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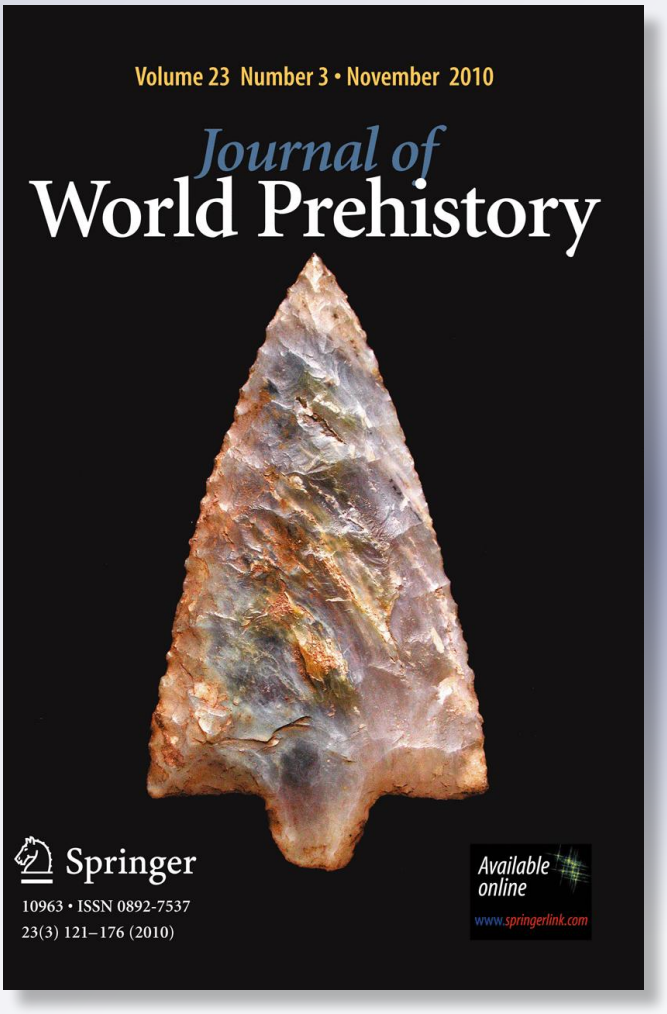

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ORIGINAL PAPER

Beyond Typology: Looking for Processes and Diversity in the Study of Lithic Technology in the Brazilian Amazon

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Abstract This article describes how the lithic industries of the Amazon have been studied in Brazilian archaeology, and presents a historical record of research in the region. The article then attempts to analyze the reasons for the relative paucity of work on this research theme. The record includes studies of lithic industries related to the presence of pottery-using (ceramist) groups as well as those related to occupation of areas by hunter–gatherers. It points to different factors that have contributed to the type and quantity of information currently available, notably the issues of changing environmental conditions relating to site preservation and visibility that necessarily interface with the disciplinary history of archaeology within the Amazon Basin region. The paper seeks to highlight the issues that have dominated the research field, contextualizing them and redefining them in order to indicate future prospects for work in relation to the lithic industries of the macro-region.

Sumário Este artigo discute como as indústrias líticas da Amazônia têm sido estudadas na arqueologia Brasileira e apresenta um histórico da pesquisa na região. O registro utilizado envolve tanto estudos de indústrias líticas relacionadas a ocupações de grupos ceramistas, quanto àquelas associadas a grupos caçadores-coletores. A partir deles se analisam as razões para a escassez de trabalhos sobre o tema. Discuti-se a respeito dos diferentes fatores que contribuiram para o tipo e a quantidade de informação atualmente disponível, como a caracterização ambiental e sua dinâmica, assim como aqueles relacionados com a história da arqueologia enquanto disciplina no Brasil. Este artigo procura realçar questões que dominaram e ainda dominam esse campo de pesquisa, contextualizando-as e redefinindo-as no sentido de indicar propostas futuras de trablaho com indústrias líticas nessa macro-região.

Keywords Lithic · Classification · Brazilian archaeology · Amazon basin

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Introduction

Thirty years ago this article could not have been written, due to a lack of basic data. Two decades ago its goal would have been to investigate the validity of the data presented and discuss its bearing on the antiquity of the occupation of the region. Today, though still relatively scarce and poorly understood, the available data on the ancient occupation of the Amazon Basin by groups whose livelihoods were based essentially on hunting, gathering, fishing and incipient forest-management, allow us to raise other questions. These emphasize the diversity of contexts and processes involved in the occupation of the macro-region since the end of the Pleistocene (Roosevelt et al. 1996, 2002, 2009; Magalhães 1994, 2005; Hilbert 1998; Silveira 1994; Miller 1987, 1992; Neves 2006; Kipnis et al. 2005).

In order to reinforce this point, we want to discuss in this article how the lithic industries associated with Brazilian Amazon contexts were and still are treated in the region's archaeology, drawing attention to two crucial issues: a shortage of work on the subject, and the theoretical and methodological approach that has so far prevailed in the characterization of the industries. As the theme is lithic industries as a whole, we will include not only those contexts linked to the initial and most ancient occupation phases, but also those associated with later, ceramist contexts.

In relation to the ancient occupation phases, now known to date back in the Brazilian Amazon at least to the initial Holocene (Kipnis et al. 2005; Magalhães 1994; Miller 1987; Roosevelt et al. 1996), both natural factors and factors related to the history of archaeology in the region contributed to an earlier widespread belief in the impossibility of the colonization of the region before the advent of agriculture (Bailey et al. 1989; Headland 1987; Lathrap 1968; Meggers 1954, 1985; Sauer 1944). But equally, in reference to later, ceramist contexts, the lack of interest in lithic remains is marked; this is not unique to Amazonian archaeology, being a recurrent theme in several parts of Brazil (Prous 1991). It appears that the lack of interest in lithic remains is intrinsically linked to the theoretical and methodological perspective that guides most studies, which favors a typological approach and an essentially formal and functional methodology (Bueno 2004). Thus, the absence of 'well elaborated' artifacts and culturally—or chronologically—diagnostic artifacts serves to exclude the category of lithic remains from the focus of interest, relegating them to a supporting position in the characterization of the region's sites and archaeological contexts.

In this discussion, four distinctive but interconnected topics are identified and sequentially presented: history, context, questions, and prospects.

