Papuan-speaking polities which held sway over an area reaching from North Sulawesi to western New Guinea. We suggest, based on the appearance of *muku in non-Austronesian and Austronesian languages, and the geographically restricted attestation of this lexeme, that these ‘Australoid’ populations were simply pre-Austronesian Papuans indigenous to the area. The two hypotheses are not incompatible, but there is no need to posit two waves of ‘Austronesian advance’ when there is ample evidence of a pre-Austronesian Papuan substrate in eastern Indonesia.

The distribution of banana terms

In considering linguistic traces of Papuan-Austronesian interaction, the term *muku is significant because it is the only term for banana found in a large number of both Papuan and Austronesian languages. Based on our dataset comprising banana terms in 950 languages across Southeast Asia and Melanesia, including over fifty reflexes of *muku, we reconstruct *muku as the protoform (Tables 2 and 3; Figure 4), matching a reconstruction previously discussed in a more restricted eastern Indonesian context by Verheijen (1984) (note that we are dealing, in most cases, with generic terms for bananas, not specific species names). Properly, *muku is a ‘false’ protoform; this is what Mahdi (1994b)

terms a *maverick* protoform, referring to a word that appears to be part of a language's inherited history, but might be an early loan from an external source. The ultimate source of the *muku term is not yet apparent. The term has not been reconstructed to Proto-Oceanic (Ross 1996) and so cannot be assumed to be etymologically Austronesian. To shed light on its origins, we examine reflexes of *muku in eastern Melanesia (Figure 2) and then in eastern Indonesia (Figure 3).

| Map Ref. | Language | Location | 'banana' | Source |
|---------------------|----------------|------------------|----------|----------------|
| Papuan | | | | |
| i | Yareba | SE New Guinea | mo | SIL survey |
| i | Nawaru (Sirio) | SE New Guinea | mo | SIL survey |
| i | Moikodi | SE New Guinea | mo/o | SIL survey |
| i | Aneme Wake | SE New Guinea | mo/o | SIL survey |
| Austronesian | | | | |
| ii | Maiadom | Milne Bay | mo'e | SIL survey |
| iii | Kaulong | New Britain | muhuk | Tryon 1995 |
| iv | Oroha | Solomons | makara | Palmer nd. |
| iv | Kokota | Solomons | muku | Palmer nd. |
| v | Anejom | Southern Vanuatu | na/mek | John Lynch pc. |
| v | Ura | Southern Vanuatu | ya/mek | John Lynch pc. |
| v | Sye | Southern Vanuatu | ya/mo' | John Lynch pc. |
| vi | Nelemwa | New Caledonia | mugic | Tryon 1995 |

Table 2. Representative examples of *muku in Island Melanesia (for locations see Figure 2).

There are attestations of *muku in Papuan languages in the extreme south-east of New Guinea (although there are sampling limitations to our data), and there are occasional attestations in Island Melanesia – in New Britain, the Solomons, southern Vanuatu and northern New Caledonia (Figure 2). The Austronesian languages of these last two areas exhibit 'aberrancies', which have been interpreted to represent a Papuan substrate (e.g. Ray 1926; Capell 1954; Lynch 1981; Tryon 1982; Donohue and Denham 2008; for a dissenting view, see Pawley 2006). It is not unreasonable to suppose that the appearance of *muku in these 'aberrant' languages represents lexical retentions from an earlier Papuan substrate. Both languages that attest *muku in the Solomons use it to refer to (unidentified) species names and not the generic term, a well-known fate for earlier terminologies. The terms from Maiadom and Kaulong, Austronesian languages closer to the New Guinea mainland, are less changed from *muku (or the modern south-east Papuan term), while the southern Vanuatu terms (Anejom, Ura and Sye) all show the accretion of an old case marker or article that typifies many etymologies in languages of the region (e.g. *na/mek* in Anejom). The overall picture from eastern Melanesia is of *muku exhibiting a limited distribution, restricted to areas with a Papuan substrate and to areas close to the New Guinea mainland where Papuan languages predominate.

