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# LITHIC OPERATING CHAINS FROM THE LATE STONE AGE AND THE NEOLITHIC OF BATANGA (SOUTHERN COAST OF GABON)

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**Abstract**

In the Late Stone Age and the Neolithic, ancient people occupied the territory of Batanga (Gabon) and exploited chains of debitage and shaping operations. Lithic evidences from La Centrale and Landfarming sites certify that these ancient people set in motion their technical skills to produce supports and tools in operational chains from local flints. Based on the technological analysis of these lithic evidences, this article tackles several operational chains.
In the Late Stone Age, two operational chains emerge from the analysis of the knapped stones from *La Centrale site*. In the first chain, dedicated to debitage, the stones' knappers select pebbles or plates which they debit mainly by direct percussion with a soft mineral hammerstone and occasionally by direct percussion with a hard hammerstone. The Landfarming Neolithic has more operational chains, four in occurrence, including one for debitage and three for shaping.

**Keywords:** Gabon, *Late Stone Age*, Neolithic, Operating Chains, Batanga, La Centrale, Landfarming.

**Résumé**

Au *Late Stone Age* et au Néolithique, des populations anciennes occupent le territoire de Batanga (Gabon) et exploitent des chaînes opératoires de débitage et de façonnage. Des témoins lithiques issus des sites *La Centrale* et *Landfarming* certifient que ces populations anciennes mettent en branle leurs aptitudes techniques pour produire des supports et des outils dans des chaînes opératoires à partir de silex locaux. S'appuyant sur l'analyse technologique de ces témoins lithiques, cet article exhume plusieurs chaînes opératoires. Au *Late Stone Age*, deux chaînes opératoires transparaissent de l'analyse des pierres taillées du site *La Centrale*. Dans la première chaîne, dédiée au débitage, les tailleurs sélectionnent des galets ou des plaquettes qu'ils débitent principalement par percussion directe au percuteur tendre minéral et occasionnellement par percussion directe au percuteur dur. Le Néolithique de *Landfarming* comporte davantage de chaînes opératoires, quatre en occurrence, dont une de débitage et trois de façonnage.

**Mots-clés :** Gabon – Chaînes opératoires – *Late Stone Age* – Néolithique – Batanga – La Centrale – Landfarming.

## Introduction

Batanga, an oil-rich town in Gabon (Central West Africa), has been home to ancient people dating back to the *Late Stone Age* (LSA) and the Neolithic.

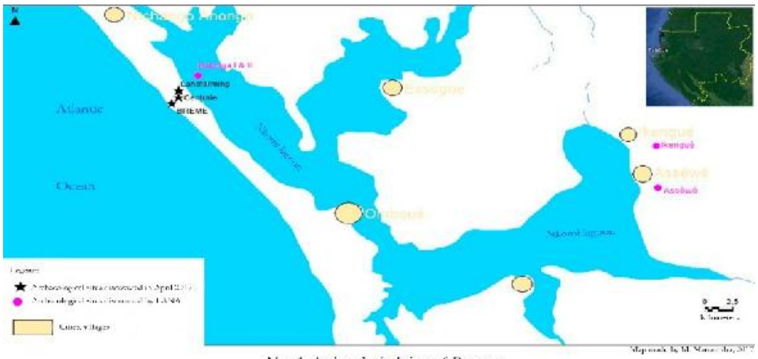
Until 2017, the existence of LSA people in this region was based on carved knapped stone from the Batanga II site, revealed in 1986 by LANA[1] researchers (L. Digombe et *al.*, 1987, p. 16; M. Locko, 2004, p. 15–24 ; 2005, p. 24). These witnesses, from a surface collection, are distinguished by the rarity of finished and typologically identifiable lithic artefacts. They were

[1] National Laboratory of Archaeology and Anthropology of Omar Bongo University (Gabon).

composed of numerous small lithic artefacts of white flint marked by a preponderance of flakes. For L. Digombé et *al. (*1987, p.16*)* and M. Locko (2004, p.15–24), these lithic artefacts would belong for the most part […] to a *Late Stone* Age industry, judging by the size and technological character of the pieces'. This material from Batanga II, which has now disappeared from LANA's collections, has never been studied technologically to highlight possible lithic reduction sequences. However, elsewhere in Gabon, studies of lithic technologies, although exceptional, show that many ancient populations have exploited lithic reduction sequences for knapping and shaping (R. Oslisly et *al.*, 2006, p. 189-198; M. Matoumba, 2009; 2013; 2020a, p. 27-51; 2021, p. 5-9).