In relation to the historical record, we will not discuss here the references made by European travellers and naturalists who visited the Brazilian Amazon starting in the sixteenth century, but rather focus on the academic work of archaeologists published from the mid-twentieth century onward, a period that marks the history of archaeology as a scientific field in Brazil (Barreto 1998). Based on that history we intend to define what were and remain the main themes of research and what issues have dominated this field of study. In connection with this, we try to highlight the theoretical and methodological assumptions underlying the selection and development of such issues. Following on from this, through discussion of the currently available data, we suggest a re-evaluation of the themes, focusing on a regional approach to the characterization of technological organization (Nelson 1991) and to the identification and understanding of the choices (Lemonier 1986) made in the processes of managing lithic resources (Bueno 2007b).

History

One of the main features of the study of lithic industries in the Brazilian Amazon is the underlying lack of work on the subject. This deficit arises for a number of reasons, which can be grouped into two distinct classes, namely the configuration of the landscape (present and past) and the history of archaeology in the region.

The first of these, the present configuration of the landscape, relates to the dense vegetation cover of the Amazon Basin rainforest, and the major difficulties this presents with regard to access to the interfluvial areas and overall surface visibility. Although ancient sites can be also found on the banks of the major rivers, which are areas that are more easily accessed, these also happen to be where the main cities of the region are located, and at the same time, they are the focus of an intensive process of erosion and sedimentation, with remodeling of the courses of rivers and natural waterways. So, if favorable places to look for ancient occupation exist, they are in the core area of Amazonian Rainforest, a place that is difficult to access and prospect with traditional methods. These natural factors and the implications for finding ancient sites are recurrent themes in the literature and serve to discourage and undermine any proposed research strategy for studying lithic industries in Amazonia, or at least, those industries related to the earliest occupation (Simões 1976; Prous 1991). The environmental characterization lends credence to the idea that it is impossible to identify contexts associated with any very ancient occupation, linked to groups whose livelihood was based mainly on hunting, gathering and fishing, and whose surviving material culture would be expected to have been made up largely of lithic artifacts. Due to the ephemeral nature of the record that would be expected to have been produced by any such occupation, and the intensity of the landscape processes in operation, it becomes easy to claim that there was no provable ancient occupation of the region. Any sites which might be relevant are thus considered invisible, due to the depth of overlying deposits, or because they have been destroyed by erosional processes, or are otherwise inaccessible, and thus unknown, because of difficulties of physical access and visibility in the areas where they might have the best chance of surviving (Simões 1976). This argument long discouraged the establishment of a research programme geared towards identification of sites related to an early period of occupation, and has contributed to the low priority given to the studies of lithic technology in Amazonia; and this, in turn, has contributed to the current lack of work on the theme.

Another factor associated with the environmental setting of this macro-region, past and present, and tending to compound the situation, concerns the alleged widespread shortage of lithic raw material throughout the Amazonian region. Thus, due to inferred scarcity of resources, it was assumed that there would be a concomitant lack of lithic remains in the archaeological record (Simões 1976, p. 1).

The third factor that we could mention mixes aspects of the environmental configuration with theoretical questions. It is related to a perception of the Amazon Forest as an environment with poor, scarce and widely dispersed resources of protein, fat, or carbohydrate, from both animal and plant sources. This view has been recurrent in the characterization of the rainforest's carrying capacity, reinforcing the idea of the impossibility of human occupation before the advent of agriculture. It has thus been very influential in the construction of the standardly accepted cultural chronology for the occupation of the region (Sauer 1944; Steward 1948; Meggers 1954, 1996, 2009; Lathrap 1968; Bailey et al. 1989; Headland 1987).

The last aspect related to the configuration of the landscape involves the paleoenvironmental reconstructions relevant to the entire region. Contrasting hypotheses have been

presented about the existence and impact of drier and colder climates on the biogeographical configuration of Amazonian rainforest (Ab'Saber 1977; Colinvaux et al. 1996, 2000; Van der Hammen and Absy 1994; Van der Hammen and Hooghiemstra 2000). During the 1970s and 1980s, the refugia theory was the main hypothesis used to explain the biodiversity of the tropical forest. It held that the existence of patches of savanna environment was a function of much colder and drier climates producing islands of speciation. By the end of the 1980s, and particularly in the 1990s, based on new temperature fluctuation data during the Late Glacial Maximum, precipitation rates and their influence on vegetation cover (Colinvaux et al. 1996, 2000), this hypothesis was strongly criticized. The outcome of this discussion is related to the arguments for or against a very early occupation of this region. Those who regard the Amazonian Rainforest as a barrier to human occupation, saw in the refugia theory an avenue to proposing an ancient occupation of these patches of open environment, where one could find large mammals and an environment similar to those that would have been favoured by big game hunters originating in North America (Sauer 1944). This question is also important because it relates to another central issue that has affected the development of lithic studies in the Amazon and other parts of Brazil and South America: the persistence of a hegemonic model to explain the earlier occupation of the continent (Gnecco 2003).

From a historical perspective, the study of lithic material in the Amazon in pre-ceramic and particularly ceramic-period occupations is still at a very early phase of development in Brazil (Bueno and Pereira 2007; Caldarelli et al. 2005; Costa 2002, 2009; Hilbert 1998; Kipnis et al. 2005; Magalhães 2005; Miller 1987, 1992; Oliveira 2007; Roosevelt et al. 1996, 2002, 2009; Simões 1976). There are just a handful of publications that have attempted a more detailed and systematic study of the composition and technological characteristics of lithic material found in either of these two types of context (Bueno and Pereira 2007; Costa 2002, 2009; Hilbert 1998; Roosevelt et al. 1996).

Although, as we have seen, a number of factors have contributed to the relatively low importance accorded to studies of lithic industries in Amazonian archaeology, these are gradually being countered and deconstructed. These factors include, on the one hand, the hypothesized absence of ancient occupation prior to the advent of agriculture and associated with groups whose livelihoods were based exclusively on hunting, gathering and fishing, and, on the other hand, the perceived irrelevance of the lithic industries associated with the ceramic-period occupation, due to the inability of lithics, considered as a broad artifact class, to provide cultural characterizations and periodizations.

