Middle to Late Holocene Paleoclimatic Change and the Early Bantu Expansion in the Rain Forests of Western Central Africa

by Koen Bostoen, Bernard Clist, Charles Doumenge, Rebecca Grollemund, Jean-Marie Hombert, Joseph Koni Muluwa, and Jean Maley

This article reviews evidence from biogeography, palynology, geology, historical linguistics, and archaeology and presents a new synthesis of the paleoclimatic context in which the early Bantu expansion took place. Paleoenvironmental data indicate that a climate crisis affected the Central African forest block during the Holocene, first on its periphery around 4000 BP and later at its core around 2500 BP. We argue here that both phases had an impact on the Bantu expansion but in different ways. The climate-induced extension of savannas in the Sanaga-Mbam confluence area around 4000–3500 BP facilitated the settlement of early Bantu-speech communities in the region of Yaoundé but did not lead to a large-scale geographic expansion of Bantu-speaking village communities in Central Africa. An extensive and rapid expansion of Bantu-speech communities, along with the dispersal of cereal cultivation and metallurgy, occurred only when the core of the Central African forest block was affected around 2500 BP. We claim that the Sangha River interval in particular constituted an important corridor of Bantu expansion. With this interdisciplinary review, we substantially deepen and revise earlier hypotheses linking the Bantu expansion with climate-induced forest openings around 3000 BP.

One African in three is fluent in one or more of the roughly 500 Bantu languages spoken south of about 4°N (Bostoen 2007; Nurse and Philippson 2003*a*). If the Bantu language family today is Africa's largest, this is the outcome of Central Africa's major Middle to Late Holocene demographic event—that is, the so-called Bantu expansion, which by now has fuelled several decades of multidisciplinary speculation (Bouquiaux 1980; de Maret 2013; Ehret 2001; Oliver 1966). Genetic evidence points toward the actual migration of peoples as the main historical event underlying the initial Bantu language dispersal rather than spread through language and culture shift. Sex-biased admixture with local hunter-gatherer groups contributed to shaping higher genetic diversity among Bantu-speaking peoples and to the further spread of Bantu languages to nonnative speakers (Pakendorf, Bostoen, and de Filippo 2011; Verdu et al. 2013). The Bantu expansion stands out because of its sheer magnitude and the relative rapidity with which it happened. Bantu languages spread from their homeland in the Nigeria-Cameroon borderland to the southern end of the continent in a time span of about 3,000 years,

Koen Bostoen is Professor at the Department of Languages and Cultures of Ghent University (Rozier 44, 9000 Ghent, Belgium [koen.bostoen@ugent.be]), where he currently leads the KongoKing Research Group, and is Lecturer at the Université Libre de Bruxelles (50 avenue F. Roosevelt, 1050 Brussels, Belgium). **Bernard Clist** is Postdoctoral Researcher in African archaeology at the KongoKing Research Group of the Department of Languages and Cultures of Ghent University (Rozier 44, 9000 Ghent, Belgium). **Charles Doumenge** is Research Director at the Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Unité de Recherche Biens et Services des Ecosystèmes Forestiers Tropicaux (Campus International de Baillarguet, 34398 Montpellier Cedex 5, France). **Rebecca Grollemund** is Postdoctoral Researcher at the Evolutionary Biology Group of the University of Reading (School of Biological Sciences, Lyle Building, University of Reading, Reading RG6 6AS, United Kingdom). **Jean-Marie Hombert** is Research Director at the Laboratoire Dynamique du Langage of the Centre National de la Recherche Scientifique (Unité Mixte de Recherche 5596, Institut des Sciences de l'Homme, 14 avenue Berthelot, 69363 Lyon Cedex 07, France). **Joseph Koni Muluwa** is Postdoctoral Researcher in African linguistics at the Department of Languages and Cultures of Ghent University (Rozier 44, 9000 Ghent, Belgium). **Jean Maley** is former Research Director at the Institut de Recherche pour le Développement, Montpellier, and also at the Département Paléoenvironnements de l'Institut des Sciences de l'Evolution de Montpellier (Centre National de la Recherche Scientifique/Unité Mixte de Recherche 5554, Université de Montpellier–2, France). This paper was submitted 19 IX 13, accepted 18 IX 14, and electronically published 5 V 15.

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if one reckons that the Bantu expansion started about 5,000 to 4,000 years ago (Blench 2006:126; Vansina 1995:52) and that the first Bantu-speech communities reached KwaZulu-Natal in the first centuries of the Common Era (Bostoen 2007:195; Phillipson 2005:257). This massive expansion is even more outstanding if one takes into account that it involved the crossing of different climate zones and ecological niches. One of the first barriers with which early Bantu speakers were confronted when moving south were the dense, humid forests of Central Africa. Being of diverse composition, these were not always equally impenetrable to the newcomers but rather imposed a gradual adjustment of production systems and social institutions (Vansina 1990). The widespread and deeply rooted Bantu conception of hunter-gatherers as religious specialists goes back to the time of the earliest Bantu expansions, when the autochthons had to ensure prosperity as experts of fauna and flora and were seen as protectors against hostile spirits of the forest (Klieman 2003).

The Central African forest block was not only home to varied vegetation but was also not always as untouched as is often assumed (van Gemerden et al. 2003). Throughout the Quaternary, it underwent important changes in forest cover and composition, mainly resulting from climatic change (Colyn, Gautier-Hion, and Verheyen 1991; Maley 1996; Maley et al. 2012). Since Schwartz (1992), the hypothesis that a climate-induced rain forest crisis during the third millennium BP facilitated the spread of Bantu-speech communities throughout Central Africa has gained growing acceptance (Maley 2001; Neumann et al. 2012*a*, 2012*b*; Oslisly 2001). Palynological and geologic data obtained over the past 2 decades indeed testify to severe disturbances in Central African rain forests during that period (Elenga et al. 2000; Maley and Brenac 1998; Ngomanda et al. 2009; Vincens et al. 1994, 1998). The discovery of the savanna crop pearl millet (*Pennisetum glaucum*) in southern Cameroon, dated between 2400 and 2200 BP, gave further substantiation to this hypothesis (Kahlheber, Bostoen, and Neumann 2009). Lesser known is the fact that climate-induced Late Holocene vegetation change already started around 4000 BP, when the periphery of the Central African rain forest gave way to savannas (Desjardins et al. 2013; Maley 2004). Moreover, exactly how paleoclimatic change influenced the Bantu expansion has never been assessed in any systematic way.

The present article therefore examines the impact of Middle to Late Holocene paleoclimatic changes on the earliest phases of the Bantu expansion in Atlantic Central Africa by reviewing in detail new and old evidence from different disciplines, that is, biogeography, geology, palynology, historical linguistics, and archaeology. This is done with a view to presenting an interdisciplinary synthesis, which has been lacking until now. We aim to stress the importance of considering climate change when studying prehistory by reconstructing the climatic and ecological context in which the early Bantu-speech communities entered and traversed the equatorial forest. Consequently, the geographic scope of this article is restricted to the following Bantu-speaking countries of western Central Africa: Cameroon, Equatorial Guinea, Gabon, southern Central African Republic (CAR), and both Congos. In "Biogeography," we discuss how biogeographic evidence attests to recurrent phases of forest disturbance in Central Africa throughout the Quaternary, especially in the so-called Sangha River interval (SRI; Gond et al. 2013; White 1979). In "Palynology and Other Paleoenvironmental Data," we review palynological evidence pointing toward significant variations in forest cover and composition during the Middle and Late Holocene. In "Historical Linguistics," a new phylogenetic tree of the northwest Bantu languages is presented and analyzed in terms of successive hubs of language dispersal. In "Archaeology," the Late Holocene archaeology of western Central Africa is reviewed to identify an archaeological signature of the Bantu language dispersal. An interdisciplinary synthesis of the possible impacts of Late Holocene paleoclimatic change on the Bantu expansion is discussed in "Discussion and Conclusions."

Biogeography

In the course of their migrations, early Bantu speakers chose those environments that best suited their way of life or had to adapt their subsistence strategies to various new environments. Present-day plant and animal populations in the rain forests may reflect past variations in forest cover and hence point out the human migration corridors that were most likely from an environmental point of view. A discontinuous series of small savannas along the Atlantic coast, for instance, may have facilitated human migration. The dense humid forests covering Central Africa from near the Atlantic coast to the Western Rift Mountains are less suitable for migration. Most of the area between southern Cameroon and Gabon harbors forests with abundant species characteristic of evergreen forests, such as Leguminosae-Caesalpinioideae (Caballé and Fontès 1978; Letouzey 1985, 1968). In some parts, these dense forests may have persisted during the Holocene (Maley 2004). They constituted an environment to which the way of life of autochthonous hunter-gatherers was better adapted than that of the subsistence economy of immigrating early Bantu speakers.

Nevertheless, global climatic variations throughout the Pleistocene and the Holocene had an important impact on flora and fauna distribution in Central Africa. The present-day Guineo-Congolian rain forests still bear the marks of past disturbances (Colyn, Gautier-Hion, and Verheyen 1991; Gonmadje et al. 2012; Koffi et al. 2011; van Gemerden et al. 2003). The presence of remnant savanna species in today's dense humid forest landscapes, for instance, is indicative of such forest retreats in favor of woodlands and savannas. Savanna species may survive for several hundred years depending on the speed of the forest recovery and the possibilities of some plants or animals to subsist in relict habitats. The absence of common forest species from some areas within the forest block may also indicate that dense forests were once disturbed or disappeared entirely. Depending on their reproductive capacity and dispersion rate, those typical forest species were not able to recolonize their former habitat since the last perturbation. The recurrence of climate changes since the Pliocene exacerbated these trends.

Letouzey (1968, 1985) was the first to bring forward the idea of a link between the Sudanian and Zambezian savannas due to forest perturbation in between. In the moist tropical forest of southeastern Cameroon, he observed a number of biotic elements at odds with present-day climatic conditions. This area—including neighboring northern Congo and southwestern CAR—shows various biogeographic peculiarities: it is known as the SRI, a 400-km-wide area approximately situated between longitudes 14°E and 18°E and latitudes 0°N and 4°N (Gond et al. 2013; see fig. 1). The SRI may have recurrently linked the Sudanian savannas in the north to the savannas of the Batéké Plateau in the south, as testified by its vegetation containing several savanna traces, such as *Phoenix reclinata*. This wild date palm is normally absent from rain forests and is mostly present in savannas on wet soils, including at medium to high altitude (1,200–1,800 m asl); on escarpments; and in open woody environments (Amougou and Mbolo 1989; Letouzey 1985, 1968). In the rain forests of the SRI, this palm occurs only on the periphery of swamp clearings and near rivers in sunny situations. It is absent from equivalent environments in the rest of the dense rain forests of Central Africa, apart from the forest-savanna mosaics along the Atlantic Ocean. This relict presence of *P. reclinata* is in line with fossil pollen data pointing to forest openings in those areas during the Late Holocene (Brncic et al. 2009).

Conversely, the SRI also lacks some plant species typical of dense humid forests that are present in both the lower Guinean and the Congolian floristic domain in Cameroon-Gabon and the Democratic Republic of the Congo (DRC), respectively. Certain *Diospyros* (Ebenaceae) species provide good examples of such an interrupted distribution pattern (White 1979), as do various Leguminosae-Caesalpinioideae species (Doumenge et al. 2014). They were presumably once present from Gabon all the way to the DRC, but their distribution was interrupted due to drier climate conditions in the past. These *Diospyros* species could not reinstall themselves in the SRI, despite the recovery of the dense, humid forest since the last dry episodes of the Pleistocene and the Holocene (Dupont et al. 2000; Maley 2001, 2004).

What applies to plants also applies to animals. During past geologic times, forest openings and subsequent savanna development in the SRI created corridors that savanna fauna took advantage of to spread south. The black rhinoceros (*Diceros bicornis*, Rhinocerotidae), which was present around 7000 BP in the Niari valley (Congo; Van Neer and Lanfranchi 1986), is a good case in point. This browser feeds on leaves and

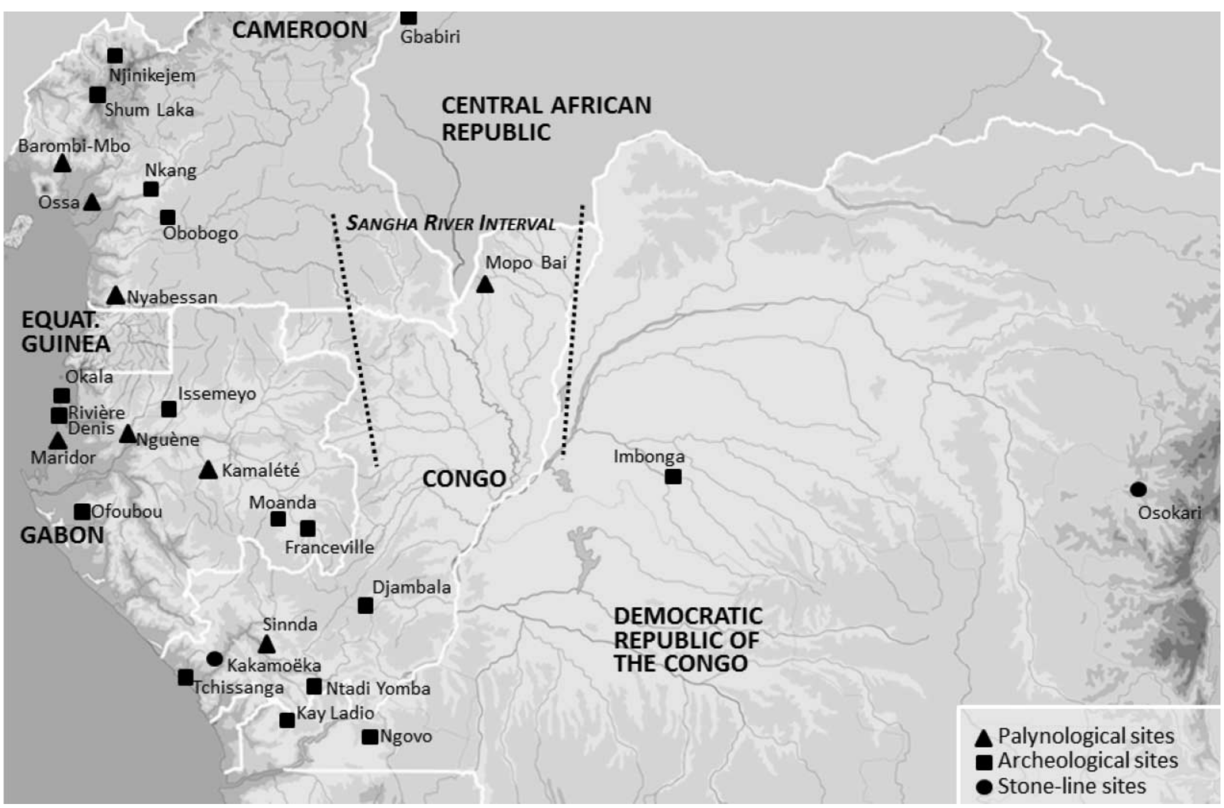

Figure 1. Palynological, archaeological, and geologic sites discussed in this article. A color version of this figure is available online.

young shoots of trees and shrubs and prefers forest-savanna mosaics with shrubs and tree regrowth. It avoids the main dense forest area but is present in a wide variety of habitats, including wooded savannas of varying density and thickets. It has its origins in eastern Africa, from where it spread to southern Africa, among other places, including Namibia and the southern part of Angola. There are no traces of its presence in northern Angola and in the savannas on the left bank of the lower Congo River (Emslie and Brooks 1999; Hillman-Smith and Groves 1994; Kingdon 1997; Lavauden 1934). We can therefore safely assume that the black rhinoceros that once lived in the Congo savannas did not come from farther south but from the Cameroon-CAR area in the north. The species may already have been rare there during the Holocene, and the Ntadi Yomba remains may reflect a residual situation (Van Neer and Lanfranchi 1986). It probably disappeared from the area during the Early Holocene climatic optimum, but its earlier presence indicates that the forest extension and composition in the SRI underwent fluctuations during the Pleistocene. The recurrence of this phenomenon is likely to have persisted during the Holocene, given the cyclic occurrence of drier or more seasonal climatic phases since the Pleistocene (Dupont et al. 2000; Maley 2001, 2004).