In 2017, we conducted new archaeological surveys in Batanga as part of an environmental impact study commissioned by Perenco Oil Gabon. These surveys added two new archaeological sites to the Batanga archaeological finds, La Centrale and Landfarming, containing carved stones that are likely to date back to the *Late Stone Age* for the former and the Neolithic for the latter. This new material offers the opportunity to find out whether, like these other areas of Gabon, the ancient populations of Batanga exploited lithic reduction sequences during the *Late Stone Age* and the Neolithic.
The lithic material discovered at La Centrale and Landfarming indicates that the Batanga populations, settled above the micro-cliffs dominating the ancient barrier beaches and lagoon channels occupied by coastal forest, certainly produced their tools in *Late Stone Age* and Neolithic lithic reduction sequences.

The present article attempts to make visible the lithic reduction sequences of these two periods at Batanga through the technological analysis of knapped stones from the La Centrale and Landfarming sites. The article successively outlines the method of analysis used in this study and the materials that underlie it, highlighting not only the sites and the witnesses collected, but also their chronology; the results of the analyses that reveal the lithic reduction sequences for each site; and the discussion of the results.



Map 1. Archaeological sites of Batanga

## 1. Analysis method and materials

The emphasis on the lithic production processes at Batanga is based on the conception of a operating chain and on the lithic material from La Centrale and Landfarming sites.

### *1.1. Method of analysis*

The conception of the operating chain underlies the technological analysis of lithic material from the Batanga sites. Introduced by A. Leroi-Gourhan (1964), this conception has been retained for several decades as a descriptive and analytical tool that makes it possible to revive the stages and gestures of the artefact manufacturing processes in an ordered and hierarchical manner, from the acquisition of the raw material to their abandonment (J. Pelegrin et *al*., 1988, p. 59). By reading the morphotechnological marks on matrices, cores, knapping products, knapping by-products and bifacial pieces, we can highlight lithic reduction sequences through the objects, the successions of gestures, the specific knowledge, etc. that mark them out. To highlight the lithic reduction sequences, we use the descriptive morphotechnological characteristics already employed by several authors such as F. Bordes (1961), A. Leroi-Gourhan et *al.* (1965), M. Nacu Brézillon (1968), J. Tixier et *al*. (1980), E. Boëda et *al.* (1990), A. Debénath and H. L. Dibble (1994), M. – L. Inizan et *al.* (1995), J. E. Morrow (1997), J. Richter (2001), W. Andrefsky (2005), J. J. Shea (2013), W. J. Hranicky Rpa (2013), P. Eid (2017), R. A. Horowitz (2018), A. Mosig Way and A. Pope (2018).

In the absence of raw matrices found on the sites, these are determined by relying on the faces of knapping products and shaped tools, particularly when they retain a natural cover. The presence of cortex or neocortex associated with rounded faces induces a pebble. Cortex or neocortex associated with flat faces infers a tabular raw material. A platform, a bulb and a splintering face conclude the existence of a flake. The absence of indexes leads to an undifferentiated matrix, etc.

Cores have been identified at the Landfarming site. Their study focuses on the criteria of raw material, general description, reduction face, abandonment phase. These technological parameters provide information on the orientation of the knapping, the progression of the knapping, the degree of exploitation of the nucleus, the reason for its abandonment and the knapping technique. However, the cores are absent from the La Centrale collection. In this case, the cores are approached through the analysis of the platforms and upper faces of the products. These elements allow us to highlight the exploitation of the raw matrices through their volumetric design and the types of knapping that result from it.