The first aspect has influenced the course of archaeological research in the region directly, resulting in an analytical focus on pottery–using cultures at the expense of research projects that seek to identify and characterize sites associated with hunter-gathering groups, in which the principal, and perhaps sole, material remains would be lithic artifacts. This orientation reflects the strong influence of the *Programa Nacional de Pesquisas Arqueológicas (National Program of Archaeological Research)*, or PRONAPA, developed in Brazil in the 1960s under the coordination of Betty Meggers and Clifford Evans. This program, which was very influential in Brazilian archaeology, lasted from 1965 to 1970 and had a particular impact on the archaeology of the Amazon basin with the implementation of PRONAPABA (*Programa Nacional de Pesquisas Arqueológicas da Bacia Amazônica*) by the mid 1970s (Meggers 1985, 2009; Meggers and Evans 1970; Simões and Araujo-Costa 1987). In order to build a historical and cultural framework with the spatio-temporal distribution of cultural areas as defined on the basis of the characterization of artifact types, the theoretical and methodological orientation of PRONAPABA was designed to make focused interventions on archaeological sites in order to obtain

samples that would be quantitatively significant in the construction of a seriation (Meggers and Evans 1970). The studies were able to analyze collected material in such a way as to determine the variation in the frequency of distribution of cultural traces that are components of the recognized types and thus define a number of archaeological cultures (Meggers and Evans 1970; Meggers 2009). Given the low representation of lithic artifacts on the ceramic sites and the difficulty of establishing criteria for defining a seriation of these adequate to the proposed goals, work conducted within this framework made no systematic attempt to characterize the lithic industry as found on the archaeological sites under study (Dias 1995, 1999). The predominant material in these projects was ceramic, which, because of the number of fragments and the presence of a very wide range of attributes which were easily identifiable and amenable to seriation, was elected as the preferred item of material culture for the diagnostic definition of the archaeological cultures that existed in the Amazonian region (Barreto 1998; Dias 2007).

Thus we see that the environmental characterization, the history of Brazilian archaeology in the Amazon, and studies of human occupation in tropical rainforests have all contributed to the paucity of studies of lithic industries and to the absence of lithic specialists in the research institutions of the region.

The situation as outlined above has, however, been criticized in recent years. Regarding the possibility that the Amazonian forest was occupied by groups whose livelihood was based exclusively or primarily on hunting and gathering, there are two very important points. The first is that, with the further and more detailed development of ethnographic studies of groups that inhabit tropical rainforests in different regions of the world, it has become clear that the diet of these groups contains a much wider range of animal and plant resources (providing a large amount of animal protein as well as carbohydrates) than previously thought (Bahuchet et al. 1991; Stearman 1991; Politis 1996, 1999; Kaplan et al. 1990). Second, through their detailing of the environmental characteristics of the Amazon Basin, these same studies now support a hypothesis that the rainforest is not a primary forest, but that its shape and composition have been intensely and directly affected by human action through management practices which were operational from early periods of the region's occupation (Ballé 1989; Denevan 1991; Descola 1994).

With regard to shortages of lithic raw materials, there are two main issues: Firstly, with the increase in archaeological survey, a series of lithic sites have been found in different parts of the Amazon (Amazon Central: Iranduba, Manacapuru and Presidente Figueiredo in Amazonas; Serra dos Carajás, Monte Alegre and Serra das Andorinhas in Pará; Vilhena, Pimenta Bueno, Guajará-Mirim and Porto Velho in Rondônia, among others) (Lima 2003; Costa 2002, 2009; Bueno and Machado 2005; Kern et al. 1992; Magalhães 1994, 2005; Miller 1992; Roosevelt et al. 2002; Roosevelt et al. 1996). Secondly, as environmental studies have become more detailed, a number of locations that may have served as a source of lithic raw material for groups who inhabited the Amazonian region have been identified, and sometimes the fact that these places are limited or are in very specific parts of the landscape raises an even more interesting research problem, since it may provide important indications as to the circulation (and therefore the existence) of exchange networks, through which the lithic raw materials used in different contexts of the region circulated (Costa 2002). This point has been emphasized since the 1990s by Roosevelt and colleagues, based on the extent of lithic collections in museums in the USA (Roosevelt 1990; Roosevelt et al. 1996).

The same researchers who have been identifying new and diversified raw material sources are pointing to the the fact that, despite the intense landscape-formation dynamic, causing a constant reformulation of the local geomorphology, there are more stable regions

that can be investigated in the search for older human occupation both at open air sites and in rock shelters (Kern et al. 1992; Lima 2003; Magalhães 2005; Miller 1987, 1992; Roosevelt et al. 1996, 2002).

Context

Among the principal research dealing with the lithic remains in contexts which can be associated with hunter-gathering groups in the Brazilian Amazon, we can cite the work of Roosevelt in the region of Monte Alegre (Roosevelt et al. 1996, 2002) and the middle Xingu basin (Roosevelt et al. 2009); of Hilbert, Magalhães and Oliveira in the shelters of Serra de Carajás (Hilbert 1993; Magalhães 1994, 2005; Oliveira 2007); of Hilbert with the collection of arrow points in the Museu Paraense Emilio Goeldi collection (Hilbert 1998); of Costa (2009) at open air sites in the central Amazonian region; of Simões with two projectile points found in southern Pará (Simões 1976); of Miller at a site in a rock shelter in northwestern Mato Grosso (Miller 1987), and at open air sites in the middle and lower Jamari river, Rondônia (Miller 1992); and of Meggers and Miller in various parts of the Amazon region (Meggers and Miller 2003). All this research, whether or not radiocarbon dating was used, points to an occupation of the Amazon region dating back to the beginning of the Holocene, around 10000 years BP. In fact, a clear association between lithic assemblages analyzed and C14 dated samples is still an exception for this region (Table 1). This kind of association is provided only by work carried out by Roosevelt at Monte Alegre, that done at Serra dos Carajás by different researchers, and that of Costa in Central Amazon. The research done by Miller and by Meggers and Miller, although presenting assemblages and dates for some sites, does not offer a clear definition of the relationship between the two kinds of data. In Table 1 we summarize most of the data available for these sites, pointing to the main characteristics of the assemblages related to different occupation periods in each dated archaeological site. As mentioned above, there are more dates for the Brazilian Amazon, but they still lack evidence of a clear association between the lithic debris described and the dates presented.