This is further corroborated by recent phylogeographic work showing that various animal species found in the southern Gabon-Congo savannas have northern rather than southern genetic affinities, such as the pygmy mouse (*Mus minutoides*, Muridae), a strictly savanna species not associated with human activities (Mboumba et al. 2011). Populations of this mouse from Gabon and Congo are genetically related to Cameroon and CAR populations in the north despite the current fragmentation of savannas. Such is the case of the bushbuck (*Tragelaphus scriptus*, Bovidae) living in savanna-forest mosaics of Gabon and Congo. This species is widespread in sub-Saharan Africa and lives in well-irrigated wooded savannas, which have permanent pools and clumps of trees and forest galleries (Kingdon 1997; Malbrant and Maclatchy 1949). Gabonese and Congolese bushbucks belong to the *scriptus* (or northern) haplotype, including all bushbucks from Senegal to western Ethiopia. On the other hand, bushbucks from northwestern Angola are related to the *sylvaticus* (or southern) haplotype, including the populations of eastern and southern Africa (Moodley and Bruford 2007). The bushbucks of Gabon and Congo are thus genetically closer to those of Cameroon than to those of Angola. Their spread from the north, just like that of pygmy mice, can be accounted for by recurrent periods of forest openings that occurred along the SRI and the Atlantic coast, which interconnected southern and northern savannas during past geologic times.

This biogeographic evidence obviously does not directly pertain to the Bantu expansion. The phenomena discussed above took place long before Bantu languages spread through Central Africa. Indirectly, however, these data have great significance in that they show that the Late Holocene forest openings that took place at the time of the Bantu expansion were not an isolated phenomenon. They are a particular manifestation of a longer-term trend of cyclic forest openings that have recurrently linked northern and southern savannas during past geologic times. The paleoenvironmental evidence for these Late Holocene forest openings and their dating is discussed in the next section.

Palynology and Other Paleoenvironmental Data

Both pollen (Vincens et al. 2010) and pedologic (i.e., ferralitic soils; Muller 1978) data indicate that the African rain forest underwent a maximal extension in the Early Holocene, from about 11,000 to 6000 BP, particularly to the north, where it extended as far as the Adamawa Plateau. After this climatic optimum, the forest fragmented on the Adamawa Plateau during the Middle Holocene, that is, between 6000 and 4000 BP (Vincens et al. 2010), a phenomenon that possibly extended to the middle Benue valley. This period marked the beginning of important variations in the forest cover and composition of Central Africa, which were important for human subsistence since they enabled concurrent access to various ecosystems. Late Holocene climate change led to the collapse of montane forests in the Cameroon volcanic line and the neighboring Adamawa and Ubangi Plateaus (Lebamba, Vincens, and Maley 2012; Lézine et al. 2013*a*, 2013*b*; Maley and Brenac 1998; Runge 2002; Vincens et al. 2010). In the lowlands, pioneer and light-demanding trees, such as *Alchornea*, *Macaranga*, *Elaeis*, and so on, expanded considerably (Lézine et al. 2013*b*; Maley and Brenac 1998; Ngomanda et al. 2009; Reynaud-Farrera, Maley, and Wirrmann 1996). Fossil pollen data from sediment cores sampled from different Central African lakes and swamps (see fig. 1) indicate significant forest perturbation during the Late Holocene, characterized by a distinct decrease of mature forest taxa and an increase in pioneers and/or grasses.

A first crisis occurred around 4000 BP, leading to forest contraction and savanna extension on the periphery of the rain forest. This phenomenon was related to an increased seasonality of the monsoon, linked to a lowering of the sea surface temperature (SST) in the Guinean Gulf (Weldeab, Schneider, and Müller 2007). This decreasing rainfall destroyed peripheral forests, which are generally of the semideciduous type or composed of pioneer species, and favored the extending of savanna environments. In the north, the main event was the abrupt opening of the Dahomey gap (Salzmann and Hoelzmann 2005). In the south, the Niari savannas in western Congo and the littoral savannas in Gabon increased in size, as evidenced by the drying of Lake Sinnda (Vincens et al. 1998, 1994) and the Maridor site (Ngomanda et al. 2009), respectively. A similar opening occurred in central Cameroon around 4000–3500 BP, especially with an extension of savannas in the wider vicinity of the Sanaga-Mbam confluence zone north of Yaoundé (Desjardins et al. 2013). However, the core of the rain forest subsisted during that period, because in that area the lowering of the SST led to the development of stratiform clouds, which produce little or no rain but reduce evapotranspiration and favor fogs in the canopy. Many typical evergreen rain forest taxa, such as Leguminosae-Caesalpinioideae and Sapotaceae, are adapted to capture the atmospheric humidity, compensating for reduced rains and favoring forest conservation (Maley 1997:620; Maley and Brenac 1998:183). These particular taxa even exhibit an increase in pollen profiles, such as in Lakes Barombi-Mbo and Ossa and the Nyabessan swamp in Cameroon and Lake Nguène near the Cristal Mountains in Gabon (Giresse et al. 2009; Lebamba, Vincens, and Maley 2012; Maley and Brenac 1998; Ngomanda et al. 2009; Reynaud-Farrera, Maley, and Wirrmann 1996).

A second crisis occurred toward 2500 BP when the SST abruptly increased, changing the monsoon and leading to a strong development of cumuliform clouds and an increased seasonality of rainfall (Maley 2002; Weldeab, Schneider, and Müller 2007). Stormy rainfall caused strong erosion, resulting in the deposit of coarse sediments, such as sands, pebbles, and stonelines. Such a stoneline has been dated in the Mayombe, a submontane region (altitude of up to 900–1000 m) in the DRC, close to the Atlantic coast (Maley and Giresse 1998). Another stoneline from the same period was found close to Osokari in the eastern part of the Congo Basin (Runge 1997). Both sites, situated on opposite sides of the Central African rain forest, contain similar and contemporary units. This indicates that climatic changes around 2500 BP, linked with major variations in the African monsoon, had a large-scale impact that even extended to the western part of East Africa, as evidenced by pollen and diatom data from Lake Victoria (Stager, Cumming, and Meeker 1997). Certain palynological sites, such as Lake Kamalété in the Lopé Reserve, are the result of erosion-induced alluvial dams (Giresse et al. 2009). The level dated 3460–2890 BP at Lake Maridor, for instance, results from the introduction of an older layer into a younger one (Giresse et al. 2009). This forest perturbation phase led to an important development of pioneer vegetation (Lebamba, Vincens, and Maley 2012; Maley 2001, 2002; Ngomanda et al. 2009; Giresse et al. 2009). In some places, such as Barombi-Mbo (southern Cameroon) or Mopo Bai (northern Congo), savannas appeared for a short period (Giresse et al. 2009; Maley 2001, 2002).

In the western part of the Congo Basin, this climatic perturbation around the middle of the third millennium BP led to the emergence of vegetation mosaics with patches of more or less open forests and wooded or grassland savannas. This is clearly evidenced by one specific pollen diagram obtained at the site of Mopo Bai (lat. 2.233°N, long. 16.262°E), a seasonally flooded swampy depression in northern Congo-Brazzaville, which is part of the SRI, just east of the Sangha River and close to the CAR border (Brncic et al. 2009; Maley and Willis 2010). The bottom of the sedimentary core around 2580 BP contained a high percentage (36%) of Poaceae pollen, signaling a strong but short savanna phase. However, this opening phase immediately triggered a new process of forest recolonization, as confirmed by the dominance of tree and shrub pollen at 50% of the pollen sum. In the following levels between 2580 and 2385 BP, the most abundant taxa were pioneers, such as *Alchornea*, *Elaeis guineensis* (oil palm), and *Macaranga*. In particular, *Alchornea* pollen peaked during this period at 40%. *Elaeis guineensis* reached about 10% (Brncic et al. 2009:84; Maley and Willis 2010), which corresponds to climate-induced fluctuations of this pioneer during the Late Holocene elsewhere in Central Africa (Maley and Chepstow-Lusty 2001). Toward the end of this period, around 2385 BP, Poaceae pollen dropped to less than 13%, and some shade-bearing tree taxa, such as *Celtis* and *Funtumia africana*, began to increase. However, pioneer taxa continued to dominate, their peak being situated around 2000 BP (especially oil palm pollen, with an increase up to 20%), but they completely disappeared only around 1000 BP. Given that Mopo Bai lies within the perimeter of the SRI, its pollen diagram attests to the fact that climate-induced forest destruction led to the reemergence of this interval around 2500 BP.

The paleoenvironmental data discussed in this section show that during the Middle and Late Holocene the Central African forest block underwent two major crises, one that caused savanna extension on its periphery around 4000 BP and another that strongly perturbed its central core around 2500 BP. As had happened in past geologic times, the latter crisis led to a reopening of the SRI, which presumably constituted an important corridor for the rapid and large-scale geographic spread of Bantu-speech communities, as we argue below. The earlier crisis affecting the forest's periphery did not lead to such a major expansion, but it may have facilitated the settlement of Bantu-speaking village communities in the Sanaga-Mbam confluence area. As discussed below, both linguistic and archaeological data suggest that this region constituted an important hub of secondary expansion south of the Bantu homeland.

Historical Linguistics

Two main contributions of historical linguistics to the reconstruction of early African history are language classification and lexical reconstruction. Because of space constraints, we focus here on the former. We refer the reader to a recent historical study of Bantu vocabulary for pioneer tree species, such as *Musanga cecropioides*, *E. guineensis*, and *Canarium schweinfurthii*, and how their present-day spatial distribution patterns possibly reflect the impact of climate-induced vegetation dynamics in the course of the Bantu expansion (Bostoen, Grollemund, and Koni Muluwa 2013).

Historical language classification basically aims at establishing genealogical relationships between languages (for more details, see, e.g., Dimmendaal 2011). The standard procedure for this is use of family trees. Most internal classifications of Bantu languages are based on lexicostatistics (Bastin, Coupez, and Mann 1999; Heine, Hoff, and Vossen 1977; Henrici

1973), a method for generating language trees through the calculation of lexical distance between language pairs in terms of percentages of shared basic vocabulary (Swadesh 1950). Since the beginning of the twenty-first century, new quantitative phylogenetic methods, originally developed within the field of evolutionary biology, have made their entrance in historical linguistics (Pagel 2000). Phylogenetic Bantu classifications were proposed using methods such as maximum parsimony (Holden 2002; Holden and Gray 2006; Rexová, Bastin, and Frynta 2006) and Bayesian inference (Currie et al. 2013; de Filippo et al. 2012; Holden and Gray 2006; Holden, Meade, and Pagel 2005; Rexová, Bastin, and Frynta 2006). If demic diffusion was indeed the major demographic event underlying the early Bantu expansion (de Filippo et al. 2012; Pakendorf, Bostoen, and de Filippo 2011), the historical relationships between present-day languages can be treated as indicative of the migration paths of their ancestral speech communities. The location of the Bantu homeland in the borderland between southeastern Nigeria and western Cameroon has found broad acceptance among linguists since Greenberg (1972; see fig. 2). It is a region of high linguistic diversity, where Bantu languages meet with several other branches of the larger Benue-Congo family, among others their closest relatives, known as Bantoid or Wide Bantu languages (Bastin and Piron 1999; Grollemund 2012; Piron 1998).

Internal Bantu classification allows pinning down the approximate homeland of successive ancestor languages descending from Proto-Bantu. From what we know about Middle to Late Holocene vegetation dynamics in Central Africa, we can then assess whether these may have facilitated language dispersal from these different hubs of expansion. We discuss here a phylogenetic tree that builds on the earlier classification of North-West Bantu languages established by Grollemund (2012). The classification presented in figure 3 is a simplified Bayesian consensus tree consisting of 168 Bantu languages. Triangle size is proportional to the number of languages, and numbers on the tree in figures 2 and 3 correspond to successive hubs of Bantu language dispersal.

The first split-off in the Bantu tree is the so-called Mbam-Bubi subgroup (Bastin and Piron 1999:152), clustering several Bantu languages of the Mbam region of central Cameroon and the Bubi language spoken on Bioko Island. These

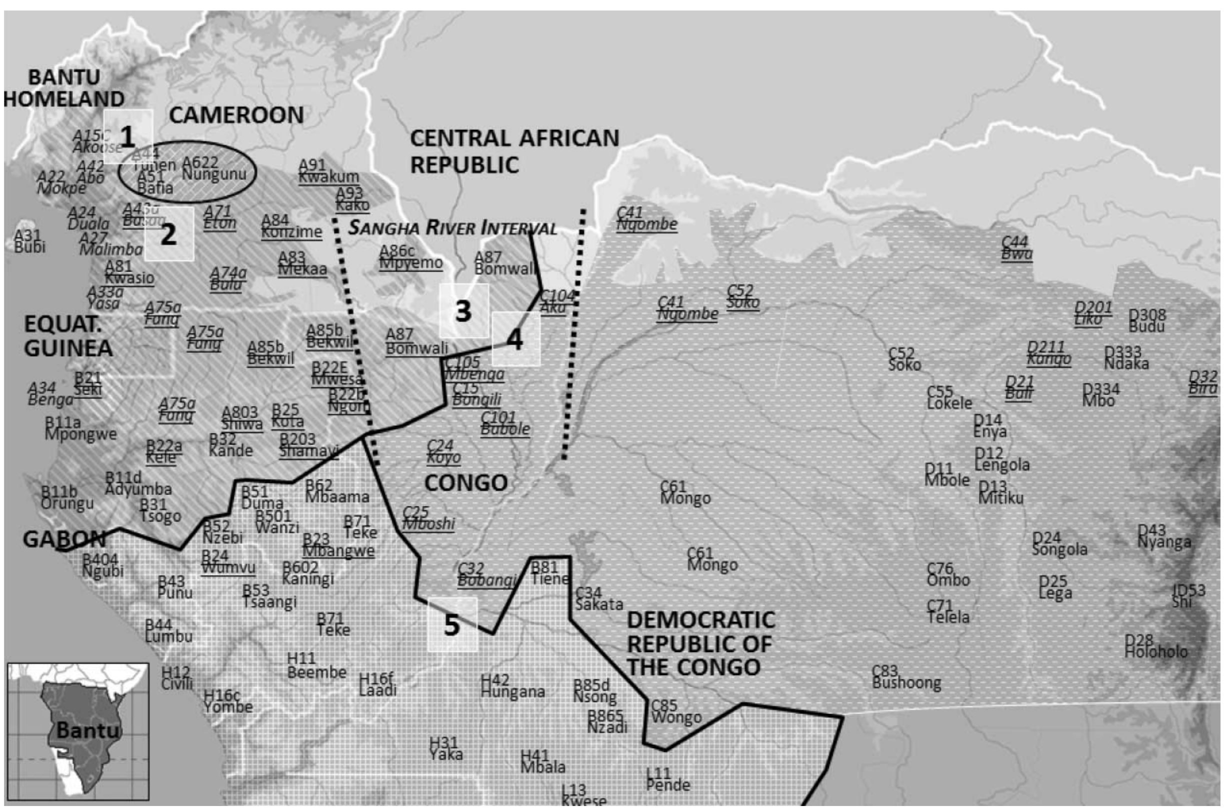

Figure 2. Linguistic map representing the historical Bantu subgroups discussed in this article. The language codes in figures 2 and 3 refer to the referential classification of Guthrie (1971), who used typological and geographic criteria to classify the Bantu languages into a number of zones indicated by a capital letter (zones A–S) and then further subdivided them into groups indicated by a decimal cipher (10–90). This referential, ahistorical classification is still used by comparative Bantu linguists today because it facilitates the relative geolocation of Bantu languages. A color version of this figure is available online.