Upon examining the distribution of *muku in eastern Indonesia, we find a striking pattern (Table 3; Figure 3). While affiliations of Tambora are unclear and unlikely to be

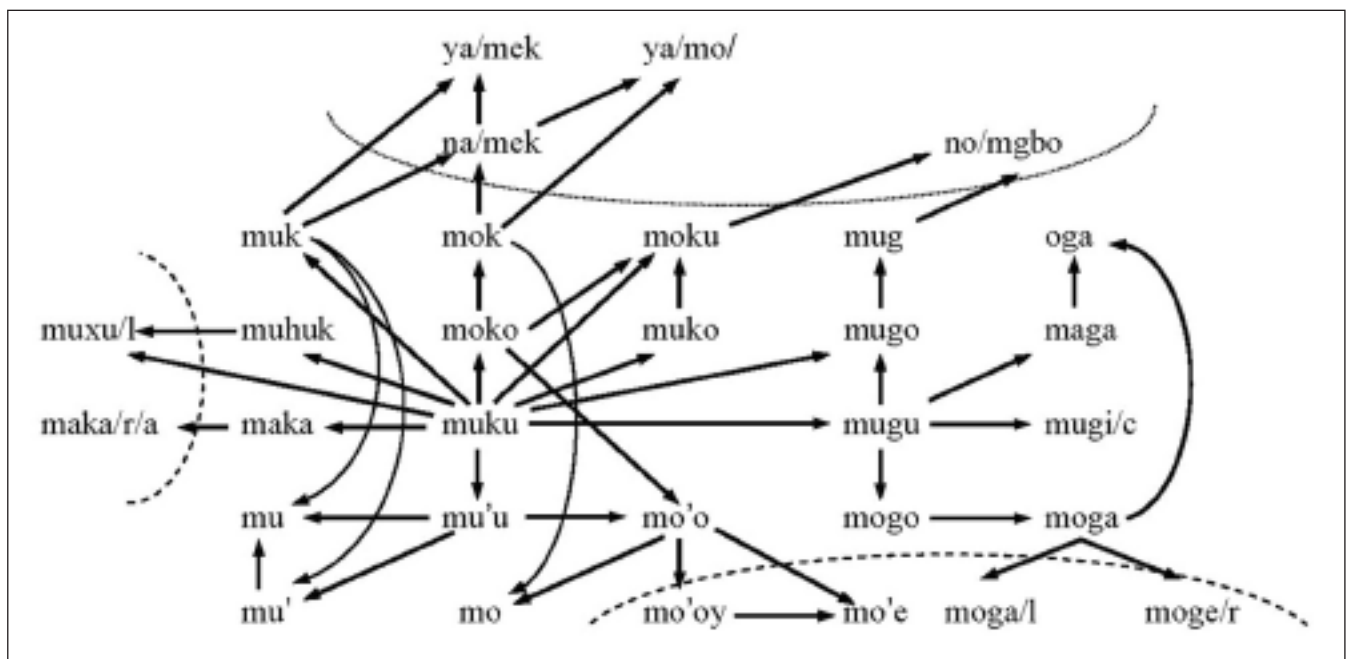


Figure 4. Likely pathways for the development of *muku to the modern forms. A series of plausible sound changes (*k > g; *k > x-h; *k > /; *vowel-/vowel > V; *u > o) all point to *muku as being the original term. Irregular developments (the accretion of a liquid -r or -l, and in some cases later developments of the liquid to -y and possible merger with a final vowel; the accretion of an initial article; sporadic lowering of a vowel to a) are largely geographically restricted. The accretion of liquids, shown to the left and in the lower right of the diagram, is characteristic of the Alor-Pantar region, while the accretion of a preceding article is found in southern Vanuatu and Iha of the Bird's Head (shown along the top of the diagram). Details of directionality are not always clear, but general principles clearly indicate *muku as a base form from which to begin.