Instead of offering dates for the late Pleistocene (Roosevelt et al. 1996; Miller 1987) and Early Holocene (Costa 2009; Magalhães 1994; Kipnis et al. 2005; Miller 1987, 1992), some of these contexts present periods throughout the Holocene for which there is no date, indicating the possibility that there was no stable and continuous occupation from this initial period until the emergence of the first densely occupied and extensive ceramic sites around 2500 years BP, as is the case for the Central Amazon (Neves 2006). However, for other places, such as Carajás and the middle Jamari river, for example, there is evidences of a continuing occupation between the pre-ceramic and ceramic horizons, involving a possible association between pre-ceramic occupations and the initial formation process of Anthropogenic Black Earth (Magalhães 1994; Miller 1992). We should also mention the occupation sequence of Pedra Pintada and Taperinha, both located on the middle–lower Amazon river. After a first occupation in Pedra Pintada by the end of Pleistocene, where remains of bifacial and unifacial flaking debris were found, there is a Holocene occupation sequence that mainly involves the production of unifacial artifacts by percussion flaking and the production of quite simple and diverse artifacts by polishing and pecking, some just with traces of use-wear alteration without intense shape preparation. This industry identified in both sites (Pedra Pintada and Taperinha) is characteristic of *sambaquis* (shell mounds), but is also quite similar to those identified five millennia later in ceramic contexts (Costa 2002; Roosevelt et al. 1991, 1996).

Table 1 Dated archaeological sites in the Brazilian Amazon region between 11500 BP and 3000 BP (non calibrated radiocarbon ages), with an indication of the main characteristics of associated lithic assemblages

Site	Earlier date	Lab. ref.	Later date	Lab. ref.	Bib. ref.	Lithic assemblage
Dona Stella	9460 ± 50	Beta 202678	4500 ± 40AP	Beta 202679	Costa (2009)	Uni and Bifacial industry with few formal artefacts; increasing proportion of informal artifacts at the upper levels
RO-PV-48	8320 ± 10	Beta 27015	6970 ± 60	Beta 27013	Miller (1992)	Itapipoca phase—Expedient unifacial technology made of local raw material
RO-PV-35	6090 ± 130	Beta 27658	5210 ± 70	Beta 27017	Miller (1992)	Pacatuba phase—Expedient unifacial technology with small and informal artifacts made mainly in quartz; presence of few small scrapers
RO-PV-48	4780 ± 90	?	2640 ± 60	?	Miller (1992)	Massangana phase—Expedient technology with small and informal artifacts made mainly in quartz, with few polished stone axes
MT-GU-1	12300 ± 95	SI-3477	8930 ± 100	SI-3736	Miller (1987)	Complexo dourados—Uni and bifacial industry with few formal artefacts
Caverna da Pedra Pintada	11145 ± 135	GX-17413	10250 ± 70	GX-19537	Roosevelt et al. (1996)	Bifacial and unifacial technology with stemmed and triangular bifacial points, with a tendency toward lower frequency of bifacial debris in the upper levels
Caverna da Pedra Pintada	7580 ± 215	GX-17415	6625 ± 60	GX-1742A-AMS	Roosevelt (1995)	Paituna phase-early pottery—small assemblages made of informal tools and flakes
Taperinha	7090 ± 80	OxA-1546	6300 ± 90	OxA-1540	Roosevelt (1995)	Assemblage composed by hammerstones, few flakes and hearth stones associated with early pottery
Gruta do Gavião	8065 ± 360	GX 12510	3605 ± 160	GX-12512	Silveira (1994)	Carajás lithic complexes—quartz flakes, bipolar percussion, few formal artifacts, mainly unifacial
Gruta do Rato	8470 ± 50	Beta 110706	7040 ± 50	Beta 110705	Magalhães (2005)	Carajás lithic complexes
Gruta do Pequiá	9000 ± 50	Beta 110699	8119 ± 60	Beta 110700	Magalhães (2005)	Carajás lithic complexes
Gruta da Guarita	8260 ± 50	Beta 110703	–	–	Magalhães (2005)	Carajás lithic complexes
NV-V	8850 ± 40	Beta 210858	8680 ± 40	Beta 210857	Kipnis et al. (2005)	Carajás lithic complexes
N4-WS-017	8310 ± 60	Beta 215050	7680 ± 100	Beta 215051	Kipnis et al. (2005)	Carajás lithic complexes
N4-WS-012	8240 ± 90	Beta 215053	6980 ± 70	Beta 215052	Kipnis et al. (2005)	Carajás lithic complexes

Table 1 continued

Site	Earlier date	Lab. ref.	Later date	Lab. ref.	Bib. ref.	Lithic assemblage
N4-WS-005	8110 ± 60	Beta 215056	8050 ± 70	Beta 215057	Kipnis et al. (2005)	Carajás lithic complexes
N5E-006	4690 ± 130	Beta 205579	–	–	Kipnis et al. (2005)	Carajás lithic complexes
S11D-001	5750 ± 40	Beta 205575	4120 ± 50	Beta 205576	Kipnis et al. (2005)	Carajás lithic complexes
S11D-101	3160 ± 50	Beta 205578	–	–	Kipnis et al. (2005)	Carajás lithic complexes
Mirim	5780 ± 60	Beta 217602	3750 ± 50	Beta 177599	Silveira et al. (2008)	Bifacial and unifacial technology, few formal artifacts, one bifacial projectile point, informal artifacts and flakes made on quartz
Breu Branco 1	9570 ± 70	Beta 215041	4890 ± 50	Beta 215042	Caldarelli et al. (2005)	Expedient unifacial technology made of local raw material
Breu Branco 2	9510 ± 60	Beta 215042	5960 ± 50	Beta 215044	Caldarelli et al. (2005)	Expedient unifacial technology made of local raw material
Ranchada	7970 ± 40	Beta 175184	–	–	Caldarelli et al. (2005)	Expedient unifacial technology made of local raw material
Remanso	4410 ± 50	Beta 205581	3920 ± 70	Beta 175186	Caldarelli et al. (2005)	Expedient unifacial technology made of local raw material

These different regional sequences indicate a diversity of occupation processes in the Amazonian macro-region (Magalhães 2005; Miller 1992; Neves 2006). Nevertheless, besides being few in number and very specific, these works do not provide detailed characterizations of the lithic industries associated with each of these contexts, and do not characterize the artifact assemblage in terms of technological organization, with the exception of Hilbert's work on the lithic assemblage from the Gruta do Gavião, and Carajás and Costa's on Central Amazonian sites (Hilbert 1993; Costa 2009). Mostly they present a preliminary characterization of the lithic material, with the indication of the main formal artifacts on each site, treating the assemblages of each site separately, without attempting to connect them to each other or providing a detailed description of the *chaîne opératoire* involved in the production of this lithic debris.