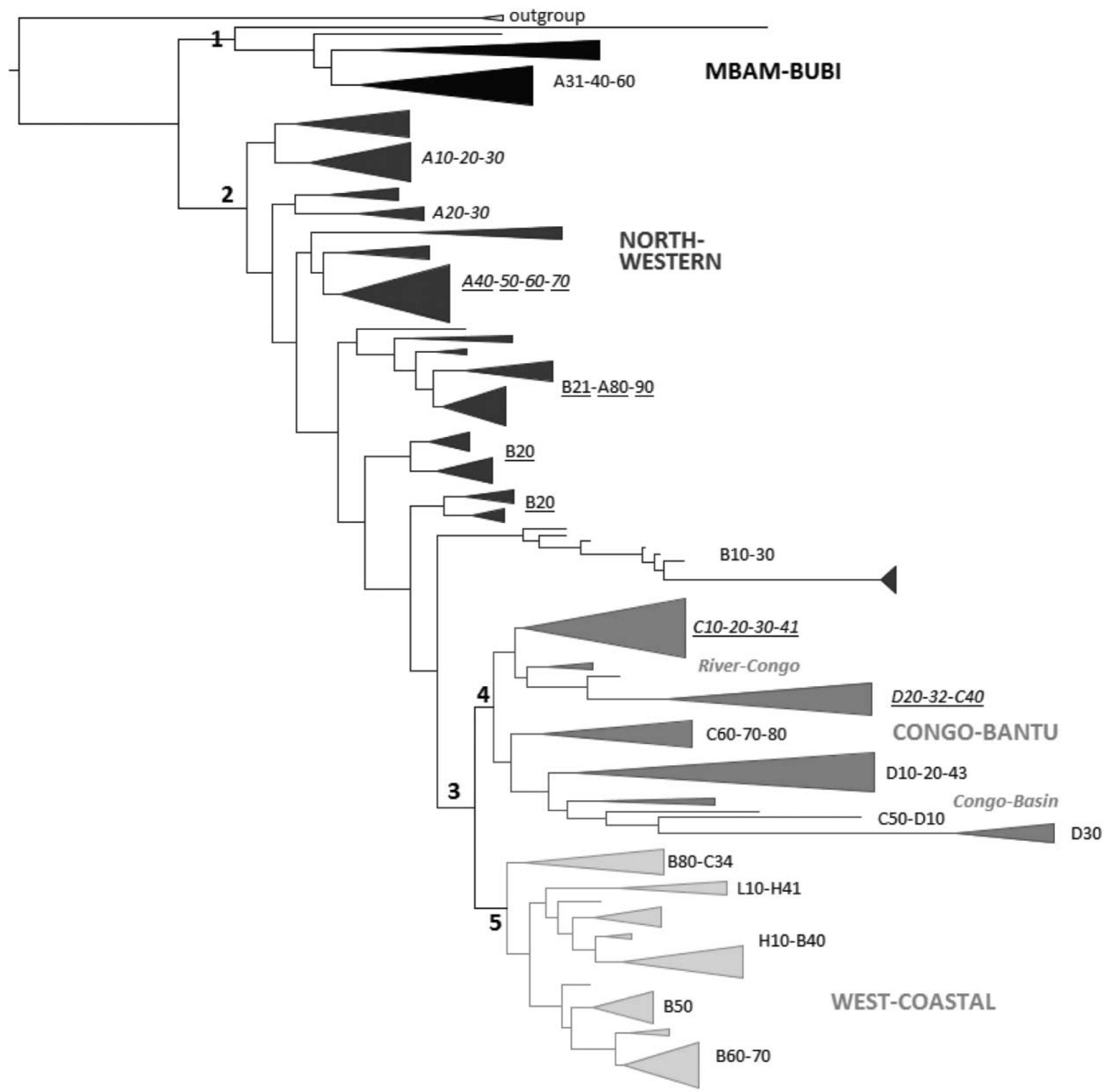

Figure 3. Simplified Bayesian consensus tree of 168 Bantu languages. Triangle size is proportional to the number of languages, and numbers on the tree in figures 2 and 3 correspond to successive hubs of Bantu language dispersal. A color version of this figure is available online.

Bantu languages are the ones most closely related to Benue-Congo languages spoken farther north, that is, in the vicinity of the Bantu homeland. It is well known that they straddle Narrow and Wide Bantu (Bastin and Piron 1999:155; Grollemund 2012:349). This central Cameroonian area, just north of Yaoundé and Douala, constituted an important secondary center of early Bantu language dispersal situated less than 200 km south of the Bantu homeland (hub 1 in fig. 2). The high degree of diversity we observe today between languages spoken in between those two hubs of early Bantu expansion is very likely the result of a long process of linguistic fragmentation. This might be due to the fact that the migration from the highlands of northwestern Cameroon to the lowlands of central Cameroon required the adaptation of subsistence strategies to new ecosystems, which was no doubt a slow and gradual process.

The following branch to split off is the so-called North-West Bantu cluster (Bastin, Coupez, and Mann 1999; Grollemund 2012; Vansina 1995), consisting of all remaining Bantu languages of Cameroon and Equatorial Guinea and a number of Bantu languages from northern Gabon and southern CAR. Taking into account the present-day geographic distribution of the North-West Bantu languages and applying Occam's razor (principle of the least moves), the separation of their most recent common ancestor from the Mbam-Bubi languages must have happened somewhere in the Cameroonian lowlands south of Yaoundé (hub 2 in fig. 2).

From this center of expansion in the wider Yaoundé region, the North-West ancestral node split up into a number of Bantu language clusters now occupying southern Cameroon and adjacent regions: coastal Cameroon (italics in figs. 2 and 3), inner Cameroon (italics and underlined in figs. 2 and 3), and the Mekaa-Kota-Kele group, mainly spoken in the borderland between Cameroon, Gabon, Congo, and the CAR (underlined in figs. 2 and 3). Divergence within the North-West cluster is thus to a great extent the result of a fairly local fragmentation in southern Cameroon and immediately neighboring regions due to slow and gradual expansions that predominantly went in longitudinal directions and not farther south than about 2°N until quite recently. It is well known, for instance, that the expansion of a language like Fang in northern Gabon started only 500 years ago and happened to the detriment of its distant relatives of the Myene-Tsogo cluster (Klieman 2003:47). Given that the distance between Yaoundé and the borderland with Equatorial Guinea and Gabon is no more than 200 km as the crow flies, the early expansions of the above-described North-West Bantu subgroups were as much latitudinal as longitudinal.

The Myene-Tsogo cluster (no italics and not underlined in figs. 2 and 3) is the only subgroup that deviates from the common pattern of early divergence within the North-West Bantu cluster. The Myene languages are spoken in the Ogooué-Maritime and Middle Ogooué provinces and in the coastal Lambarene area in northwestern Gabon, and the Tsogo language group is mainly situated in the Ngounie and Ogooué-Lolo provinces of central Gabon. The Myene-Tsogo cluster is to be considered a geographic outlier within the North-West Bantu subgroup. Its genesis is the result of an early long-distance expansion that was primarily longitudinal and reached south of the equator, most likely through the coastal plains of northern Gabon (Klieman 2003:56). This contrasts with fragmentation within the remainder of the North-West Bantu subgroup, which is the result of rather small-scale expansions between roughly 5°N and 2°N and 9°E and 12°E.

The clade splitting off after North-West Bantu consists of two parallel subclades: Congo Bantu and West-Coastal Bantu. Given the relative position of those two subclades vis-à-vis each other and vis-à-vis the North-West Bantu clade from which they arose, their most recent common ancestor must have split off from North-West Bantu in the area that today constitutes the border region between Cameroon, Gabon, the Congo, and the CAR (hub 3 in fig. 2). This is close to where Vansina (1995) situates the homeland of this subclade, that is, "somewhere in northern Congo [. . .] in the inundated forests and swamps between the Sangha and Ubangi rivers" (187).

The first block, the Congo Bantu subclade, soon underwent a further fragmentation into two main subclades (hub 4 in fig. 2), that is, River Congo Bantu (italics and underlined in figs. 2 and 3) and Congo Basin Bantu (no italics and not underlined in figs. 2 and 3; Bostoen 2006; Vansina 1995). The River Congo Bantu subgroup mainly comprises those Bantu languages spoken immediately west and northwest of the great Congo River bend in the area in between the Sangha, Ubangi, and Congo Rivers as well as the Bantu languages spoken north of the Congo River extending eastward close to the border area in between the DRC and Uganda. This subgroup clearly underwent an eastbound expansion in the forest margin north of the Congo River. The Congo Basin subgroup mainly consists of those Bantu languages spread over the enormous watershed east and south of the Congo River, extending east into the eastern part of the DRC and south into the lower Kasai area. The distribution of this subgroup is the result of a gradual expansion that probably started somewhere in the vicinity of present-day Mbandaka (DRC) and largely followed the enormous river network constituted by Congo's left-bank tributaries.

The West-Coastal Bantu subclade started to split up much farther south than the Congo Bantu subclade. It consists of languages spoken in the southern part of the Congo and Gabon as well as in the Bandundu and lower Congo regions of the DRC. The fragmentation center of this subclade is difficult to pin down with exactitude, but it was probably situated somewhere in between the Batéké Plateau and the Bandundu region, that is, around 3°S and between about 14°E and 17°E (hub 5 in fig. 2). This is the area of highest linguistic diversity within the subgroup and also the one nearest to the closest relatives of the Congo Bantu subgroup.

The internal classification of western Bantu languages presented here indicates that the initial stages of internal Bantu diversification all happened in fairly close proximity to the Bantu homeland. The first two major Narrow Bantu subgroups—that is, Mbam-Bubi and North-West Bantu—split off within the confines of present-day Cameroon, probably closer to Yaoundé than to the borderland with Gabon and Equatorial Guinea. This early fragmentation resulted from a gradual process of expansion over relatively short distances. The transition from a highland habitat in a mixed savanna-forest ecotone to a way of life in the dense forest of the lowlands probably did not allow for a rapid expansion over large distances. However, as we argue below, the 4000 BP forest crisis probably did facilitate the settlement of Bantu speakers in the Sanaga-Mbam confluence area of central Cameroon, where the oldest archaeological evidence for a sedentary way of life south of the Bantu homeland is also found.

Long-distance expansions took place only in a later phase. Two longitudinal expansions are particularly striking: the

Myene-Tsogo expansion along the coasts of northern Gabon and the western Bantu expansion from the marshlands of northern Congo at around 2°N, across the equator to about 3°S. The closest relatives of the West-Coastal Bantu—that is, the Congo Bantu languages—instead underwent a latitudinal and more gradual expansion up to the eastern part of the DRC, either in the forest margin north of the Congo River or inside the inner Congo Basin along the left-bank tributaries of the Congo. As we claim below, the reopening of the SRI probably constituted an important corridor for the rapid expansion of western Bantu-speech communities across the equator.

Archaeology

Several scholars have reviewed Neolithic and Early Iron Age sites from central, eastern, and southern Africa potentially constituting the archaeological signature of the early Bantu expansion (Bostoen 2007; de Maret 2013; Phillipson 1985, 2005:245ff.; Russell, Silva, and Steele 2014). We discuss here only the archaeological sites from western Central Africa that are of immediate relevance for our present purposes.

The principal archaeological site associated with the Bantu homeland is the Shum Laka rock shelter, whose four large stratigraphic units bear witness to 30,000 years of human occupation from the Late Pleistocene to the Late Holocene (Asombang and de Maret 1992; Cornelissen 2003; de Maret et al. 1993, 1995; Lavachery 2001). Just like nearby rock shelters (Asombang 1988; de Maret, Clist, and Van Neer 1987), it attests to the slow evolution of the Late Stone Age. The lower Late Pleistocene layers at Shum Laka reveal a microlithic quartz industry used by people who exploited an open environment with patches of forest that did not undergo drastic changes between about 30,000 and 10,000 BP (Cornelissen 2003). The upper Holocene unit shows significant evolution in human activities. Local preexisting microlithic Late Stone Age traditions became gradually mixed with a new industry. The layer dated around 7000–6000 BP bears the first marks of the Ceramic Late Stone Age, that is, bifacial macrolithic and polished stone tools and a few decorated potsherds. Around 5000–4000 BP, this macrolithic industry had become predominant over preexisting microlithic industries and reached a point of completion. A new type of pottery appears in the same period (de Maret, Clist, and Van Neer 1987; Lavachery 1998, 2001, 2003; Lavachery and Cornelissen 2000; Ribot, Orban, and de Maret 2001).

Small immigrant communities from farther north, settling into the Grassfields due to a serious climatic deterioration around 7100–6900 BP in the Sahara and the Sahel, have been held responsible for the slow introduction of these new technologies (de Maret 1994:320; Hassan 1996; Lavachery 2001: 240–241). The increased use of macroliths from 5000 to 4000 BP onward reflects a shift in the technical requirements of the shelter's occupants. Especially noteworthy in this respect is the emergence of partially polished tools of the axe/hoe type (de Maret 1994). The fact that, once introduced into the area, these new practices grew slowly in significance suggests that they underwent a long local development in the Grassfields, probably in relative isolation (Lavachery 2001: 241). Although these evolutions point toward changes in the subsistence economy, there is no unmistakable archaeological evidence of plant food production during the Ceramic Late Stone Age. Fauna and flora remains indicate that hunting and gathering were then important subsistence strategies. The occupants of Shum Laka hunted forest game only in the heavily wooded hunting grounds surrounding the shelter, as confirmed by the identification of several forest tree species. However, they also had access to more open landscapes, as evidenced by the remains of grasses and charcoal of savanna shrubs. From 7000–6000 BP to 5000–4000 BP, the site was clearly situated at a forest-savanna border (Lavachery 2001), as confirmed by the presence of nuts of *C. schweinfurthii* (bush candle, African olive) in all layers at Shum Laka, except the earliest. This pioneer species first appears at Shum Laka around 7000–6000 BP as a dietary supplement to forest game. Its exploitation grows in importance toward 5000–4000 BP.

These rock shelters mainly served as hunting camps and do not necessarily give us a comprehensive view of the evolution of subsistence economies through time. Since they were not permanent settlements, we need to rely on indirect evidence for a more sedentary way of life in the Grassfields, such as the burials at Shum Laka. After a minor funeral phase around 7000 BP, a more important funeral phase follows, around 3000 BP (Lavachery 2001; Ribot, Orban, and de Maret 2001). The people using the rock shelter as a cemetery may have lived in a nearby village. The only open air village site in the Grassfields, possibly dating back to that period, is Njinikejem 1, whose unique refuse pit remains undated (Asombang and Schmidt 1990). However, its pottery is typologically affiliated with both the pottery found at Shum Laka, dated to 5000–4000 BP, and the earliest-created ceramics found at Obobogo (Yaoundé), which are slightly younger (Clist 2005:715). Since the Njinikejem 1 pottery is not decorated with roulette impressions, it probably predates 2500 BP. This new decoration technique prevails during the Early Iron Age at Shum Laka between 2150 and 900 BP (Livingstone-Smith 2007).

The earliest direct evidence for a sedentary way of life comes from farther south, that is, from several village sites around Yaoundé, especially from Obobogo. This site provides the oldest attestations of villages south of the Bantu homeland, ranging between about 3500 and 3000 BP (de Maret 1982, 1992). As an accident of current archaeological knowledge, a temporal gap of at least 1 millennium and a geographic gap of several hundred kilometers for the time being separate Ceramic Late Stone Age pottery traditions in the Grassfields from their typologically related counterparts around Yaoundé. No archaeological data are yet available to reconstruct what happened between the Grassfields and the

Yaoundé area before 3000 BP (Clist 2005:715–716). If not a lack of data, a slow process of adaptation to the equatorial forest ecozone could also account for the considerable time gap compared with the relatively limited distance. Charcoal identifications indicate that the Obobogo village was located at that time in a degraded gallery forest, possibly linked with the forest perturbation episode that Desjardins et al. (2013) have observed around 4000–3500 BP in the Sanaga-Mbam confluence area of central Cameroon. All identified tree species are fruit bearing (Claes 1985:71).