| Map Ref. | Language | Location | 'banana' | Source |
|---------------------|-----------|--|----------|--------------------------|
| Papuan | | | | |
| 1 | Tehit | western Bird's Head | oga | Erin Hesse pc. |
| 2 | Mor | Bomberai Peninsula | moga | Anceaux 1958 |
| 3 | Oirata | eastern Timor | mu | De Josselin de Jong 1937 |
| 4 | Bunak | central Timor | mok | Stokhof 1975 |
| 5 | Tanglapui | eastern Alor | maka | Stokhof 1975 |
| 6 | Teiwa | Pantar | muxul | Stokhof 1975 |
| Austronesian | | | | |
| a | Teor-Kur | eastern Maluku | muk | Wallace 1962 |
| b | Kola | southern Maluku (Aru) | muk | Nivens pc. |
| c | Batuley | southern Maluku (Aru) | mug | Nivens pc. |
| d | Karey | southern Maluku (Aru) | mogo | Nivens pc. |
| e | Fordata | southern Maluku (Tanimbar) | mu'u | Nivens pc. |
| f | Ili'uun | Wetar island, southern Indonesia | mu'u | Hinton 2000 |
| g | Mambai | central Timor | mu | Capell 1944 |
| h | Lamaholot | eastern Flores | mugo | Donohue (own notes) |
| i | Sika | eastern Flores | mu'u | Tryon 1995 |
| j | Palu'e | north-central Flores | muku | Donohue (own notes) |
| k | Ngadha | central Flores | muku | Tryon 1995 |
| l | Manggarai | western Flores | muku | Verheijen 1990 |
| m | Sawu | Sawu island, southern Indonesia | womu'u | Wijngaarden 1896 |
| n | Kambera | eastern Sumba (muku refers to a particular species) | muku | Onvlee 1984 |
| o | Uma | central Sulawesi (moku refers to a particular species) | moku | Martens pc. |

Table 3. Representative examples of *muku in eastern Indonesia and East Timor (for locations see Figure 3).

As noted in the text, not all 'Papuan' languages are related to each other. The languages in this table have the following affiliations: Tehit: West Papuan family; Mor (isolate); Oirata: East Timor family; Bunak, Tanglapui, Teiwa: Timor-Alor-Pantar family. Not all languages reflecting *muku are shown in this table; a further 13 Papuan and 15 Austronesian languages, shown in Figures 2 and 3, attest this lexeme in eastern Indonesia and East Timor.

resolved, the Papuan languages of the Timor area are almost certainly related to languages of the mainland of New Guinea. They have been variously affiliated with the widespread Trans New Guinea languages that are said to span New Guinea from east to west (Stokhof 1975; Voorhoeve 1975), and to the West Papuan languages of the Bird's Head in north-west New Guinea (Capell 1975; Donohue 2008). There is a mainland base for the term among Papuan languages on the north-western fringe of New Guinea, and then a spread south and west, following the area in which we see a Papuan substrate in the grammar of the languages (Capell 1975; Donohue and Grimes 2008;

Donohue and Schapper 2008). The area in which *muku is found in the Austronesian languages of Maluku connects the New Guinea beachhead to the Timor area, where Papuan languages are still spoken today. The distribution of *muku through Sawu and Sumba, and across central and western Flores represents an aspect of a Papuan substrate in these islands – a substrate which is independently evidenced by the unusual analytical nature of these languages (Arka 2007) and the unusual numeral systems they display (Mbetse 2007) – to just short of Sumbawa, where the Papuan-speaking kingdom of Tambora was located (see also Capell 1975).

The distribution of modern reflexes of *muku is highly constrained west of New Guinea. None of the languages of Asia, including the vast reach of Island Southeast Asia in which Austronesian languages are found, are known to show a reflex of *muku. In other words, the area defined by the distribution of *muku banana terms traces out the southern distribution of attested Papuan-speaking populations west of New Guinea. Different explanations can be invoked to account for the presence of a similar word in two languages: both languages could have inherited the word from a shared ancestor; one might have borrowed the word from the other; both might have borrowed the term from an external source; or, the similarity could be due to chance. In the case of the distribution of *muku terms we know that not all of the languages involved are related, and so a common ancestor cannot explain the distribution. The contemporary social situation in eastern Indonesia, and the fact that we are dealing with more than 50 widely-dispersed languages means we can discount recent borrowing or chance similarity as explanations. Given that *muku does not occur in Austronesian languages away from the area of known Papuan contact or known historical Papuan distribution, an Austronesian source for the term is not supported by the data.