Recently, Cultural Resource Management (CRM) initiatives have identified a number of archaeological sites associated with the pre-ceramic period in the southeast region of Pará and central area of Maranhão state (Caldarelli et al. 2005; Kipnis et al. 2005). However, in these cases too, publications so far have not specifically focused on the issue of lithic technology, limiting themselves to generic descriptions of raw material, flaking technique and artifact assemblage.

For the southeastern region of Pará, there is another context, located in Serra das Andorinhas, with high potential for characterization of lithic technology using a contextual approach. A number of rock-shelter and open-air sites have already been identified and the region has been known archaeologically since the late 1980s. However, there have been few interventions and the region still lacks a chronological sequence to support suggestions about the possible relation of the pre-ceramic occupation of the area with those of Serra dos Carajás (Atzinger et al. 2003; Kern et al. 1992; Pereira 2001).

As already mentioned, for sites relating to an ancient occupation, the main approach to lithic technology involves a general description of the site assemblage, oriented toward the identification of index types, mainly projectile points. If any of the artifacts merit more detailed description they are always bifacially retouched and represent different types of projectile points (for a detailed distribution map of this artifact type see Meggers and Miller 2003, p. 296). This is the main procedure even in the case of surface finds and isolated stray finds, for which there is no good chronological reference. As discussed below, this is problematic in a region where there are no detailed and robust technological definitions for such artifacts and, at the same time, there is evidence that points to the presence of bifacial projectile points throughout the Holocene. Unfortunately, the large quantity of debris collected along with these artifacts has not yet been fully studied in order to more precisely characterize the *chaîne opératoire* and/or lithic technological organization of production, use, circulation and discard of these artifacts.

The literature on the lithic industries associated with ceramist occupations is even scanter. It includes work by Roosevelt et al. (1996) in Monte Alegre, where ceramic remains with dates close to 7000 BP were identified; by Magalhães (2005), who has identified a continuity in the occupation of shelters in the south hills of Carajás since the pre-ceramic period; and by Costa (2002) on the lithic material associated with ceramic sites of the Central Amazon region, characterized by the wide dispersal of the ceramic remains associated with the Guarita phase and by the presence of thick deposits of Anthropogenic Black Earth. Aside from these works, most of the archaeological research in contexts of ceramist occupation has been restricted to very preliminary and synthetic descriptions of the lithic material, rather than characterization of the organization of lithic technology.

An interesting case is that of the prestige artifacts, made of lithic raw material and widely known in the archaeological literature of the region, such as the Muiraquitãs and

other stone sculptures. These artifacts have never been associated with a lithic industry, and issues such as the procurement of raw material, manufacturing technique and the identification of production debris have long been ignored. However, recent observations about some lithic assemblages from the region of the Trombetas River (researched by Vera Guapindaia from 2000 onwards to Guapindaia 2008). indicate the existence of remains associated with the recurrent use of the percussion and pressure techniques, pointing to an extremely sophisticated lithic technology that could have been involved in such production, Some of the identified remains present the same technological characteristics as remains associated with the production of flint pendants found in the region of Pantanal, Mato Grosso, near the town of Cáceres, which presented a complex mix between bipolar, pressure and unifacial and bifacial, as well as polishing and, probably, pecking too (Miggliacio and Bueno 2005). In the production process of such artifacts we identified sequences of use of different techniques in the production of the same artifact, producing a diverse assemblage of lithic remains (Miggliacio and Bueno 2005; Miggliacio 2006). These inferences about lithic assemblages from the Trombetas river region are very preliminary, based on a general observation of the remains, but they draw attention to the fact that the lithic industry that was linked to the ceramic sites of this specific region (the lower Trombetas river) is completely different, from a technological point of view, from the lithic industries associated with ceramic sites of other nearby Amazonian regions, for example, Central Amazon (Costa 2002) and southeast Pará (Bueno and Pereira 2007). So, in recent contexts, associated with sedentary, horticultural and pottery production groups, we still have coordinated lithic production and a possible correlation between lithic production skills and social organization at an intra and extra-community level. According to ethnohistorical documents, this area of Nhamundá-Trombetas has been claimed to be a possible source for the spread of such artifacts, so these new findings could provide very important information about political and social aspects of lower Amazon occupation just prior to European contact.

The same could be said of the huge number, and stylistic diversity, of axes that have been found in recent CRM projects in different parts of Amazonia (Figs. 1 and 2).

This scenario presents positive prospects, as it definitely opens up the possibility of studying the technological variability of the lithic industries in the Amazonian region in comparative terms, and confirms the existence and diversity of these types of remains in several parts of this macro-region. There are a number of contexts that have been known for over 20 years, but they remain little studied. There is, currently, an expansion of research in certain portions of the Amazonian region that has identified more and more contexts associated with an ancient occupation of the region or with a major process of

Fig. 1 Stone axes from different archaeological sites at Ji-Paraná, Rondônia. Photo: Juliana Machado

Fig. 2 Locale for polishing the stone axes at Ji-Paraná, Rondônia. Photo: Juliana Machado

diversification in more recent periods. This shows that the idea of scarcity (of ancient sites and of sources of lithic raw material) is a historical product only, and that over the last 20 years significant references have emerged to overturn the old and accepted view and expand, enhance and re-orientate studies concerning lithic technology in the Amazonian region.

This opens two avenues for investigation that would combine field and laboratory work: (1) the analysis of existing collections, deposited at different research institutions in the region; and (2) the identification and analysis of lithic remains associated with new contexts.

Questions

From the case studies mentioned, we can identify some issues that have been discussed in relation to the occupation process of the Amazon and which might be addressed through the study of lithic industries.