Several large villages sites, such as Avoh, Ndindan, Okolo, and Obobogo, having unusually large refuse pits and a common type of specific pottery, point toward a densification of human settlement in the Yaoundé area around 2500 BP (Atangana 1988; Claes 1985; Clist 2005:721–738; de Maret 1993, 2003; Mbida Minzie 1996). Their subsistence economy is well reflected at Nkang (Mbida Minzie 1996), a site some 40 km north of Yaoundé where conservation conditions were exceptional. Villagers there exploited forest trees, hunted, fished in rivers, and had some livestock (Clist 2005:733–738; Mbida Minzie 1996:686–693). To date, the oldest direct archaeobotanical evidence for food plant production also comes from Nkang, that is, banana phytoliths dated around 2500 BP (Mbida Minzie et al. 2000). However, it remains an isolated find whose significance has been debated (Kahlheber, Bostoen, and Neumann 2009; Mbida Minzie et al. 2005; Neumann and Hildebrand 2009; Vansina 2003). Another indication for plant cultivation in that area during that era are the seeds of *Pennisetum* species embedded in the clay of two potsherds from two fully studied pits in Obobogo dated around 3000 BP (pit 2) and 2100 BP (pit 7; Claes 1985; de Maret 1992:245). These archaeological finds are confirmed by those of *Pennisetum glaucum* subsp. *glaucum* discovered at two Cameroonian sites farther south, that is, Bwambé-Sommet and Abang Minko'o (Eggert et al. 2006), dated between 2350 and 2200 BP. By that time, people south of the Sanaga River had learned how to domesticate and produce plants as an additional subsistence strategy. The cultivation of pearl millet had become possible due to a more accentuated seasonality also favoring forest perturbation (Kahlheber, Bostoen, and Neumann 2009; Neumann et al. 2012*a*).

By the time densification of human settlement occurs in the Yaoundé area, villages also start to appear farther north up to the Sanaga River (Mbida Minzie 1996, 1998) and farther west toward and along the southern Cameroonian coast (Eggert et al. 2006; Gouem Gouem 2010; Lavachery et al. 2010; Meister 2007; Nlend Nlend 2013; Oslisly 2006). Those sites are dated between about 2600 and 1500 BP and reveal village structures similar to those found in the Yaoundé area. They yield large amounts of pottery, often extensively decorated by comb or spatula stamping, in association with charred nuts of *E. guineensis* and *C. schweinfurthii* and with macrolithic tools, although in decreasing quantities, possibly due to their progressive replacement by iron tools (Clist 2006*b*; de Maret 2013). The first direct evidence for iron metallurgy in the area appears from 2380 BP onward (Clist 2012).

More or less contemporaneous to these southern Cameroonian traditions are a number of village sites situated around Libreville and the Gabon estuary and more inland on the Lopé and Ogooué Rivers ranging between 2700 and 1900 BP (Assoko Ndong 2002, 2003; Clist 2005), also known as the Okala tradition (Clist 1995:143–145). These sites manifest meaningful resemblances with villages sites farther north in terms of pottery and subsistence. Their subsistence economy is also similar: exploitation of wild fruit trees, hunting, and keeping livestock (Clist 2005:525–527). Other Gabonese village sites synchronous to the Okala tradition—that is, ranging between 2700 and 2350 BP—indicate that this new way of life also spread in the forest north of the Ogooué River (e.g., Issemeyo 7 site; Oslisly and Assoko Ndong 2006:36), to the savannas of the Haut Ogooué province in the southeast (e.g., Franceville site), and into the forest east of the Fernan Vaz and Iguela Lagunas between Port-Gentil and the Congo border (e.g., Ofoubou 5 site; Clist 2005:511; Clist et al., forthcoming).

The introduction of industries characterized by pottery and polished stone axes or adzes in northwestern Gabon may actually be significantly older than the appearance of the Okala tradition. It may even be as old as at Obobogo in central Cameroon, as evidenced by the archaeological record of the coastal Rivière Denis site opposite Libreville (Clist 2005:429–478). This site's earliest pottery is markedly different from the Okala tradition. As the radiocarbon dates turned out to be useless here (Clist et al., forthcoming), the dating of the village depends on paleoenvironmental data (phytoliths and ^{13}C analyses), which suggest that the producers of that pottery lived in a coastal savanna habitat, unlike the producers of Okala pottery. Indeed, as discussed above, palynological studies indicate that more open landscapes started to replace the forests along the coasts of Gabon and Congo after 4000 BP (Ngomanda et al. 2009; Vincens et al. 1994, 1998). Pottery typology and paleoenvironmental evidence combine to indicate that the archaeological assemblage at Rivière Denis predates the Okala tradition (Clist et al., forthcoming). Hence, the arrival of pottery-producing village communities on the northwestern coasts of Gabon in all likelihood happened around 3000 BP, that is, after the local development of coastal savannas but before the development of the Okala tradition.

Farther east and south, early attestations of village sites belonging to the transition period from the Neolithic to the Iron Age occur in the inner Congo Basin and north of the lower Congo. In the Congo Republic, the oldest village sites are located at Tchissanga West along the coast north of Pointe-Noire, with pottery dated between about 2700 and 2350 BP (Denbow 2012), and farther east at Djambala on the Batéké Plateau, with pottery dated between 2550 and 2100 BP (Dupré and Pinçon 1997; Lanfranchi and Pinçon 1988; Pinçon 1991; Pinçon and Dechamps 1991; Pinçon, Lanfranchi, and Fontugne 1995). The Ngovo group from the lower Congo region farther south is slightly younger, that is, 2300–2000 BP (de Maret 1986). Its thick and roughly decorated pots, associated with polished stone tools, look similar to the material from Tchissanga West (Clist 2005:755, 789–790). The archaeological record from the Ngovo cave allows a better insight into the local subsistence economy than records from Tchissanga West and Djambala: fishing, hunting, and exploitation of fruit trees (de Maret 1986). The settlement history of the central Congo Basin starts with the Imbonga pottery tradition dated between about 2350 and 2050 BP (Eggert 1987; Wotzka 1995), more or less synchronous with the emergence of Ngovo pottery in the lower Congo. Imbonga pottery marks the penetration of the region by pottery-producing communities. Any substantial preceramic Stone Age or previllage occupation of the area is highly unlikely due to the scarcity and limited distribution of lithic artifacts (Wotzka 1995:238ff.). If small hunter-gatherer groups lived there before this time, they did not leave significant traces in the archaeological record. The basic morphological and decorative features of this pottery ancestral to all subsequent pottery traditions from the Congo Basin share common features with contemporaneous traditions in Gabon and Cameroon (Clist 2005:750–751; Wotzka 1995:295). Moreover, this pottery is also found in association with remains of the nuts of *E. guineensis* and *C. schweinfurthii* (Eggert 1987:132).

Archaeological sites in western Central Africa clearly attest to a chronological gradient, on the basis of several dozen radiocarbon dates, indicating that a sedentary way of village life spread from central Cameroon to the lower Congo and the central Congo Basin in a time span of about 1 millennium, that is, from about 3500 to about 2300 BP (Lanfranchi and Clist 1991; Oslisly et al. 2013; Russell, Silva, and Steele 2014; Wotzka 2006). The first evidence for a sedentary way of village life south of the Bantu homeland appears around Yaoundé from 3500 BP onward and, possibly in the same period, also farther south at the Rivière Denis site in Gabon. A marked proliferation of village sites occurs from about 2700 BP. Not only is a densification of human settlements observed in the Yaoundé area, but village structures also turn up more or less contemporaneously in three geographically distant regions, that is, the area around Libreville, the Gabon estuary, and neighboring inland zones (Okala); Pointe-Noire along the Congolese coast (Tchissanga West); and, a bit later, the central Congo Basin (Imbonga). Village sites not only increase during that period but also become geographically much more widespread than before, indicating the relatively rapid expansion of sedentary pottery and (probably also) food-producing peoples. As we argue below, this is without a doubt the archaeological signature that the earliest migrant Bantu-speech communities left throughout Central Africa.

This initial dispersal of Bantu-speaking villagers happened independently from the spread of iron metallurgy, which occurs slightly later in the same region and cannot have been one of the forces driving early Bantu expansion. For the time being, the oldest uncontroversial iron-smelting site in the wider region is Gbabiri 1 in the CAR, dated to 2800–2700 BP (Zangato 1999). However, this site is typologically unrelated to the Ceramic Late Stone Age and Neolithic sites discussed above and could be linked with non-Bantu speakers from the Sudanic zone. The oldest known iron-smelting centers farther west, dated between 2400 and 2300 BP, are near Yaoundé and at Moanda (Gabon; Clist 2012:76–77). The Okala tradition has to date provided only indirect evidence of contacts with iron producers, for instance, in the form of rare iron artifacts (Clist 2005:773–777). Farther south, iron metallurgy appears on the Atlantic coast at Tchissanga East and other sites around 2150 BP (Denbow 2012:396). In the lower Congo, where it is associated with the Kay Ladio tradition, iron is known since around 1870 BP (de Maret 1986; de Maret and Clist 1985; Rochette 1989). In the central Congo Basin, no material other than pottery is found in association with the ancestral Imbonga tradition. There, the earliest direct evidence for iron technology comes from the Pikunda-Munda tradition about 2000 BP, where it is found in the form of iron slag (Eggert 1993). Village sites without evidence of local iron production may have relied on trade for the acquisition of their iron tools.

The successive spreading of village communities and iron technology in Central Africa led to a situation whereby mosaics of diverse communities lived alongside each other for a long time, that is, groups of hunter-gatherers uniquely relying on stone tools, village communities having a mixed subsistence economy without iron, and, later on, iron- and food-producing villagers gradually becoming predominant (Clist 2006*a*; Dupré and Pinçon 1997; Pinçon, Lanfranchi, and Fontugne 1995). The impact of this situation on Bantu language evolution is difficult to assess. The latter two categories of communities were presumably Bantu speakers. The higher technological and economic performance of iron- and food-producing villagers may have contributed to the success of their Bantu languages to the detriment of those spoken by other types of village communities, but this is hard to substantiate for the time being.

Discussion and Conclusions

Biogeographic evidence attests to recurrent phases of climate-induced forest perturbation in the course of the Pleistocene and the Holocene. Phyto- and zoogeographic evidence for recurrent openings in the Central African forest is especially abundant in two particular subregions, that is, the forest-savanna mosaics along the Atlantic coast, in Gabon and Congo, and the SRI in the heart of the Central African forest block.

Palynological data confirm that the Central African rain forest also went through two climate-induced crises during the Holocene, the first one at the end of the Middle Holocene, around 4000 BP, and the second one during the Late Holocene, around 2500 BP. The first climate crisis was triggered by a lowering of the SST in the Guinean Gulf, which favored savanna development on the periphery of the rain forest—for instance, on the coastal plains of Gabon and Congo—but also in the Sanaga-Mbam confluence area. The second crisis was triggered by an opposite phenomenon, that is, an abruptly increased SST that brought about strong erosion and was conducive to the development of pioneer and savanna vegetation in the central forest block. Fossil pollen data from Mopo Bai (northern Congo) show that forest fragmentation also occurred in the SRI (Maley and Willis 2010), while vast areas in Gabon and Cameroon as well as in the Congo swamps remained forested (Maley 2001).

Both linguistic and archaeological evidence identify the Grassfields of Cameroon as being part of an ancient center of human development in Central Africa. Archaeologists have discovered that its rock shelters contain the region's oldest marks of the Ceramic Late Stone Age around 7000–6000 BP, while it is widely agreed by linguists that (Wide) Bantu languages originate from that area. Both bodies of evidence equally point toward the north for the introduction of these new cultural elements and to the south for their further expansion. Bantu's closest external relatives of the Benue-Congo family are spoken in northern Cameroon, Nigeria, and Benin. Linguists have situated their homeland in the Niger-Benue confluence area of Nigeria (Williamson 1989). Likewise, archaeologists have held immigrants from farther north responsible for the slow introduction of technologies characteristic of the Ceramic Late Stone Age into the Grassfields. Aridification striking the Sahara and the Sahel around 7000 BP may have driven them southward (de Maret 1994:320; Hassan 1996; Lavachery 2001:240–241). Furthermore, both linguistics and archaeology provide evidence for a slow process of human settlement and local development in the Grassfields before these kinds of societies turn up in the Central African forests farther south. Thanks to archaeology, this process can be dated between 7000–6000 BP and 5000–4000 BP. Archaeological finds indicate a subsistence economy depending on products from both the savanna and the forest, but there is no conclusive evidence for a sedentary way of life, let alone for farming (Lavachery 2003). Proto-Bantu lexical reconstructions point in the same direction (Maniacky 2005; Bostoen 2014).

When exactly the first Bantu speakers started to emigrate from their homeland to the south remains unclear for the time being, as does the paleoclimatic conditions under which this happened. The first direct evidence for a more sedentary way of village life south of the Grassfields is dated between 3500 and 3000 BP and stems from the Obobogo site near Yaoundé. This is also the area where a secondary hub of language expansion has been situated, that is, the split-off point between the Mbam-Bubi and North-West Bantu branches. It is situated only some 100 km south of the Grassfields. This relatively high linguistic diversity in a relatively restricted geographic area is most likely the outcome of a very gradual process of linguistic diversification. This could be attributed to the fact that when migrating from the highlands of northwestern Cameroon to the lowlands of central Cameroon, early Bantu speakers had to adapt their way of life to an unfamiliar forest environment that made them live in small speech communities that were quite isolated from each other and that could only slowly expand southward.

On the other hand, the Mid-Holocene climate crisis that struck the periphery of the rain forest around 4000 BP is likely to have created environmental conditions that facilitated the immigration of Bantu-speaking village communities into the central Cameroonian lowlands. The climate-induced extension of savannas in the Sanaga-Mbam confluence area around 4000–3500 BP must have favored their migration into the Yaoundé region from 3500 BP onward, even if this did not lead to a rapid and strongly longitudinal expansion of Bantu speakers, as happened during the forest crisis of the middle of the third millennium BP.

The opening of savannas in the coastal plains of Gabon and Congo, which also occurred around 4000 BP, could have enabled such a rapid southward expansion. However, according to current knowledge it considerably predates the first appearance of village communities in that area. The only possible archaeological site pointing toward the early presence of such societies on the coast of Gabon is Rivière Denis, whose first pottery could not be accurately dated. It is typologically different from Okala pottery from the same region, which it probably also predates (i.e., older than about 2700 BP). This means that the appearance of village dwellers in this part of Gabon might be only slightly more recent than around Yaoundé and that their comparatively early arrival could have been facilitated by the development of coastal savannas in Gabon from 4000 BP onward. However, this is a very tentative hypothesis with the evidence currently at our disposal. Even more speculative is the possible link with the dispersal of the Myene-Tsogo subgroup, which constitutes a geographic outlier within the North-West Bantu cluster and must have undergone an expansion that was far more north-south oriented compared with other North-West Bantu subgroups.

From about 2700 BP, archaeological data attest not only to a densification of villages around Yaoundé but also to their emergence much farther south, especially in northern Gabon and coastal Congo. A few centuries later, villages also appear farther east in the central Congo Basin. Around the middle of the third millennium BP, the archaeological data testify to a rapid proliferation and a significant geographic spread of village sites in Central Africa.

This is reflected in the phylogenetic Bantu tree presented here in that the clades subsequent to North-West Bantu—that is, Congo Bantu and West-Coastal Bantu—expand the Bantu domain from Cameroon and immediately neighboring areas to the Congo Basin in the east and several degrees south of the equator. Both branches are parallel, which means that they split up rapidly after moving away from the homeland in the northwestern edge of the Congo Basin, in the

Sangha and Ubangi region, at about 2°N. Given that the homeland of the most recent common ancestor of Congo and West-Coastal Bantu languages is approximately situated in the middle of the SRI (numbered 4 in fig. 2), in the vicinity of the Mopo Bai palynological site, the most plausible hypothesis is to assume that the perturbation that affected the rain forest in the region during the third millennium BP facilitated the rapid and geographically significant dispersal of Bantu languages from there.

Ancestral Congo Basin Bantu speakers may have taken advantage of the dense river system of the right bank of the Ubangi River and the Ubangi itself to rapidly reach the Congo River and its southern tributaries. Ancestral West-Coastal Bantu speakers may have benefited from forest openings and perturbation as well as the presence of the Sangha River as a main waterway to migrate farther south. If the fragmentation center of this subgroup is indeed situated at approximately 3°S, their ancestor language must have moved across the equator rapidly enough not to have broken up farther north. This is an important and new insight from the joint and careful analysis of palynological and historical linguistic evidence carried out in this article.