In order to highlight the phases of the technical processes, we have selected several parameters that relate to the products and by-products of the knapping. These parameters include the raw material, the general morphology, the platform, the underside, the upper side and the termination of the distal part.

The identification of technical process sequences is based particularly on the ‘triple cortex’ (W. Andrefsky Jr, 2005, p. 116–117). This conception makes it possible to classify knapping as primary, secondary or tertiary. Primary knapping includes products with more than 50% cortex on their dorsal surface. Secondary knapping includes products with less than or equal to 50% cortex on the dorsal side. Tertiary products are distinguished by the absence of cortex on the back side.

For the modified edges, limited to the by-products of knapping and shaped tools, flooding indexes of the retouch are defined according to the method of C. Clarkson (2002, p. 65–75). After following the steps indicated (Fig. 1), the flooding index for each piece is calculated as the ratio of the sum of the indexes of all segments to the number of segments. The invasiveness of the retouching is between ‘0′ (no retouching) and ‘1′ (completely retouched) (*Ibidem*, p. 68). The same method is applied to calculate the invasiveness indexes of the removals of the shaped parts.

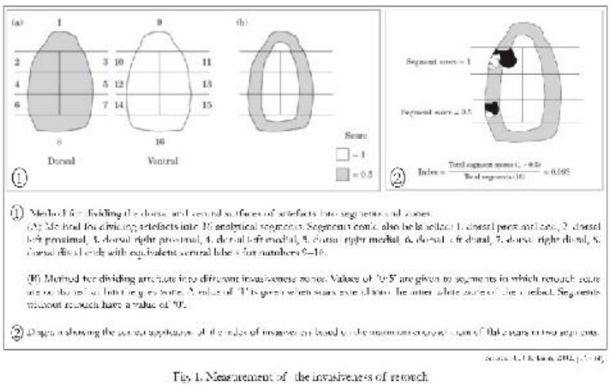



Fig. 1. Measurement of the invasiveness of retouch

### *1.2. Materials*

As the Batanga II site lithics were not found in the LANA archives, the analysis of the Batanga workings is based on lithics from La Centrale and Landfarming sites.

#### 1.2.1. La Centrale

With geographic coordinates E 9.11672222° and S 1.45441667 °, this site (Fig. 2) is located 100 m from the Batanga power station, on the left-hand side of the road leading to the base. This reworked site shows a mound of white sand alongside and overlying a pipeline running parallel to the road. The site extends to approximately 100 m (25 x 4m) covered with savannah grasses resting on a sandy soil. The left edge of the site contains a water-filled channel. The lithic remains found come from this channel from which the sand was extracted to cover the pipeline. The remains, only knapped stones, consist of a flaked axe and knapping products.

Fig. 2. Views of the La Centrale site

#### 1.2.2. Landfarming

This site (Fig. 3) yielded knapped stones and pottery at two different locations: Breme and Landfarming. With geographic coordinates E9.11125° and S1.46016667°, Breme is located approximately 200 m from the base camp in a savannah grassland environment with a dark sandy bedrock. Breme is a secondary deposit of archaeological remains (knapped stones and ceramic shards) encased in sands extracted from Landfarming. These sands were used to construct the trackway from the service road to the beach opposite the Breme platform.

It was while researching the provenance of the allochthonous remains of Breme that we discovered the Landfarming site. Landfarming is located about 100 metres from the power station, on the left-hand side of the road leading to the village of Batanga, and has geographical coordinates E9.11680556 and S1.44844444. The area is located in the savannah and is used to treat contaminated soil from various boreholes. These treatments resulted in the stripping of a large surface layer of dark sand containing knapped stones and fragments of pottery. Partly destroyed, the site still has archaeological levels in place.