Ancient Occupations

Discussions of the more ancient occupations associated with hunters–gatherers focus on:

(a) The extent and meaning of the diversity of lithic industries identified in the Amazonian region, mainly with reference to the production of unifacial and bifacial artifacts and the recurrent use of the bipolar technique in industries made mainly by quartz flakes in some contexts, such as the shelter of Serra dos Carajás (Hilbert 1993: Magalhães 1994; Oliveira 2007), Serra das Andorinhas (Kern et al. 1992), and western Rondônia (Miller 1992).

(b) The way of life of these groups: indications are of generalized hunting-gathering activity, leading to the predominant broad spectrum diet coupled with intense collection of vegetable resources (Roosevelt et al. 1996, 2002; Gnecco and Mora 1997; Gnecco 2003).

(c) The antiquity of occupation (Kipnis et al. 2005; Neves 2006; Miller 1987; Roosevelt et al. 2002).

Beyond the above-mentioned issues, one of the most discussed topics of Amazonian lithic industries is the presence and characterization of projectile points (Simões 1976; Hilbert 1998; Meggers and Miller 2003). However, if we confine ourselves to existing

descriptions of the artifact assemblages, a contradiction emerges: in most cases, what was identified in the archaeological record corresponds to an essentially unifacial lithic industry, with few retouched formal artifacts, usually terminal or lateral scrapers, with only just a few any remains of the production of bifacial artifacts, and even more rarely, the bifacial artifacts themselves. Besides the article published by Hilbert (1998) about projectile points in the Amazon, which describes ten projectile points from different places deposited in the collection of Museu Paraense Emilio Goeldi, and the article of Simões (1976) that shows two projectile points from the Upper Tapajós, references to projectile points identified in situ are restricted to just three contexts, also located in different regions and associated with different chronological periods. These comprise: the evidence of bifacial remains and projectile points reported by Roosevelt et al. (1996) in Monte Alegre, Pedra Pintada shelter, with dates between 11200 and 10500 BP; secondly, a projectile point identified at the open-air site of Dona Stela, central Amazon, identified by Neves (Costa 2009; Neves 2006) and dated around 7000 years BP (Fig. 3); and another projectile point recently found by Silveira at the open air site of Mirim, located in the basin of the river Salobo, in the Carajás region, southeast Pará, dated around 5500 BP (Silveira et al. 2008). With the exception of the Pedra Pinatada assemblage, although the information is still preliminary, the general lithic technology that characterizes these industries is a unifacial technology and these projectile points represent exceptions in the broader artifact assemblage, there being few remains associated with the use of a bifacial technology.

Fig. 3 Projectile point from Dona Stela archaeological site, Central Amazon, dated c. 7000 BP. Photo: Wagner Souza e Silva

Whereas Costa mentioned the existence of some bifacial flakes in deeper levels of Dona Stela, the main remains produced at the site came from unifacial flaking even during the ancient phase of occupation (Costa 2009). Nevertheless, Costa highlights that for this site the ratio of unifacial to bifacial remains tends to increase for the upper levels of the stratigraphy. So, if bifacial flaking was present, it would appear to relate to the ancient occupation. But, for Serra dos Carajás, this is not the case. The ancient levels of occupation in the rockshelters have mainly unifacial flaking debris and the unique projectile point known for this area is related to an open-air site, dated to the middle Holocene (Silveira et al. 2008).

If we take the characterization usually applied to the lithic industries of Brazil in general (Prous 1991; Schmitz 1987), these features bring the Amazonian context much closer to its neighboring region, that of Central Brazil, which is traditionally characterized as displaying a lithic assemblage without points, than to the southern region, in which an industry with bifacial technology undoubtedly prevails. Comparing these regions in more detail, we can even see that in Central Brazil there are more references to projectile points than in the Amazon.

This is the same when we compare this assemblage with what has been found in Suriname (Boomert 1980; Rostain 2008) and the lower Orinoco (Barse 1990, 2003). In these regions, although some bifacial projectile points are found as surface finds, most of the lithic assemblage, dated to the beginning of the Holocene, is essentially unifacial.

It therefore appears to be an issue of great importance not only to understand the nature and focus of the studies accomplished so far, but also to re-orient future studies: if the few available data taken together point to a predominance of an essentially unifacial technology in the production of lithic industries from different regions and periods of the Amazon, why, historically, has so much importance been accorded to finds of projectile points? How does this contribute to our characterization of contexts and processes?

We can point to two main reasons for the construction of this scenario. The first concerns the prevalence, even now, of an essentially typological perspective in the study of lithic industries in the region (and in Brazilian archaeology in general). This perspective is associated with a culture-historical orientation that aims to define cultural traits that will allow spatial and chronological ordering of culturally monolithic assemblages (Bueno 2004). The second relates to the prevalence of the Paleoindian model to characterize and explain occupations related to the Pleistocene/Holocene transition across almost all of the South American continent.

Regarding the first factor, we might mention at this point some specific aspects of the study of lithic remains in other parts of Brazil. Currently, lithic assemblages associated with different sites, areas or periods have been classified and organized by the concepts of 'Phase' or 'Tradition' (Willey and Phillips 1958), betraying an intellectual influence that dates back to the 1960s and which arrived in Brazil via proposals put forward by the PRONAPA (Meggers and Evans 1970). The lithic industries characteristic of those 'Traditions' have been frequently characterized on the basis of artifactual morphological aspects classified in a functional typology—one for which there is no agreed terminology. Those artifacts have then been utilized as index markers and the assemblages have been described by typological lists which characterize each Tradition or Phase. The degree of similarity between the artifacts that are part of those typological lists has been used as the main proximity index for measuring between the artifactual assemblages (Bueno 2004).

At the same time, new work has focused on technological aspects of such industries, such as the relationships between debitage techniques and raw material, *chaîne opératoire*, and artifact design. Nevertheless, these studies have not produced a regional scenario

capable of offering an alternative explanation. This is because these works are typically site-specific monographs, producing consistent characterizations of the lithic industries at a single location, without setting it in a regional context and focusing on the dynamic relation between sites.

In addition, most of the work that has been done and the major syntheses produced do not offer the necessary qualitative and quantitative parameters to establish a comparison between these industries that is based on significant technological aspects.

Regarding the methodology of lithic analysis, we could relate it to at least two distinct periods, influenced by lithic studies in France, on the one hand, and in the USA, on the other, but both equally embedded within a culture-historical perspective (Bueno 2004).