If the perturbation of the Central African forest block around the middle of the third millennium was indeed an incentive to the dispersal of Bantu-speech communities over larger distances, it especially favored the rapid southward expansion of the West-Coastal Bantu ancestral language toward the area straddling the Batéké Plateau and Bandundu as well as the eastward expansion of the Congo Basin Bantu ancestral language toward the Congo-Ubangi confluence area. The SRI, which was an important corridor for the spread of certain biotic elements from the Sudanian savannas in the north to the savannas of the Batéké Plateau in the south during past geologic times, also seems to have been a crucial passageway for these Bantu-speech communities around 2500 BP. Unfortunately, this hypothesis cannot yet be tested archaeologically due to the general lack of excavations in that subregion.

Both linguistic and archaeological data suggest that the crisis that occurred about 2500 BP that affected the core of the Central African forest block, as evidenced by fossil pollen data, especially favored the rapid expansion of Bantu-speaking village communities from the borderland between Cameroon, Gabon, Congo, and the CAR to the Congo Basin in the east and across the equator to the south. During the preceding 2 millennia, their ancestors had migrated at a much slower pace from the Grassfields into the Yaoundé area and farther south because they subsisted in a denser forest environment and needed time to adapt to it.

While no archaeological data are available yet from the SRI for that period, the appearance of Imbonga pottery farther east, in the vicinity of present-day Mbandaka, can be tentatively linked with the earliest immigration of Bantu speakers into the inner Congo Basin. Farther south, Tchissanga pottery on the Congolese coast is the oldest tradition within the present-day confines of the West-Coastal Bantu subgroup. This is at odds with the tentative location of the west coastal homeland in the approximate vicinity of the Batéké Plateau. This apparent paradox is hard to account for because of a lack of archaeological data from the latter area. Either slightly older ceramic traditions are to be found in the region of Pool Malebo and farther upstream or the producers of Tchissanga pottery along the coast spoke Bantu languages not belonging to the West-Coastal subgroup. Recent phylogenetic linguistic research has shown that the West-Coastal Bantu languages spoken along the Congolese coastline might indeed be the outcome of a relatively late expansion (de Schryver et al. 2013).

Our new interdisciplinary synthesis substantiates and further deepens the original hypothesis of Schwartz (1992), but it also considerably revises it. Schwartz (1992:361) concludes that Bantu-speech communities benefited from climate-induced forest openings around 3000 BP to traverse the Central African forest block more rapidly than they had before and to establish themselves in this area in a sustainable way. Our review confirms that the Bantu languages did at some point spread considerably more rapidly southward than they had before because of paleoclimatic change. However, Holocene vegetation variations started earlier than Schwartz (1992) assumed—that is, around 4000 BP, due to decreasing rainfall—but occurred mainly on the periphery of the rain forest. The extension of savannas in the Sanaga-Mbam confluence area around 4000–3500 BP, a local manifestation of this Mid-Holocene forest crisis, was favorable for the settlement of early Bantu-speaking village communities in the Yaoundé area, to date the first archaeologically attested site south of the Bantu homeland.

On the other hand, the actual forest crisis, which gave a strong longitudinal impetus to the Bantu expansion, started only around 2500 BP. It was the one that affected the central forest block and was caused by increasing seasonality of rainfall. It enabled the cultivation of cereals, such as pearl millet, and probably also facilitated the sudden and rapid spread of metallurgy in Central Africa, which took place during that same period and gradually caught up with expanding Bantu-speaking village communities. In contrast to what Bayon et al. (2012) assume on the basis of unusually high aluminum-potassium ratios in an Atlantic sediment core, the rapid migration of Bantu-speaking village communities and the subsequent spread of iron working were not the cause of anthropogenic deforestation around 2500 BP. As discussed above, archaeological data do not bear witness to an intensified land use during that period. Direct evidence for food production is scarce, being limited to southern Cameroon, and indicate only that small-scale plant cultivation coexisted with hunting, fishing, collecting, and animal husbandry. The early Bantu-speech communities acted at most as "potential amplifiers of environmental change" (Neumann et al. 2012*b*: 1040). That the forest retreated almost synchronically from Cameroon to Congo and subsequently recovered, as testified by the exponential increase in pioneer species in the pollen data, confirms that this vegetation change was first and foremost climatically triggered (Maley et al. 2012; Schwartz 1992). The broad regional synthesis presented here needs to be substantiated by in-depth studies on a local level, preferably in those parts of Central Africa that to date have remained deprived of biogeographic, palynological, linguistic, and/or archaeological research.

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Comments

Roger Blench
Kay Williamson Educational Foundation, 8 Guest Road, Cambridge CB1 2AL, United Kingdom (rogerblench@yahoo.co.uk). 10 XI 14

To those of us following the conference presentations by the multiple authors in the past few years, the conclusions of this paper will not come as a surprise. Nonetheless, it is extremely useful to have them synthesized in a single place. Given the decades of largely unproductive speculation about the Bantu expansion, the narrative developed here seems to be the beginning of a model that coheres across different disciplines. In some ways I wish the authors had been even bolder. They nearly say that the earliest phase of the Bantu expansion may have been nonagricultural, and I am increasingly inclined to this view. I pointed out some time ago the difficulties of reconstructing crop plants in Proto-Bantu (Blench 1996), and in more recent times the significance of fisheries and useful trees has become apparent. Some of the authors of this paper have published an extremely valuable discussion of "split" tree names in Bantu, which reflect the vegetation patterns they discuss (Bostoen et al. 2013). This could have been flagged up more in the light of their conclusions. It would have been useful to speculate on exactly what was the impetus that drove the first phase of Bantu expansion. My guess is that the climate-driven opening of the forest gave hunters access to "naive" animal populations, those trapped in the forest earlier and suddenly available to mobile foragers. Similarly, the rivers, rich in aquatic resources, would be easier to access. Such a model has been proposed for Nilo-Saharan languages and the "Green Sahara" (Drake et al. 2011).

On the linguistic front, there is a great deal of discussion of the early subgrouping of Bantu drawn from the thesis of Grollemund (2012). I am aware that Bayesian phylogeny is extremely fashionable, but I retain the view that this is just the discredited old lexicostatistics with glamorous graphics. Moreover, the detail of the early splits in Bantu (and the paper does not really discuss the vexed question of whether we can draw a conclusive line between Bantu and Bantoid) cannot be made congruent with the archaeology; the small number of sites allows us to draw only general outlines of the pattern of settlement. Since this era there has been so much interbranch borrowing that sorting out these relationships is likely to take much more hard slog historical linguistics.

The next step from the linguistic point of view is to see whether the sort of split patterns identified for tree names are also reflected in more general vocabulary and whether reconstructions for large trees and fish can enrich our understanding of the habitat of the early Bantu. I strongly recommend the mass of data in the two volumes on Cameroon large trees and wild fruits recently republished (Vivien and Faure 2011*a*, 2011*b*), which need to be sorted for this type of evidence. The equatorial forest is an unforgiving environment for archaeobotany, but the analysis of synchronic tree-product data may well assist us to interpret palynological profiles. It is worth underlining at this point just how much valuable palynology and radiocarbon dating is now available for this part of the forest; most other regions are embarrassingly empty of this sort of quality data.

The exciting part of the story is undoubtedly the second-phase expansion apparently driven by access to iron tools. The rapid expansion of iron smelting once it is introduced from the anthropic savannas in Central Africa suggest strongly the value attached to clearing dense forest more rapidly. It seems likely that this was somehow related to the expanded cultivation of vegetative crops. The 2500 BP banana phytoliths remain disputed, but the likelihood that some types of nonseed cultigen drove population expansion seems high, notably taro and *Dioscorea esculenta*. At the same time, enhanced forest clearance makes it possible to provide space for translocated wild trees, such as the oil palm, *C. schweinfurthii*, and *P. reclinata*. The authors do not give much space to the attraction of rivers and the sea coast, but work on the reconstruction of fish names also points to the importance of aquatic resources as stimulating movement deeper into the forest (Mouguiama-Daouda 2005).

All in all, it is a model paper for the collaboration of different disciplines and a major step forward in our understanding one of the great movements in human history. The major parallel elsewhere in the world is undoubtedly the expansion of the Austronesians, also coincidentally leaving Taiwan some 4,000 ago, whose archaeology and linguistics have been the subject of an order of magnitude more research. The authors will undoubtedly continue to explore the evidence for a more nuanced version of the narrative they have brought together.

Pierpaolo Di Carlo and Jeff Good
DiLeF, University of Florence, Piazza Brunelleschi, 4, 50121 Firenze, Italy/Department of Linguistics, University at Buffalo, 609 Baldy Hall, Buffalo, New York 14260, U.S.A. (jcgood@buffalo.edu). 6 XI 14

The paper by Bostoen et al. is a landmark attempt to synthesize results from a range of disciplines to refine our understanding of the Bantu expansion. It comes at an important moment in the field of linguistics, where new quantitative methods are reviving disciplinary interest in questions of language and prehistory (see, e.g., Wichmann and Good 2014). We find particularly impressive the range of data types considered and are not aware of previous work drawing on such diverse strands of evidence.

Having attempted similar work ourselves, although on a much smaller scale (Di Carlo and Good 2014), we are well aware of the difficulties involved in efforts of this kind and immediately acknowledge that some degree of simplification is required to effectively conduct interdisciplinary investigation. Nevertheless, we believe that the presentation of the linguistic results and, to some extent, the genetic ones is oversimplified and rendered with more certainty than the evidence warrants. We focus on two concerns here: (i) the methods employed to arrive at a classification of Bantu languages and (ii) the assumed model of the relationship between languages and speaker communities.

The authors base the linguistic aspects of their synthesis on the results of the application of computational methods originally developed within the field of evolutionary biology to linguistic data. The particular phylogenetic methods they employ have become commonly used in linguistic work in recent years (see, e.g., Dunn 2014) and even applied to domains associated with cultural anthropology (Jordan et al. 2009). They represent a powerful means to discover treelike patterns within large comparative data sets. However, the nature of the input data and the theoretical assumptions built into the algorithms necessarily limit the scope of the inferences that one can make from the results of their application. Here, it is important to note first that Bostoen et al.'s classificatory tree for Bantu is based solely on the comparison of 92 items of so-called core vocabulary from 542 Bantu languages. The Indo-European genealogical tree, by contrast, was developed using both lexical and grammatical data. Moreover, they have chosen to distill the data into a single tree-based representation, when it is well known that "the Bantu languages have the remarkable ability to act much more like a dialect continuum than as discrete and impermeable languages" (Schadeberg 2003:158). In such a context, contact relationships are at least as important as genealogical ones for uncovering prehistoric patterns of change. It is therefore surprising that they have chosen to use a tree-generating algorithm rather than a network-generating one (see, e.g., Heggarty et al. 2010), which would depict linguistic relationships in the Bantu area in a way that explicitly recognizes the significance of language contact. In our view, these concerns mean that the conclusions reached by examination of the subgrouping presented in Bostoen et al. can be viewed only as preliminary hypotheses. Our criticisms along these lines can hardly be considered new. Almost 2 decades ago, Nurse (1997), for instance, presented a detailed review of key aspects of some of the issues discussed above.

Perhaps more problematic, however, is the authors' uncritical adoption of a model of language spread wherein branches of a phylogenetic tree are equated with migration paths (and splits) of speech communities, following an assumption that demic diffusion was the dominant mechanism of the Bantu spread. While actual demographic movements must have played a role in this process, they can hardly account for the whole of it. Moreover, such a view glosses over culturally significant aspects of population expansion (e.g., involving differential rates of integration of non-Bantu speaking women than men in early, assumedly expanding Bantu-speaking communities), for which there is some genetic evidence (Pakendorf et al. 2011:72). Our impression is that here the authors have unambiguously crossed the boundary between simplification and oversimplification in adopting a model based on the tree metaphor in its simplest form, thereby missing the chance to increase its explanatory power via the inclusion of ethnographic insights. In particular, a failure to pay attention to the pervasiveness of multilingualism throughout sub-Saharan Africa, which is so woven into the fabric of daily life that it seems impossible to consider it to be a recent phenomenon (Whiteley 1971:1), is an especially significant gap. How can a model of language diversification built around prehistoric population dispersion be rectified with the idea that the migrating communities were likely multilingual and in constant contact with nearby groups? This is not simply an incidental complication to their model, in our view, but a fundamental one.

In sum, we find ourselves deeply impressed by the level of synthesis attempted here. At the same time, however, we are anxious to see how a more complex and culturally informed linguistic and genetic picture could be integrated into the authors' historical framework.

Gerrit J. Dimmendaal
Institute for African Studies and Egyptology, University of Cologne, Albertus-Magnus-Platz 1, D-50925 Cologne, Germany (gerrit.dimmendaal@uni-koeln.de). 5 XI 14

In a part of the world where written sources usually do not date back more than a few centuries, social scientists and linguists interested in historical processes sometimes like to take recourse to multidisciplinary approaches. The contribution by Bostoen et al. is an impressive example of this. From a linguistic point of view, the most interesting result emerging from their collaborative research presumably is the natural explanation the authors provide for an initial demic diffusion of Bantu (associated with the Middle to Late Holocene, 4000 BP) as well as for a second phase starting around 2500 BP, involving a rapid expansion.

The authors decided to make use primarily of lexicostatistics (i.e., counting cognates) as a subclassification technique. The alternative method, the so-called comparative method, involves the subclassification of genetically related languages on the basis of shared innovations. Africanists sometimes use lexicostatistics as "a quick method" (Dimmendaal 2011:74). Bantu specialists like Bastin and Piron (1999:149, quoted in the article), for example, claim that lexicostatistics leads only to preliminary classifications whose results need to be validated by other approaches. Lexicostatistics is sometimes distinguished from glottochronology. But of course, if one claims that lexical replacement in languages occurs at regular intervals (a basic premise of lexicostatistics), one should also be able to make claims about the time frame. It would have been interesting, therefore, to know how well or badly the archaeological evidence matches up with the time frames suggested by the lexicostatistical (glottochronological) calculations.

The second phase of Bantu expansion, initiated around 2500 BP, resulted in vast spread zones due among other things to technological innovations such as iron working, which also affected the linguistic situation in the areas where the Bantu expansion started. Mouguiama-Daouda and van der Veen (2005) use the comparative method in their study of a group of zone B languages and argue that speakers of B10 languages (constituting an early Bantu split-off) probably acquired iron-working technology at an early stage, and so speaking their languages implied access to this important technological innovation. Intermarriage with speakers of B30 languages and corresponding patterns of multilingualism apparently led to a copying of structural features from B10 languages into languages belonging to B30. Detailed studies such as Mouguiama-Daouda and van der Veen (2005) thus show the complexity of the Bantu expansion, also in the areas (zones A, B, and C) where it was initiated.

According to Bostoen et al., physical anthropological evidence points to the actual migration of peoples rather than spread through language shift as the main historical event underlying the initial Bantu language dispersal. The degree to which the admixture with preexisting local groups played a role presumably is a matter of dispute. Nevertheless, some caution is in order concerning "hard-core evidence" from the physical sciences given the sampling methods of geneticists. "If ethnic fission and fusion has been a common and permanent feature of the cultural history of Africa, the number of individuals participating in investigations of genetic distance through mitochondial DNA research needs to be increased, at least if one intends to capture the genetic variation pool within communities," as argued by Dimmendaal (2011:343). The deviant grammatical structure of several Bantu languages in the area—for example, Nzadi (zone B865, described by Crane, Hyman, and Tukumu 2011)—would also seem to suggest a pre-Bantu substrate influence accompanying language shift, itself warranting a rethinking of the dynamics of the Bantu expansion during its initial stage. Archaeology is not much of a help here in putting the jigsaw puzzle together, as former hunter-gatherer communities presumably left few if any material traces.

A further bone of contention presumably lies in the role played by food production in the early Bantu expansion. Bostoen (2006, 2007, 2014) has shown what kind of contribution the "words-and-things" method (reconstructing lexical items associated with the culture of its speakers) can make to the reconstruction of the social and natural environment of early Bantu communities. But dating the archaeobotanical evidence, for example, remains problematic. Bostoen et al. refer to the identification of banana phytoliths in Cameroon about 2500 BP, but authors such as Rossel (1998) have criticized such claims about the early introduction of *Musa*.