In eastern Melanesia *muku appears in a small number of Papuan languages, in areas suspected of having had an earlier Papuan presence, and in a couple of languages of the Solomons and New Guinea where Papuan languages are still attested. Consequently, taken together, the eastern and western distributions strongly implicate a Papuan, pre-Austronesian source: the term is found nowhere in Micronesia, Polynesia, or, as noted above, in Island Southeast Asia away from areas of Papuan contact. Despite the great time depth we are proposing, predating the Austronesian dispersal into Southeast Asia, the presence of the maverick cognate form in at least two unrelated language families leads us to believe that this lexical trace has persisted into the modern languages. Given the current distribution of the term in Flores and Sumba, where there is no modern Papuan population, but linguistic and genetic persistence of a pre-Austronesian Papuan presence (e.g. Lansing *et al.* 2007), we conclude that the Austronesian languages borrowed the word from a pre-existing Papuan language, namely, they inherited *muku as part of a Papuan substrate.

Significantly, the geographical distribution of *muku, which is applied generically to banana cultivars today,

crosses a botanical boundary. It extends from the natural ranges of *Musa* and *Callimusa* (those formerly termed *Australimusa*) section species (see Figure 1) to regions where cultivars were introduced, i.e. Timor, Flores, Vanuatu and New Caledonia. Although various banana species are native to many areas in Island Southeast Asia and Melanesia, we argue that *muku is associated with the anthropic dispersal of (some) utilised bananas eastwards and westwards from New Guinea. In eastern Melanesia, bananas referred to as *muku were spread to Vanuatu and New Caledonia; the term is a lexical retention of an earlier Papuan substrate in these now Austronesian languages. In eastern Indonesia, bananas referred to as *muku were spread westward by a pre-Austronesian culture with a maritime component. Maritime cultures flourished in the eastern Indonesian region (O'Connor and Veth 2005) and in Near Oceania (Torrence and Swadling 2008) in pre-Austronesian times, namely pre-dating c 4000 years ago. Thus, the distribution of the Papuan-derived term *muku tracks the pre-Austronesian spread of cultivars, most probably AA or AAA hybrids, westward from New Guinea. The term has been lost further west, where local and more widespread processes of Austronesian replacement have increasingly obliterated earlier Papuan traces – largely due to the expansion of Indian and Islamic influences and states of the last 1500 years.

The linguistic evidence fills a major gap in the archaeobotanical record, thereby allowing us to both map and date (approximately) the early dispersal of bananas from New Guinea. Since *muku has a Papuan origin, we can date the dispersal of bananas as preceding the arrival of Austronesian language-speakers in eastern Indonesia and New Guinea, namely, earlier than c 4000 years ago. The dispersal of *muku bananas accords with evidence for a maritime culture in the area from the early Holocene (White 2004; O'Connor 2007) and the timeframe accords with archaeobotanical evidence for the domestication of bananas in the New Guinea region, subsequent dispersal to Indonesia and onwards eventually to Africa.

Conclusion

Archaeobotany provides a pre-Austronesian timeframe for banana domestication in New Guinea and, possibly, for the dispersal of cultivars to Africa and the Indian subcontinent by 5000 and 4000 years ago, respectively. However, there is no archaeobotanical evidence tracking the mid-Holocene dispersal of banana cultivars across Island Southeast Asia westward from New Guinea. Linguistic data demonstrate that the term *muku is restricted to some Papuan languages of the western and eastern fringes of New Guinea, and in locations where a Papuan substrate persists. The Papuan substrate extends through Sawu and Sumba, and across central and western Flores. The appearance of this term in widely separated Papuan languages, and its extremely strong substrate in the area indicated, tracks and demonstrates a pre-Austronesian timeframe for this

dispersal. Further linguistic research that will most likely prove useful in elaborating our understanding of early maritime society in eastern Indonesian will include investigation of other cultivars that are found both in New Guinea and in islands to the west. Preliminary investigations in the field of tubers have not been fruitful (Hays 2005), but the examination of cultivars closely integrated into the symbolic life of the communities that utilise them offers a promising avenue for research (following e.g. Chlenov 1980). The complex processes of banana cultivar dispersal and hybridization across Island Southeast Asia, particularly in regions west of eastern Indonesia where linguistic traces of pre-Austronesian speaking peoples have been removed, are yet to be elucidated, but clearly indicate the existence of a seafaring society, or societies, practicing cultivation, extending at least from New Guinea to Sumba. These complexities will only be revealed following the systematic application of plant microfossil techniques during archaeological investigations across these regions and following the advent of more refined methods to discriminate banana phytoliths and starch grains to the species and subspecies taxonomic levels.

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