These are the general trends, and describe the overall framework within which lithic technological variability has been debated in Brazilian archaeology. Nevertheles, in the last decade, there has been research which attempts to define more consistent criteria to characterize and analyze technological variability in a regional perspective. Besides the widespread concern with technological variability, there is still a strong apparent division between a French approach based on the analysis of the *chaîne opératoire* of the assemblage of a single site, and a North American approach based on reduction sequences in a regional perspective (Bueno and Isnardis 2007).

We could identify two different levels of difference involving the concepts of *variability* and *variation*, based on Schiffer and Skibo (1992): variability could be related to different archaeological cultures, while variation could be related to adaptative aspects in terms of the specificities of the climatic/environmental contexts of each region. Nevertheless, as has been discussed in the context of Brazil as a geographical unit, both variability and variation have been related to different climatic/environmental contexts, which then reveals something about the historic attraction of theories in which environmental determinism plays an important role, as is the case for culture-historical and cultural ecology paradigms, which have significantly influenced archaeological thought in Brazil.

In the Amazon basin, where research has long been dominated by the culture-historical paradigm, with the definition of phases and traditions based almost exclusively on ceramic seriation, the lithic assemblage has received much less attention than in other parts of the country, and has been described exclusively in terms of formal aspects and typological lists.

For the paleoindian model, the main question is that, with such importance attached to final formal artifacts, the study of assemblage composition and variation, especially with regard to lithic debris, has, for a long time, been dismissed. This bias connects with the Brazilian tradition of lithic studies and serves to reinforce the emphasis on the analysis of just one class, or a few classes, of artifacts, associating assemblages with postulated cultural entities, and thus ignoring all discussions of the meaning of technological variability.

These two aspects appear complementary if the main archaeological correlate fact of the paleoindian model remains the projectile point. In other words, the influence and predominance of a model to explain both the antiquity and the process of the initial Amazon occupation directs studies of the lithic industry by giving them an emphasis on typology. However, both the chronometric dates that are currently available (see Table 1), and the artifact assemblages identified in contexts related to the initial Holocene, point to a highly diversified scenario and an occupation of the Amazon basin that extends at least as far back as Clovis in North America (Gnecco and Aceituno 2006; Miller 1987; Meggers and Miller 2003; Mora and Gnecco 2003; Roosevelt et al. 2002).

It is fair to say that the hegemony of this model as an explanatory hypothesis obscures the progress and advance of perspective in studies of the occupation of Amazon, and of

South America in general. With regard to this last, the set of dates currently available allows us to raise another issue involving the continuity of, and the processes related to, the occupation of that region during the Holocene. This seems to be a very promising development for a discussion of issues such as the emergence of the production and use of ceramic artifacts, and the process of management and domestication of plants (Gnecco and Mora 1997; Aceituno and Loaiza 2007). It is a topic that is also very relevant to the process of settlement in Central Brazil (Bueno 2007a; Kipnis 2003; Schmitz 1987). Research like Roosevelt's in Taperinha, Pará (Roosevelt et al. 1991) points to the existence of very ancient ceramics in the region and also the presence of some domesticated plants. The same seems to happen in some Carajás rock-shelters, where rudimentary ceramics have been found in association with lithic material related to the occupation of hunter–gatherers of the Middle Holocene (Magalhães 1994), and even in Colombia, as noted for the Peña Roja and nearby sites, where there is various evidence for early processes of forest management (Gnecco and Mora 1997; Gnecco 2003; Aceituno and Loaiza 2007).

A related issue is the technological variability that characterizes the industries of the Amazon, and its relation with areas bordering or offering contact with surrounding ecosystems. As already mentioned, the only Amazon lithic industry that shows clear evidence of a bifacial technology comes from Monte Alegre. In the Amazonian border regions, such as southeastern Pará, central–southeastern Rondônia, central–western Mato Grosso, central–northern Tocantins, and central–western Maranhão, the lithic industries known are essentially unifacial, and resemble the lithic industries that characterize the occupation sites known in central Brazil. So what do these border areas tell us? Is it possible from that variability to think in terms of distinct territories for the macro-region of the Amazon? Would there be an opposition between center (occupations close to the Amazon valley) and periphery (occupations in the headwaters and interfluvial areas), as is believed for the later period of ceramist occupation? Do these border areas indicate places where there was more intense climatic oscillation and cultural contact with other areas and human groups, responsible for causing, or at least stimulating, social changes and technological variability?

Thus, this characterization of the lithic industries of the Amazon as essentially unifacial, and at first sight very similar with those of Central Brazil and northern South America, raises a number of issues, such as, for example, the relationship between environmental settings, vegetation cover and lithic industry, and the different routes and processes by which the region was occupied (Bueno 2010).

We can again infer the fragility of the typological approach, and its inefficacy, especially when essentially based on formal aspects of the artifacts, in characterizing contexts in terms of socio-cultural organization and processes. At the same time, the question arises of the association normally made between an artifact assemblage and vegetation cover, in which open environments would be characterized by unifacial industries without projectile points, and closed environments would be characterized by bifacial industries with projectile points. So far, this does not appear to be the case for the Amazon, unless many of the sites currently surveyed underwent Holocene climate oscillations that could have interfered with the prevalent vegetation cover.

Recent Occupations

With regard to ceramist contexts, there are a number of issues which have been debated since the beginning of Amazonian archaeology as a discipline, and which still owe much to Steward's proposals (Steward 1948). Current discussions involve social complexity

(Heckenberger 2005; Gomes 2008; Machado 2006; Neves 1999; Schaan 2004), the intensity of, and intentionality in, the transformation and construction of landscapes (Schaan et al. 2010; Neves et al. 2003; Petersen et al. 2001; Neves and Petersen 2006), and cultural diversity and its relationship with the artifact assemblage (Silva 2000; Gomes 2002; Neves 2008; Machado 2007; Lima et al. 2006). But, in relation to the lithic material associated with these contexts, we can say that there are no identified issues, and no clearly formulated debate. The closest thing to a theme would be the identification of the raw materials and the sources used in the making of Muiraquitãs and stone idols (Aires 2008). However, recent work on the lithic material associated with these contexts suggests new research possibilities. These include the characterization of the use of intra-site space (Bueno and Pereira 2007); and the study of technological change in a given region in long-term perspective (Bueno 2006).