Manfred K. H. Eggert
Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Eberhards-Karls-Universität Tübingen, Schloss Hohentübingen, 72070 Tübingen, Germany (manfred.eggert@uni-tuebingen.de). 7 XI 14

Anyone interested in the most intriguing topic of sub-Saharan language and cultural history—linked as it is to the immense biotope north and south of the equator—will be grateful for the largely comprehensive recent literature assembled in this paper. Moreover, syntheses are generally welcome in that they embody two important functions: while they intend to summarize and bundle different strands of evidence with reference to a specific topic, they more or less implicitly expose various lacunae in the web of evidence adduced. In both aspects this paper is a typical example, all the more as the authors qualify it as a "new interdisciplinary synthesis." However, a closer look reveals that this synthesis is based on evidence that to its better part has been treated many times all over again. Of course, the paleobotanical and biogeographic sections present an additional summary to those already available, and the bantuists augment the many existing linguistic trees of Bantu languages with another, this time a "simplified Bayesian consensus tree consisting of 168 Bantu languages."

Given this, one may ask which role archaeology plays in this synthesis as its third column. Obviously, it is here more perhaps than elsewhere that there is a fly in the ointment. As far as the inner Congo Basin—which is of major importance for the main argument—is concerned, the paper does not apport anything new due to the lack of systematic fieldwork in the past 3 decades. As to the SRI to which the authors attach prime importance in their reasoning, the results of a prolonged archaeological reconnaissance in 1987 (see Eggert 1993) are only now being prepared for detailed publication (Seidensticker, PhD dissertation in preparation). Central African rain forest archaeology in general has been summarized just recently (Eggert 2014). To sum up, the paper appears to serve old wine in new skins.

The most important critique to be leveled against this synthesis, however, is that the authors only address their disciplinary specialties, while the putative interconnectedness of these with respect to the Bantu problem, although relentlessly claimed in vague terms, is neither seriously reflected nor demonstrated on the basis of hard empirical evidence. To give an example, Bostoen and coauthors seem to start from the premise that the forest as such constitutes an impediment to intrusive populations practicing a subsistence economy. Anyone familiar with the inner Congo Basin and its multitude of waterways in the form of rivers, creeks, swamps, and lakes, however, is surprised when confronted with prejudices of this sort. Likewise, it is hard to agree with the authors that ceramics constitute "an archaeological signature of the Bantu language dispersal." Unfortunately, as it has been shown recently in the context of a comparative study of the Bantu and Indo-European problem, it is not as easy as this (see Eggert 2012). Furthermore, there is not only "a temporal gap of at least 1 millennium and a geographic gap of several hundred kilometers" that intervene between the Shum Laka rock shelter in the Grassfields and the area around Yaoundé. More to the point is the lack of any linking ceramic tradition. And this applies not only to Shuma Laka but also to the Grassfields as such as well as to the presumptive Bantu homeland in the Nigerian-Cameroon borderland—in both regions, ceramic evidence that might be connected with the ceramic traditions in the rain forest to the south is as yet lacking.

Perhaps, however, one should not be all too surprised by the overall impression of this paper given the fact that in the opening paragraph of "Archaeology" the linguistic study of Bantu pottery vocabulary by Bostoen (2007) is cited in the context of the aforementioned "archaeological signature." Proceeding in this manner amounts to starting with an inbuilt vicious circle. Thus, it seems justified to conclude that this synthesis is different from those that have been gone before only in its integration of a sheer mass of literature from the different fields concerned but not in integrating these fields toward a coherent approach to the so-called Bantu problem. In other words, this synthesis is not—as the authors claim—interdisciplinary but rather multidisciplinary, which makes a big difference. To cut the Gordian knot of the Bantu enigma, we need much more than *une énième synthèse*, as the French would say. First and foremost, we need to reflect on the basic issues involved, not least on the relationship between "material culture" and the immaterial world (and vice versa) as well as on what makes people move and migrate under which circumstances. We need also to reflect on peoples's resilience under environmental stress, their adaptability to different or changing habitats, and so on. And, of course, what we need very urgently as well before any other synthesis is written is fieldwork, fieldwork, fieldwork.

Pierre Giresse
Centre for Education and Research on Mediterranean Environment, Unité Mixte de Recherche Centre National de la Recherche Scientifique 5110, Perpignan Via Domitia University, 52 avenue Paul Alduy, 66860 Perpignan, France (giresse@univ-perp.fr).
16 X 14

Climate-induced forest disturbance in Central Africa throughout the Holocene affected the Central African forest block, first its more vulnerable periphery around 4000 BP and later its more resistant humid forest core around 2500 BP. It is presumed that each opening of the landscape (woodlands and savannas) favored an extensive and rapid expansion of Bantu-speech communities. There are two interconnected processes about which knowledge has increased significantly over the past 20 years. Thus, this welcome interdisciplinary synthesis associating new and old evidence from biogeography, palynology, geology, historical linguistics, and archaeology proposes to the reader the current stage of works that are not far enough from having examined the question from all sides. The illustrative maps show clearly the still small number of archaeological and palynological sites compared with the exhaustive presentation of the linguistic map of the Bantu subgroups. This deficiency remains particularly clear in a large zone of the catchment basin of the Congo River (both Congo countries).

The location of the Bantu homeland in the borderland between southeastern Nigeria and western Cameroon has found broad acceptance among linguists and others. Around 4000 BP, decreasing rainfall was linked to the lowering of the SST of the Guinean Gulf; however, the atmospheric humidity compensated for reduced rains and favored core forest conservation. The rhythm of colonization of the Bantus was uneven according to region: it was early and fast in some regions, as in western Cameroon. The climate-induced extension of savannas in the Sanaga-Mbam confluence area of central Cameroon around 4000–3500 BP facilitated the settlement of early Bantu-speech communities in the region just north of Yaoundé and Douala, which constituted an important secondary center of early Bantu language dispersal less than 200 km south of the Bantu homeland. In the same region, the oldest archaeological evidence for a sedentary way of life was found, ranging between about 3500 and 3000 BP.

Then the series of discontinuous savannas on the costal plains of Gabon and Congo provided successive settlement places.

A second crisis occurred toward 2500 BP when the SST abruptly increased, changing the monsoon and leading to a strong development of cumuliform clouds and an increased seasonality of rainfall. Archaeobotanical samples indicate a mosaic of mature and secondary forests composed of shade-tolerant and light-demanding trees around the settlements. This crisis spread from the southern Cameroonian borderland to the Congo Basin and perturbed the central core of the Central African forest block. The SRI still constituted an important corridor of a large-scale geographic Bantu spreading across the equator. By that time, people south of the Sanaga River had learned how to domesticate and produce plants as an additional subsistence strategy. The savanna crop pearl millet (*P. glaucum*), dated to 2400–2200 BP, could be cultivated only because of the development of a distinct dry season, increasing seasonality, and the replacement of mature forest by pioneer formations. Long-distance longitudinal and latitudinal expansions took place only in this phase; however, it was even later, near 1000 BP, that the first direct evidence for iron metallurgy appears in the Batéké Plateau and, probably, south of the equator (Congolese "bowl"). But in some parts, the dense forests may have persisted during all of the Holocene.

Archaeological data do not bear witness to an intensified land use during that period. Direct evidence for food production is scarce, being limited to southern Cameroon and indicating only that small-scale plant cultivation coexisted with hunting, fishing, collecting, and animal husbandry. When the major fragmentation of forest started at 2500 BP, the colonization of the Congo Basin by Bantu farmers was only beginning; it reached a peak between 1900 and 1600 BP.

Stormy rainfall caused strong erosion, resulting in the deposit of coarse sediments, such as sands, pebbles, and stonelines. In this phase of renewed erosion, the destruction of the deeper horizons of soils was most probably at the origin of the isotopic signals recently recorded in the sediment cores off the mouth of the Congo River (Bayon et al. 2012). Al/K ratio downcore variation correlated with Hf isotopes depth profile could simply mean that repeatedly the erosion was able to affect deeper horizons of the soils, which archived the signatures of more or less ancient chemical weathering. These data are very interesting because they elegantly confirm the outbreak of erosion already identified. But on no account can they demonstrate that Bantu pioneers significantly cleared land for farming and iron smelting. Moreover, Bantu expansion followed its development on large sides of the Congo Basin to reach its maximum only around 1000 BP (Duprè and Pinçon 1997).

At this time, it would be premature to establish a too-precise general chronology of these processes and more careless still to suggest their simultaneity to a too-large geographic scale.

Thomas Huffman
School of Geography, Archaeology, and Environmental Studies, University of the Witwatersrand, Private Bag 3, PO Wits 2050, Johannesburg, South Africa (thomas.huffman@wits.ac.za). 27 X 14

Bantu migrations have been an important topic for 5 decades. Following Guthrie's monumental classification, scholars initially referred to western versus eastern Bantu. The dichotomy is less popular today because the two divisions are unequal. Western Bantu, for example, includes several linguistic clusters (Bostoen et al. give four in the core area), each being equal to or greater than the whole of eastern Bantu.

The present contribution focuses on the core of western Bantu. The authors make a compelling case for the correlation between two paleoclimate shifts and the earliest stages of western Bantu expansion. The linear distribution of languages (and archaeological sites), one should add, shows that people followed rivers rather than moved through forests. For the archaeological signature of early western Bantu, the authors point to sites with Okala, Tchissanga West, and Imbonga pottery. Perhaps Ngovo should be added to this list because it has a different stylistic structure (profiles, design layouts, and decorations). Whatever the case with Ngovo, the different ceramic traditions probably mark different linguistic clusters. This is probable because of the vital relationship between worldview, material culture, and language. Presumably, further research will strengthen linguistic and cultural associations.

The second climatic shift also affected the likely expansion of eastern Bantu. Some of us argue that eastern Bantu evolved within communities that stayed behind in the Proto-Bantu homeland rather than from one of the western Bantu clusters (Huffman 2007). In the homeland, they acquired cereal agriculture, domestic animals, and metallurgy, and then, at about 2500 BP, they began moving across the top of the forests into East Africa, where they are recognized as the Urewe tradition of the Chifumbaze complex (following Phillipson 1977). The archaeological signature of eastern Bantu has been known for some time as the Early Iron Age package: that is, settled villages (houses, grainbins, and storage pits) with large and small domestic stock, grain agriculture, metallurgy, and Chifumbaze pottery. None of these interrelated traits evolved from an earlier hunter-gatherer base in eastern or southern Africa. Unfortunately, archaeologists studying these early farming communities have had to contend with a rejection of migration hypotheses for political reasons. As Bostoen et al. point out, however, the Bantu language family unquestionably evolved in West Africa, and its expansion into the Congo Basin had to have been the result of a physical movement. The same conclusions apply to East Africa and southern Africa. In the latter case, the expansion was also rapid.

Although specialists sometimes disagree over the ceramic units in Chifumbaze, there is general agreement over the correlation with eastern Bantu. A reanalysis of the ceramic complex and associated cultural and linguistic features highlights the problems with Guthrie's east/west line. His line ran through the middle of the subcontinent, but some so-called eastern languages, such as Ila/Tonga, Bemba, and Kikuyu/Kamba, have western origins (Huffman and Herbert 1994). Our combined use of cultural profiles (worldview, social organization, and settlement patterns) and grammatical elements (phonological, morphological, and syntactic features) was not meant to be a new way of classifying Bantu languages, as some thought, but a way of challenging the existing scheme.

However one classifies modern languages, the savanna south of the tropical forest is and was home to both western and eastern languages. This mixture is evident in the archaeology. One ceramic complex extends across a broad savanna zone from the Congo River mouth to Lubumbashi in Katanga. Within this broad zone, Naviundu in Katanga (Anciaux de Faveau and de Maret 1984) appears to be the earliest. Besides its geographic location, it can be associated with western Bantu through the similarity of its designs with those carved into wooden objects and woven into raffia mats among historic western Bantu groups (see, e.g., Cornet 1972). These interwoven motifs contrast markedly with the range of motifs in the Chifumbaze complex. In the seventh to ninth centuries, Naviundu descendents moved to the Tsodilo Hills in Botswana, where their ceramic style is called Divuyu (Denbow 1990; Wilmsen and Denbow 2010); to the mouth of the Congo, where it is called Madingo-Kayes (Denbow 2014); and to the Batoka Plateau in Zambia, where it is called Gundu (Huffman 1989). In the Zambian case, Gundu people moved into an area previously occupied by people making Kalundu pottery, a Chifumbaze tradition associated with eastern Bantu.

At one time I thought Kalundu pottery was brought from the Proto-Bantu homeland along open corridors through the forest onto the savanna of Angola. Early Iron Age pottery at Benfica near Luanda (Dos Santos and Ervedosa 1970) suggested such a route. Bostoen et al. show that this was possible at about 2500 BP. If Benfica does not belong within Chifumbaze, however, Kalundu may have followed another route along the eastern edge of the tropical forest. Thus, from an outsider's viewpoint, the present study has ramifications for the whole of Bantu.

Kairn A. Klieman
Department of History, University of Houston, 524 Agnes Arnold Hall, Houston, Texas 77024, U.S.A. (kklieman@uh.edu). 17 XI 14

This article makes a very important contribution to the study of Bantu history. The data presented, especially in terms of flora, fauna, and forest types that existed in specific eras and locales, is fascinating and new. Consequently, we have a more precise vision of the environments that Bantu speakers encountered as they moved into the rain forest; any lingering notions of the rain forest as static or primordial can be jettisoned for good. I agree with the authors' argument that the "forest crises" of about 4000 BP and 2500 BP likely had different impacts on the early Bantu expansion. Data from my own work support this thesis.

I also commend the authors for relaunching a discussion of the Bantu expansion. Contrary to their assertion that the topic has "fuelled several decades of multidisciplinary speculation," it must be acknowledged that it suffered a hiatus in the 1990s, when scholars of the "new archeology" decided that theories of speech communities moving across geographic space and introducing "advanced" technologies were neoevolutionist and reminiscent of nineteenth-century diffusionist models. As the authors intimate, studies of population genetics in Africa have reinvigorated old questions. While such studies do confirm that "demic diffusion" was at work, it must be acknowledged that their preoccupation with "Bantu" and "Pygmy" admixture often reifies nineteenth-century notions of technology and race.

This historiographical background is important, for it highlights what I also see as a problem in the article. Put briefly, the authors fail to locate their study in the broader context of the field. As a result, aspects of their presentation are misleading and shortchange possibilities for moving beyond old paradigms. It is incorrect, for example, to state that an interdisciplinary synthesis "has been lacking until now," since I presented one based on historical linguistic, archeological, and ethnographic data in my 2003 book. While this aspect of my work is ignored, I am cited on more minor points that the authors mistakenly assert support their own. For example, the authors twice cite my book in support of hypotheses about the early origins and coastal settlement patterns of the "Myene-Tsogho cluster"—Guthrie's B10 and B30 groups. This cluster, however, does not exist in my work. While I did propose an early coastal expansion for B10 (Myene) language speakers, my data indicated that the Tsogho languages emerged from a divergence that occurred to the northeast in the Congo panhandle (the Sangha-Kwa divergence, about 2400–2000 BCE). This is but one of three mistaken interpretations that, due to space constraints, cannot be treated here.

Language classifications can be idiosyncratic in that skills, bias, and data selection impact the results. While I would not assert that mine was correct and the authors' wrong, I do believe results should be compared and similar patterns identified. Although my study posited an earlier start for the move out of the Bantu homelands (about 4500–4000 BCE) and slight differences in terms of the number of sequential language "splits" in the North-West Bantu group, the broad outlines of migration patterns are very similar in both works. The evidence for the first "forest crisis" about 4000 BP also correlates with mine, since the two earliest large-scale divergences took place in the northern peripheries of the rain forest (the proto-Nyong-Lomami in southern Cameroon and the proto-Sangha-Kwa in the Congo panhandle) and are dated broadly to about 2700–2400 BCE and about 2400–2000 BCE.

Perhaps disagreements about methodology lie behind the authors' unwillingness to engage with my book. I used glottochronology to date language divergences (a method linguists do not trust), and for archeological correlations I broke with convention by utilizing the earliest published dates from the assemblages the authors cite. These are generally rejected as outliers, but I argued that they might be evidence of early interactions between Bantu immigrants and the autochthons they met. My classification also differed by incorporating Bantu languages spoken by modern-day Batwa ("Pygmy") communities. There exists a striking correlation between my hypotheses about the formation of these languages communities and the evidence of a second "forest crisis" about 2500 BP, especially in the SRI. It is in this period and region that the first appearance of distinct Batwa-speech communities appear, these being formed when the linguistic ancestors of modern-day Batwa communities separated from the Bantu-speaking communities they formerly shared languages with. The implications of this correlation are intriguing, since I argue that Batwa communities then began to develop their own economic niche as specialist purveyors of forest products for more widely scattered (savanna dwelling?) Bantu agriculturalists.

These correlations suggest that the data provided in this article may prove to be pathbreaking if analyzed in close consideration with data from other fields. Despite my complaints, the study constitutes a major step forward for the field of Bantu studies. I am grateful that the authors came together to synthesize their data and look forward to reading more.

Scott MacEachern
Department of Sociology and Anthropology, Bowdoin College, Brunswick, Maine 04011, U.S.A. (smaceach@bowdoin.edu).
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This article is a masterful and convincing synthesis of data from a variety of different disciplines, providing a model for the initial expansion of populations speaking early Bantu languages into the Central African tropical forests during the Late Holocene. Given the rather different environments existing in the areas northwest of the forest where the Bantu languages originated, significant cultural and behavioral adaptations would seem to have been necessary for that expansion. One of the central questions involved in the study of the Bantu expansion has thus always been how, precisely, these early Bantu-speaking groups adapted to these new and challenging environments and whether they carried a "cultural package" (eventually including agriculture and iron working) around the peripheries of the Central African tropical forests or in some way penetrated through the forest itself.

This reconstruction is made possible by the accumulation of archaeological data in the region, by new and detailed linguistic analyses of the phylogenetic relations between Bantu languages, and by an appreciably more detailed knowledge of environmental change in the region through the last Pleistocene and Holocene. The paleoenvironmental data indicates phases of breakup of northwestern Congo tropical forest environments into savanna and forest-savanna mosaic at about 4000 and 2500 BP, periods that fit quite well with archaeological and linguistic data on the initial expansion of Bantu communities. Among other processes, this breakup may have made it feasible to use already-domesticated savanna species like pearl millet in areas that had previously been forested. It would appear that early Bantu-speaking communities took advantage of the more open environments during these periods of forest fragmentation, first moving into the northern peripheries of the forest in southern Cameroon and then in the mid–third millennium BP farther south into modern Gabon and Republic of Congo and into the Congo Basin, on a trajectory that would eventually lead to the occupation of most of Africa south of the equator by Bantu-speaking peoples.

The analysis itself is, as already noted, convincing: I have no major critiques of the reconstructions as presented. It may be useful to underline some of the many unknowns that are still associated with the broader historical phenomenon of the Bantu expansion. As the authors note, we understand very little of the initial stages of the expansion from the Grassfields area of northwestern Cameroon to the southern part of the country, with really only one well-known site (Shum Laka) in the Grassfields and virtually nothing known of occupations between there and the area around Yaoundé. Perhaps even more seriously, we know equally little about Shum Laka's cultural associations with areas farther to the north and west in the Mid-Holocene. Economic adaptations at Shum Laka show patterned similarities with some contemporary sites in West Africa, and pearl millet and ovicaprids were presumably being obtained from the savannas to the north during this period, but the dynamics of those relations will only be understood with more substantial research programmes in other parts of the (modern) forest-savanna interface.

One of the most interesting elements in the paper is the authors' brief consideration of the possible dynamics of relations through time between foraging communities; populations pursuing mixed economies of hunting, gathering, arboriculture, and stock keeping (in various combinations); and full-fledged farming communities through this period. This would have been an extraordinarily complex process, made even more complicated by the patchwork introduction of iron working, with its economic and ideological implications, probably in and after the early third millennium BP. It is quite possibly a process with no good modern analogues. Given the logistical and political challenges of archaeological fieldwork through much of the region, it is likely that our understandings of these processes will accumulate only very slowly (although the discovery of just one or two sites can certainly change our assumptions; see, e.g., González-Ruibal, Sanchez-Elipe, and Otero-Vilarino 2013; Meister and Eggert 2008). Under those circumstances, these questions might well be a fertile field for historical linguistic and archaeogenetic analyses in the near term. A further question will involve the cultural adaptations that continued within the disappearing savanna zones and more generally through the Central African forest after the third millennium BP and the closing of forest environments again: by this point, Bantu-speaking populations were presumably sufficiently well established to continue their expansion through Central Africa and beyond. There is evidently much more work to be done.

This paper is comparable in its aims and interest to the recent biogeographic reconstruction of the peopling of the Sahara during the Early Holocene by Drake et al. (2011). Both papers clearly demonstrate the power of regional, interdisciplinary analyses in elucidating African history and provide fascinating perspectives on extraordinarily important demographic and cultural processes on the continent.

Katharina Neumann
Goethe University, Institute of Archaeological Sciences, Grueneburgplatz 1, 60323 Frankfurt, Germany (k.neumann@em.uni-frankfurt.de). 3 XI 14

The Bantu expansion is one of the most intriguing issues of African prehistory. For decades, linguists and archaeologists have published numerous scenarios on the rapid spread of the Bantu languages. Schwartz's hypothesis of a major climatic change and forest disturbance after 3000 BP has been corroborated by recent palynological data, placing the forest crisis more precisely to the second half of the third millennium BP. For the same period, finds of domesticated pearl millet in southern Cameroon and the DRC (Kahlheber et al. 2009, 2014) furnish independent evidence of increased seasonality. However, this modest progress in archaeological and paleoenvironental research cannot hide the distressing fact that we know almost nothing about the subsistence of the people who are archaeologically attested by pottery and pit features from the third millennium BP onward all over the Central African rain forest and who are supposed to have been Bantu speakers. Is hard or even impossible to prove archaeologically if these people spoke Bantu languages—despite numerous attempts. Much more interesting than their language is their way of life, technologies, social system, and subsistence; all of these aspects can be best studied using archaeological data.

The question arises whether a compilation of well-known paleoecological and sparse archaeological data, supplemented by a new phylogenetic tree of North-West Bantu languages, can bring real progress for the issue of the Late Holocene occupation history of the rain forest. Concerning subsistence, the compilation is rather disappointing because it uncritically refers to the archaeobotanical evidence. The alleged pearl millet finds of Obobogo in Cameroon consist of two charred grains embedded in potsherds—a very unusual mode of preservation—which were never fully documented and published and therefore have to be cited from a secondary reference. The pearl millet grains of Bwambe Sommet and Abang Minko'o are not a "confirmation" of the Obobogo finds, but they are the first well-dated and properly documented evidence of domesticated plants in the rain forest. It is furthermore not true that "by that time, people south of the Sanaga River had learned how to domesticate and produce plants as an additional subsistence strategy." This suggests that pearl millet was domesticated in the rain forest, which is not the case. Robust archaeobotanical data all over West Africa clearly indicate that pearl millet was domesticated in the south-central Sahara in the fifth millennium BP, spread from there to the West African savannas, and eventually arrived in southern Cameroon and even the DRC shortly after 2400 BP (Kahlheber et al. 2014; Ozainne et al. 2014). In some respects, the *Pennisetum* grains are the only unequivocal material evidence for contacts between the savannas north and northwest of the forest block and its interior: pearl millet is definitely an immigrant.

What was the subsistence strategy to which pearl millet cultivation should have been additional? Bostoen et al. seem to know, but actually we have currently no clear idea about the subsistence of the pottery-producing rain forest populations. We do not even know whether their primary source of food consisted of domesticated or wild plants, despite the fact that numerous remains of fruit-bearing trees have been found in many archaeological sites—perhaps overrepresented due to preservation conditions. Basic questions on diet and subsistence of the "Bantu" immigrants are still completely open: Were they mainly cultivators, or did they predominantly rely on wild food plants? Did they cultivate other crops in addition to pearl millet? Did they utilize yams, and, if so, did they bring the knowledge of yam cultivation with them, or did they acquire it through contact with indigeneous rain forest populations? Which crops were planted after pearl millet cultivation was no longer possible from the end of the third millennium BP onward? When did banana cultivation, only attested by single, unconfirmed finds of *Musa* phytoliths in Nkang, start in Central Africa, and how did it spread? What was the role of wild tree fruits in the diet? Was there any form of tree management?

Historical linguistics can contribute to the subsistence issue, as recent publications by Bostoen and collaborators—for example, on tree names or pearl millet—have shown (Bostoen 2014; Bostoen et al. 2013; Kahlheber et al. 2009).

But given that there are only four sites in the vast area of the Central African rain forest from which firm archaeobotanical evidence of crops is published, plus a few other sites with remains of wild fruits, it must be concluded that compilations of old data and refined hypotheses do not help very much as long as no new material evidence is available. More excavations are needed, including recovery of plant and animal remains, followed by careful identification and accurate documentation. Only with these new data at hand we will eventually be able to rewrite the Late Holocene settlement history of the rain forest.

Paul Verdu and Serge Bahuchet
Centre National de la Recherche Scientifique/Muséum National d'Histoire Naturelle/University Paris Diderot/Sorbonne Paris Cité, Unité Mixte de Recherche 7206 Ecoanthropology and Ethnobiology, Musée de l'Homme, 17, Place du Trocadéro, 75016 Paris, France (bahuchet@mnhn.fr). 15 XII 14

This article proposes a refined model for the historical migrations and rapid expansions of Bantu-speaking populations throughout the Congo Basin during the past 4,000 years. The authors reviewed a vast corpus of scientific evidence from biogeography, palynology, geology, historical linguistics, and archaeology to propose that Bantu-speaking communities' historical expansions and migrations were triggered by Middle to Late Holocene paleoclimatic crises that induced forest fragmentations at variable geographic scales. They propose a two-step demic expansion of Bantu speakers from their homeland in western Cameroon. The Middle Holocene paleoclimatic crisis mainly affected the fringes of the equatorial forest block, thus facilitating the first early Bantu speakers' migration and settlement in the Yaounde region around 4000–3500 BP. Second, the Late Holocene paleoclimatic crisis affected the core of the equatorial forest around 2500 BP, hence allowing a rapid migration and expansion of Bantu speakers to the south and west of the Congo Basin.

The multidisciplinary review and synthesis that the authors conducted enabled them to propose an elegant model relying on dynamic interactions between human migrations and ecological changes over time. The idea that agricultural Bantu-speaking populations may first have expanded from savanna regions into the forest block at a slow rate, since they had to adapt to this novel ecological environment, followed by much more rapid expansions favored by paleoclimatic crises fragmenting the forest block is of particular interest.

A first perspective from this model concerns the nature and timing of cultural interactions between forest hunter-gatherer populations and the newly arrived agricultural populations. While hunter-gatherers and agricultural neighbors currently share complex sociocultural and economic interactions, very little is known about the initial relationships between communities and about the timing of cultural and linguistic shifts among hunter-gatherer populations (Hewlett 2014). Following the Bostoen et al. model, early contacts may have started at 3500 BP in the northern part of the equatorial forest, followed more recently at 2500 BP by another wave of Bantu speaker migrations, possibly triggering new encounters in the heart of the western Central African forest block. Following these encounters, the forest hunter-gatherer populations may have transferred knowledge and technology to the newly arrived agricultural Bantu speakers, which in turn may have improved agricultural populations' adaptation to forest ecologies and favored their permanent settlement in the region.

Under such a model, it is essential to understand why and when hunter-gatherer populations adopted the languages of their newly arrived agricultural neighbors. Indeed, most forest hunter-gatherer populations in western Central Africa speak Bantu languages mostly spoken by their agricultural neighbors with the exception of the Gbanzili-Sere-speaking Baka and the Bantoïd non-Bantu-speaking Bezan from Cameroon, and no traces of the languages spoken previous to Bantu expansions remain today (Bahuchet 2012). Therefore, it is critical to understand why and when the populations practicing foraging activities and culturally adapted to the equatorial forest shifted to adopt the languages spoken by agricultural populations originating from vastly different ecological environments. Furthermore, recent findings from population genetics have shown that genetic admixture patterns identified between western Central African hunter-gatherers and agriculturalist populations likely started at most at 1000 BP (Patin et al. 2014), much more recently than initial contacts between groups suggested by Bostoen et al. It would thus be of major interest to further understand the cultural and social dynamics that may have triggered the delayed onset of genetic admixture between Central African agriculturalists and hunter-gatherers roughly 2,000 years after the initial encounter between communities.

Another perspective seldom investigated in this article is the influence of Bantu-speech expansions on the other linguistic families currently spoken in Central Africa, in particular the Adamawa-Ubangian and Sudanic linguistic families. Today, the Bantu linguistic family is mainly in contact with Adamawa-Ubangian speakers in southern CAR and is mainly in contact with Sudanic languages in northeastern DRC, southern Sudan, and western Uganda. The authors consider that paleoclimatic changes have triggered the expansion of Bantu-speaking communities, but what about the other major linguistic families spoken in the region? Were they also affected by the same climatic and environmental changes? What was the influence of the Bantu language expansions on these linguistic families? While the authors integrate numerous independent sources of evidence to reconstruct Bantu-speech migrations, they do not consider culture-culture interactions with other linguistic families settled in the region as a possible factor influencing both preferred migration routes and the evolution of the Bantu languages. Nevertheless, the multidisciplinary review approach proposed by Bostoen et al. could very well be expanded in the future to investigate the historical construction and migrations of other major linguistic families spoken in the Congo Basin. This would undoubtedly provide the anthropological community with a comprehensive view of possible forces having influenced the cultural and linguistic diversity of Central African populations.

Reply

We thank all commentators for sharing their considerate and stimulating thoughts on our article. Their comments point toward possible improvements on different levels, which we will take to heart in our future intra- and cross-disciplinary research. The range of comments by highly esteemed scholars from disciplines as diverse as linguistics (Blench, Di Carlo and Good, Dimmendaal), archaeology (Eggert, Huffman, MacEachern), archaeobotany (Klieman), paleoclimatology (Giresse), molecular anthropology (Verdu), ecoanthropology (Bahuchet), and African history (Klieman) further strengthens us in the conviction that originally urged us to write this article. In contrast to what is too often taken for gospel truth, we believe that the Bantu expansion is far from a settled issue, and this despite the fact that it raised more multidisciplinary speculation than any other question in Central African prehistory. New research in different fields is needed, and old evidence needs to be looked upon with new eyes. We are happy to read that several colleagues share this belief and welcome our effort to unite a heterogeneous set of data from different disciplines that have seldom been examined together. In this respect, we admit, as Blench and Eggert point out, that most of the data discussed in our article have been around for many years. We also agree, as several commentators note, that our article is predominantly multidisciplinary, because we have first considered evidence from different disciplines independently. We have deliberately done so exactly to avoid what Eggert has repeatedly warned of, that is, the premature linking of archaeological and linguistic data that are not firmly established within their own discipline. After having discussed what is more or less accepted within each of the disciplines, we do come up with a new synthesis that intends to be interdisciplinary. We have attempted to identify those patterns that match between the different disciplines without shying away from pointing out the mismatches. The resulting model is admittedly quite robust and to be considered only as a next step toward a more refined and better-substantiated model that will hopefully rely on new data fostered by each of the disciplines. It is reassuring to read, however, that all commentators—even the most critical ones—accept our principal conclusions. For the time being, our proposal appears to stand up to scrutiny, in spite of some specific critiques that will be addressed in the following paragraphs.

All linguists voice some criticism of our method and model of language classification and of the linguistic evidence used.