The problems with the typological approach mentioned for the ancient assemblages also apply to the study of lithic industries associated with ceramist contexts, thus leading to the neglect of important information. A notable feature of research, from fieldwork onwards (and one with important consequences) is that only formal artifacts, or those considered more elaborated, are looked for or selected for study and publication. This leads to the non-collection of a number of other lithic remains. Two categories of important remains in ceramic contexts that have been consistently rejected are remains produced or altered by thermal action, and remains that, despite showing no marks of anthropic change, are clearly manuports, being exogenous to the area and whose location is therefore clearly due to anthropic transportation and deposition (Fig. 4). There are numerous unmodified cobbles or blanks at those sites used to provide a hearth for fire or provide a foundation for tents, of the same sort that are used for spatial divisions in modern villages. These remains are almost unmodified, with unclear patterns of use, indicated only by an initial polishing or abrasion of small areas of the surface. An essentially typological perspective has greater consequences when applied to the study of lithic remains from ceramic sites, because in these contexts the logic governing the relationship of these groups with that category of remains is different, and therefore, their perception, appropriation and use are also differentiated. In many cases the lithic remains go into the site and are used in activities involving the delimitation of space, construction and maintenance of combustion structures, the processing of vegetable or mineral items (such as mineral temper for the ceramics—see Bueno and Pereira 2007), all of which leave tenuous evidence of raw material transformation. If in this case we adopt a purely typological approach, or even a techno-typological one, we will not select such artifacts for analysis and so will not obtain important information about the use and occupancy of space, both intra-site and regionally, for example, about types of raw material and the different ways in which raw material sources are selected and those material then transported and transformed.

If we take account of these aspects, a focus on the identification and understanding of the dynamics of appropriation and management of all types of lithic raw materials that entered the site through anthropic action can provide more accurate information about the technological system in question, going beyond the traditional universe of morphological and techno-typological analysis. We have to ask all sorts of questions about the way these materials reached the site, were transformed, used and discarded. An excellent example of such an approach is the work by Petrecquin and Petrecquin in Papua New Guinea, involving aspects of all the activities performed by the artisans in the location, displacement, collection, transformation, transportation, production, use, re-use, circulation and discard of stone axes (Petrecquin and Petrecquin 1993).

Fig. 4 Typical artifacts showing different intensity of modification by polishing, commonly identified in sites associated with large numbers of pot-sherds and dated after 2000 BP. Photo: Edithe Pereira

This brings us to the final topic: research perspectives and a proposal for a re-orientation of the previously standard approach.

Prospects

The issues raised above point to the possibility and necessity of a general re-orientation of research in the Amazonian region, in order to give more importance to identifying and tracing ancient sites associated with occupation by hunter–gatherer groups and to work on lithic technology in ceramic sites. This requires the institution of more systematic studies of the existing lithic collections in the museums of the region, which can and should also include lithic collections from ceramic sites, as these can provide very relevant information about patterns of use and space utilization, mainly through an emphasis on the

identification of raw materials, in order to locate their sources, and the discussion of their circulation between the stages of acquisition, use and disposal (Bueno 2006). Moreover, the study and characterization of the production process of the artifact assemblages present in different contexts can also yield important information about both social organization and processes of cultural interaction between ceramist groups who inhabited a given region (Bueno and Pereira 2007; Bueno 2010).

One research problem is the issue of technological diversity in the Amazonian region and its relationship with the border areas, with other ecosystems and, in particular, southeastern Pará and Rondônia. It is very important to integrate the study of lithic industries into the discussion of climate change during the Holocene—and the variation between open areas with savanna vegetation type and closed areas with tropical rainforest—to ultimately discuss the relationship between habitat (vegetation cover, climatic variation, and the ranges and distributions of resources) and artifact assemblage. To what extent does the first influence the second, with repercussions for the elaboration and composition of the artifact assemblage? It currently appears that in both areas—Cerrado (Central Brazil) and the Amazonian rainforest—a broad spectrum diet, incorporating both wild and domesticated resources, prevailed from the end of the Pleistocene through the Initial and Middle Holocene (Roosevelt et al. 1996; Silveira 1994; Kipnis 2003). As the artifact assemblages are associated with activities which in turn require certain performances, the question that arises involves the definition of the sphere of choice, and how to identify it in the artifact assemblage. We can define two approaches to the work that can be implemented, either in isolation or together: (1) emphasis on the sequence of reduction in the artifact assemblage of each context; and (2) emphasis on the diversity of remains and its articulation at different spatial levels—intra-site, inter-site and in the landscape—as has been applied in North American archaeology and elsewhere for more than 30 years (Binford 1979; Shott 1986; Odell 1998; Andrefsky 1994; Nelson 1991).

In either case, contextual research with regional coverage is needed in order to characterize the organization of lithic technology (as discussed by Nelson 1991) rather than elaborating and comparing typological lists of artifact assemblages, especially those based on a unique and decontextualized category of artifact. What we are arguing for is simply the application of attribute analysis (Shott 1994; Prentiss 1998), despite all the criticism that that has been directed at such a procedure (Ramenofsky and Steffen 1998; Sullivan and Rozen 1985), in order to offer quantitative data about technological aspects of all these assemblages. Such an approach, integrated with regional projects, and the collecting and recording of lithic remains of all sorts at different sites, could greatly improve our knowledge of sources and the meaning of lithic technological variability in space and time in the Amazonian basin.

What we propose, and have previously discussed for other areas of Brazil (Bueno 2007b) is the reconciliation of two perspectives that have been seen as contradictory, but should be viewed more as complementary: reduction sequence and *chaîne opératoire* (Shott 1999). The idea is to orient research toward the identification and explanation of the diverse factors influencing technological variability. We could develop research to emphasize the methodology of *chaîne opératoire* or reduction sequence in regional perspective, associating the remains related to these different steps to their spatial distribution in order to comprehend the strategies related to the production, use and distribution of assemblages founded in different sites of the same occupation system.

The questions that we should address are: what are the designs and related performance characteristics (Schiffer and Skibo 1997) that have been selected and prioritized? On this basis, it seems to be possible to discuss the diverse situational factors that could have

influenced the choices made by artisans and various groups in different periods to produce a specific assemblage and to incorporate the raw material in different ways, involving adaptative (Nelson 1991) and symbolic/social (Dobres 2000; Pfafenberger 1992) aspects at the same time.

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