As for the method, Dimmendaal supposes that we make use of lexicostatistics as a subclassification technique and summarizes well what African linguists do indeed think about that method. Dimmendaal and Klieman also refer to glottochronology, which is derived from lexicostatistics and designed to provide absolute dates for language divergences. Klieman (2003) did use that much-criticized method to propose a dated classification of North-West Bantu languages, which she associated with an unconventional interpretation of archaeological ^{14}C dates. Despite the fact that there are correspondences between certain patterns identified by her and by us, she came up with a time frame for the Bantu expansion that we judged indeed too unlikely for our results to be compared in detail. We apologize if this caused discomfort and wish to emphasize that we highly esteem other parts of Klieman's work. Blench recognizes that we rely on a different and more recent quantitative approach to language classification but criticizes our Bayesian phylogeny—in his characteristic straightforward way—as "just the discredited old lexicostatistics with glamorous graphics." It is important to stress that although both methods usually rely on so-called core vocabulary, they are fundamentally different. Lexicostatistics is a distance-based method that calculates the percentage of shared cognates between languages to propose a tree without distinguishing between retentions and innovations and implicitly assuming a constant rate of lexical change. The Bayesian method used in our article and other phylogenetic methods are much more complex since they are character based. Such methods focus on the study of the character, which is in our case the study of innovations or the loss and gain of cognates. Character-based methods have a model of cognate evolution and try to find the best scenario of evolutionary history. We refer the reader to Dunn (2014) for further reading. We understand the skepticism toward these rapidly evolving statistical methods, but un- or ill-informed criticism should not constitute an obstacle to collaboration between historical linguists and computer linguists or phylogeneticists or to progress in the field of phylogenetic historical linguistics.

As for the linguistic data, Di Carlo and Good, who recognize the power of the method we applied to discover tree-like patterns with large comparative data sets, rightfully note that the nature of the input data and the theoretical assumptions built into the algorithm necessarily limit the scope of inferences one can make. Although they seem to confuse our data set with that of previous studies—we have worked on a word list of 100 words documented in 167 languages—we obviously agree that the more diverse the data are that one considers, the firmer the conclusions become that one can draw. Their suggestion to apply the same phylogenetic methods to Bantu grammatical data is saluted with enthusiasm. Pioneering quantitative research in Bantu classification on the basis of grammatical evidence, using a traditional distance-based method, was done by Bastin, Coupez, and de Halleux (1979), and their data were partially reanalyzed with the Bayesian method by Rexová, Bastin, and Frynta (2006). A more systematic phylogenetic analysis of grammar data, especially from the Bantu languages considered in our study, would be most welcome but would also require a long-range and multidisciplinary research program. That is easier said than done.

As for the model of language classification, Di Carlo and Good criticize that we have opted for a single tree-based representation, while the Bantu languages would rather act like a dialect continuum for which a network-generating algorithm is better suited. As is generally accepted and as we have repeatedly written ourselves, we do recognize that long-term Bantu-internal language contact had an important structural impact on Bantu language evolution. This is exactly the reason why the comparative method, to which Dimmendaal refers as a good alternative to quantitative classification methods, has never led to a satisfying global proposal of internal Bantu language classification (Schadeberg 2003:155). The difficulty of finding bundles of coinciding shared innovations neatly delimitating genealogical units seriously reduces its applicability, as Nurse and Philippson (2003*b*) experienced. It is a more powerful tool on lower levels of the Bantu language family. In line with molecular anthropological evidence suggesting that an initial rapid spread of Bantu-speech communities was followed by backward and forward migrations (de Filippo et al. 2012), linguistic evidence points toward a pattern of "spread over spread over spread" and intensive language contact that induced convergence between Bantu languages that were originally more distant. The initial signal of ancestral language divergence became disturbed by subsequent waves of language convergence. It is exactly to uncover as satisfactorily as possible that original signal that we have chosen here to consider only "core vocabulary." Although it is certainly not entirely contact-free, it is definitely more resistant to borrowing than other kinds of vocabulary. Moreover, it has been shown that even if there are borrowings, we would need a great amount of horizontal transmission for it to have an effect on the phylogeny (Greenhill, Currie, and Gray 2009). Since we specifically targeted the pattern of initial divergence without wanting to take into account subsequent convergence, we have preferred to depict genealogical relationships between languages as a tree rather than as a network. In her PhD dissertation, Rebecca Grollemund (2012) used the same data to generate a network through the Neighbor-Net algorithm (Bryant and Moulton 2004). The major clades resulting from that method are exactly the same as those produced by the Bayesian method. Since we refer only to those major clades and not to internal relationships within those clades, it actually did not really matter whether we depicted genealogical relationships as trees or as networks.

This leads us to another very important critique by Di Carlo and Good, which is also echoed in the comments of Dimmendaal, Klieman, and Verdu and Bahuchet—that is, our assumedly uncritical adoption of an oversimplified model of language spread wherein branches of a phylogenetic tree are equated with migration paths of speech communities and wherein we would disregard alternative population dynamics, such as admixture with communities not speaking Bantu languages. We admit that we take a Bantu-centric stance in our article and have only considered the Bantu expansion from the point of view of the Bantu-speaking migrants. Just as we do recognize that Bantu-internal contact had a formative impact on Bantu language evolution, we are also well aware that early Bantu speakers got in touch with indigenous and foreign speech communities and that this sometimes favored the further spread of Bantu languages through language shift by nonnative speakers, as suggested by Dimmendaal. That said, it is important to stress that, in line with genetic evidence (Pakendorf, Bostoen, and de Filippo 2011), we do believe that demic diffusion was the dominant mechanism of initial Bantu language spread. In that sense, we also think that the major clades of the Bantu language phylogeny—whether it is represented as a tree or a network—do roughly reflect the initial migration of Bantu-speech communities. These clades are robust and recur independently of the (quantitative) classification method applied. On the contrary, we do not think that each and every split within these major clades does correspond to historical linguistic reality or that each branch in the tree can be equated with a migration path, and we nowhere make such a claim. The internal phylogenetic structure of each clade is the result of subsequent evolutions that are not considered in the present article.

Several commentators allude to the paucity of archaeological data for certain regions of Central Africa and to the lack of clear-cut interrelationships between the scattered Neolithic and Early Iron Age ceramic traditions that have been documented to date. Eggert emphasizes not only that there is a chronological gap between the earliest villages of the Yaoundé area and the rock shelters excavated in the Grassfields, as we call attention to in our article, but also that ceramic evidence that might be connected with the rain forest traditions farther south is also missing. In the same vein, MacEachern rightly points out that little is also known about how Shum Laka relates to Middle Holocene sites farther north and west, a fact that we do not address in our article. Huffman brings the Urewe tradition of the Great Lakes region to the forefront as well as other early Early Iron Age traditions from East Africa that have been commonly associated with the spread of East Bantu languages. Since these are linked with later phases of the Bantu expansion, we did not deal with them in our article. Here again, it still needs to be demonstrated how Urewe, ancestral to several Early Iron Age traditions farther south, is possibly linked with more western traditions that predate 2600 BP, the time of the earliest Urewe attestations. According to the currently available archaeological evidence, the Urewe tradition seems to appear "out of the blue" (Bostoen 2007:197). Some scholars have pointed toward possible similarities with pottery traditions from Chad (Soper 1971) and the CAR (Van Grunderbeek 1992), but the evidence is not conclusive. Although the model according to which the arrival of East Bantu in the Great Lakes region results from an eastward dispersion along the northern borders of the rain forest is contradicted by recent language classifications (de Filippo et al. 2012; Holden 2002; Holden, Meade, and Pagel 2005; Pagel and Meade 2006; Rexová, Bastin, and Frynta 2006), more archaeological fieldwork in northern DRC and southern CAR, which continues to be hampered for reasons of insecurity, inaccessibility, and disinterest, would definitely be beneficial to test this hypothesis archaeologically. Similarly, more archaeological data from northern and eastern Angola (Clist and Lanfranchi 1992) and from the area between the lower Congo region and Katanga (Kanimba Misago 1991) are needed to check the rather speculative connections that Huffman sees between Early Iron Age ceramic traditions discovered in the savannas south of the equatorial rain forest block. In sum, we cannot agree more with Eggert's call for "fieldwork, fieldwork, fieldwork," to which we would like to add "publish, publish, publish," so that the sometimes decades-old, hard-won, and dearly paid archaeological evidence becomes available to the wider scientific community. In this respect, we are happy to learn that the results of a rare archaeological reconnaissance within the SRI, carried out by Eggert in 1987, will eventually be published in detail. We sincerely hope that our synthesis will stimulate more archaeological research in that area.

The importance of publishing research findings is also well illustrated by the Obobogo pearl millet case. Neumann is of course fully right in pointing out that the archaeobotanical identification of these grains was never published. Although they were discovered earlier and identified as pearl millet by Hugues Doutrelepont (Royal Museum for Central Africa, Tervuren), the Obobogo grains can therefore indeed not be seen as a confirmation of the properly documented pearl millet grains of Bwambe Sommet and Abang Minko'o. The publication of these Obobogo finds and the archaeobotanical analysis of other pits uncovered there in the early 1980s, which might result in the discovery of more cereal grains, would therefore be most welcome. In that respect, we can only endorse Neumann's view that more excavations should include recovery of plant and animal remains followed by careful identification and accurate documentation. Sadly enough, proper archaeobotanical analysis during and after archaeological fieldwork is too often the first victim of budget restrictions. As Neumann correctly observes, more archaeobotanical data would give us better insight into the subsistence strategies of early Bantu-speech communities, especially into the much debated question—to which several commentators allude (Blench, Dimmendaal, Neumann)—of whether banana cultivation was one of them. In contrast to what Neumann suggests, we do not have any settled ideas on this and other subsistence-related issues. We do believe, however, that archaeological and linguistic evidence concur today to indicate that early migrant Bantu-speech communities had mixed subsistence economies in which plant cultivation—if already practiced—did not play a decisive role. Contrary to common belief, we think with Blench that agriculture was not a trigger for the initial expansion of Bantu speakers from their homeland in the Nigeria-Cameroon borderland. To date, there is neither archaeological nor linguistic evidence indicating that the earliest Bantu speakers cultivated pearl millet or any other crop. In that sense, we consider pearl millet cultivation, as dated between 2400 and 2200 BP in southern Cameroon (Kahlheber, Bostoen, and Neumann 2009) and around 2200 BP in the inner Congo Basin (DRC; Kahlheber et al. 2014),[1] as "additional" to the original subsistence strategies of early Bantu speakers, whatever these may have exactly looked like. This said, we obviously mistook "cultivation" for "domestication" when we wrote in our article that people south of the Sanaga River had learned how to domesticate plants. We are well aware that pearl millet was domesticated in West Africa, as Neumann rightly emphasizes.

Different commentators (Dimmendaal, Verdu and Bahuchet) discuss the interactions between the immigrating villagers and the autochthonous Late Stone Age hunter-gatherers during the early stages of the Bantu expansion. Dimmendaal assumes that archaeology is not of much help here, as former hunter-gatherer communities left little if any material traces. There is some archaeological evidence for their coexistence, either because we have roughly contemporaneous ^{14}C dates for both nonceramic Late Stone Age sites and ceramic village sites in the same broad geographic area or because potsherds were found associated with Late Stone Age lithic assemblages in one and the same site. This type of evidence is available for southern Cameroon (Lavachery et al. 2010), the Republic of Congo (Denbow 2014), and Gabon (Clist 1995) for the period between about 3000 and 2000 BP. For later periods, it becomes very difficult, not to say impossible, to archaeologically discriminate hunter-gatherers having abandoned their lithic technology from villagers, given that the recoverable equipment of both types of communities became very similar, if not identical. Verdu and Bahuchet refer to recent genetic research by Patin et al. (2014), pointing out that substantial admixture between farmers/villagers and hunter-gatherers would only have begun within the past 1,000 years. On the basis of the archaeological evidence available today, this would mean that for more than 1,000–2,000 years villagers and hunter-gatherers coexisted without any substantial admixture. It might be important to note that Patin et al. (2014) have relied on the widely used ALDER method to

1. In our original article, we could not refer yet to the pearl millet identified in Kahlheber et al. (2014), because their article was still forthcoming.

date the admixture event. Recent research has pointed out that ALDER tends to seriously underestimate dates. Xua et al. (2012), for instance, have dated admixture in eastern Indonesia with two different data sets and two different dating methods. The dates they infer are very similar and agree with the archaeological record, in contrast to the substantially more recent dates that Lipson et al. (2014) obtained by applying the ALDER method to the very same data set.[2] These insights from Asia possibly challenge the rather surprising conclusions by Patin et al. (2014).

To stress the complexity of the Bantu expansion also in the areas where it was initiated, Dimmendaal raises a case from Gabon where one Bantu language group would have undergone strong structural influence of another Bantu language group because the speakers of the first wanted to get access to the iron-working technology of the speakers of the second (Mouguiama-Daouda and van der Veen 2005): "speaking their languages implied access to this important technological innovation." This is indeed a very important point often neglected with regard to the diffusion of iron metallurgy, which happened independently of the initial dispersal of Bantu-speaking villagers. The acquisition of this technology by certain Bantu-speech communities but not by others may indeed have had important social consequences. Recently discovered cemeteries in Equatorial Guinea (González-Ruibal, Gelabert, and Mane 2011; González-Ruibal, Sanchez-Elipe, and Otero-Vilarino 2013) and southwestern Cameroon (Meister 2010), dating back to the period 2000–1500 BP and hosting graves with elaborate iron artifacts, some of which are clearly related to later symbols of prestige and local currencies, suggest early social stratification favored by the introduction of iron technology.

Eggert accuses us of prejudice because we would think that "the forest as such constitutes an impediment to intrusive populations practicing a subsistence economy." We do believe indeed that the Central African forest block constituted an obstacle to the migration of Bantu-speech communities, not so much because the rain forest would be impenetrable—as he seems to assume—but rather because it required an adaptation in terms of subsistence strategies. As we state in the article, between about 6000 and 4000 BP their ancestors lived in a relatively open highland environment to the north of the forest block. Their initial expansion to the lowlands in the south first entailed an adjustment to a dense forest habitat but was facilitated around 4000 BP by a sudden climate change that led to the extension of savannas up to the Sanaga River. This forest opening probably allowed Bantu speakers to migrate more rapidly to the south and to reach, for instance, the region around Yaoundé, where we have the oldest archaeological evidence for villages. It possibly also facilitated a southwest expansion through the coastal savannas that emerged around that period, which may explain the arrival of pottery-producing village communities at the northwestern coasts of Gabon around 3000 BP. The lowering of the SST in the Gulf of Guinea, which was at the origin of this savanna extension on the periphery of the Central African forest block, led in more equatorial regions to the development of an evergreen forest environment (Maley 2012). Such evergreen forests have a composition and cover that is relatively different from that of semideciduous forests. This type of flora was less welcoming to Bantu-speaking villagers and their way of life, which was more adapted to open environments. They could more easily exploit the space offered by the newly developed woodland savannas and had access there to fauna and flora with which they were more familiar.

Even if—as Eggert rightfully observes—the inner Congo Basin with its multitude of waterways might have been accessible to village communities well before 2500 BP, it remains a fact that it is only from that period onward that they did make their entrance. The Imbonga pottery tradition, which Eggert (1987) himself and later on Wotzka (1995) dated to about 2350–2050 BP, is for the time being the oldest archaeological evidence relatable to such a way of life. Wotzka (1995) sees the Imbonga style as the starting point of an inner Congo Basin ceramic sequence that "reflects an uninterrupted pottery tradition which has been active for the last 2400 years" (290). This starting point "cannot be interpreted as an already evolved part of a developmental series which originated outside the study area," even if "the immediate origin of the first immigrants into the inner basin remains unknown." He further—prudently—concludes that "the same holds for the background of the Imbonga pottery used by these pioneering groups, although there are indications that it might ultimately stem from western or northwestern central Africa." In light of these conclusions and taking into account the broad temporal correspondence between the emergence of Imbonga pottery and the opening up of the SRI around 2500 BP, it is not unreasonable to assume that the initial settlement of the inner Congo Basin by sedentary communities was enabled—or at least facilitated—by the Late Holocene climate crisis that affected the central forest block. Indirectly, this implies that the evergreen forest formations that existed before were less favorable to the migration of villagers into the inner Congo Basin. Likewise, given that no languages other than Bantu are spoken there, it also does not seem entirely prejudiced to believe that Imbonga pottery constitutes "an archaeological signature of the Bantu language dispersal" in that area.

—Koen Bostoen, Bernard Clist, Charles Doumenge,
Rebecca Grollemund, Jean-Marie Hombert,
Joseph Koni Muluwa, and Jean Maley

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