Fig. 3. Views of the Landfarming site

1.2.3. Chronology of La Centrale and Landfarming

The chronology of the Landfarming and La Centrale sites is based on environmental data. The Batanga archaeological sites are located in a sandy stratigraphic context derived from a paleocontext. The latter is characterized by the presence of barrier beaches that were established mainly during the Pleistocene and Holocene. At the end of the Pleistocene (around 40,000 years BP), the Inchirian marine transgression led to the first accumulation of sands on the coast. The development of the coastal forest then made it possible to fix the first barrier beaches, which began with a phase of small discontinuous accumulations. Between 30,000 and 10,000 years BP, the dry and cool climate resulted in the retreat of the forest in favour of the savannah. The first coastal strips were then colonized, moving from the stage of banks to that of large linear and continuous accumulations. The Holocene period, between 10,000 and 500 years BP, is marked by a warm and humid climate and by the rise in sea level. The Flandrian transgression set up the second series of barrier beaches fixed by the forest, which extended at the expense of the savannah. From 500 years BP onwards, with a warm and very humid climate, the forest reached its optimum development. The savannah remained along the coastline and in a few enclaves, and the barrier beaches appeared to be fully developed from this period onwards. Thus, the archaeological material from the La Centrale site, embedded in the underlying sands of the oldest barrier beaches, probably dates back to the Pleistocene; around 40,000 BP, at the time of the first accumulations of sand on the coast. However, as sites in a sandy context on the Gabonese coast are often disturbed, it is not impossible that this site is younger. As for the Landfarming site,

> the association of the knapped stones with the ceramic shards leads us to place this site (…) in the Neolithic. This mixture of knapped stones and pottery effectively evokes the *Late Stone Age* – Neolithic transition period. A similar association of types of remains dating back to 2460 ± 80 BP (Beta-16174) was discovered at Ikengué. This is a level between -50 cm and -43 cm which revealed 'a population whose way of life was still based on knapped stones, but which already knew ceramics' (M. Matoumba, 2020b, p. 204–222).

## 2. Results of the lithic analysis

### *2.1. Late Stone Age operating*

The material from the La Centrale site highlights two reduction sequences. The first is dedicated to the knapping of flakes, some of which were used as supports for side scrapers. The second, the shaping operating chain, produced mainly flacked axes.

2.1.1. Knapping

The knapping operating chain is evidenced in the collection by the presence of raw twelve flakes, three raw blades and knapping by-products consisting of seven side scrapers, one notch and three retouched flakes.

The collection at this site does not contain any raw matrices. However, a side scraper (Fig. 4:10) and an unretouched flake indicate that matrices were introduced to the site as pebbles or tabular cherts. Both of these artefacts have rounded faces covered mainly with neocortex which indicates that they are pebbles.

Direct percussion with a mineral soft-hammer is the main technique used at this site. It is manifested by the marked presence of knapping products distinguished by diffuse bulbs and the absence of lips (24/26). This technique stands alongside direct percussion with a hard-hammer, highlighted by raw shards that have prominent bulbs and no lips (Fig. 4:2). The orientations of the anterior negatives of the upper faces and the platforms found on several knappings indicate that the knappers at La Centrale had two die designs:

- the first, longitudinal volumetric design, results in unipolar knapping with removals parallel or subparallel to the longitudinal axis. Presumably, knappers cut unidirectional or bidirectional products from complex or smooth striking planes;
- the second, volumetric design from the virtual intersection plane delimiting two reduction faces, is manifested in centripetal knapping. The products with subcentripetal removals, obtained from complex striking plans, indicate that the knappers certainly resorted to a method with recurrence in exploitation and a certain morphological predetermination of the flakes.

Knapping is regularly carried out from prepared striking planes. In a set of 25 knapping products and by-products, fourteen of them show complex platforms (eight convex faceted, three concave faceted, three planar faceted) while eleven of them show smooth platforms (nine planar, one convex and one concave).

The knapping collected shows three knapping sequences: primary, secondary and tertiary. The primary knapping is evident from three rough flakes (Fig. 4:5) and two flake side scrapers (Fig. 4:9, 10). From small flint pebbles and mainly using direct mineral soft-hammer percussion, the knappers chop flakes, the evidence for which is the products mentioned above. The raw flakes measure on average 24 mm ± 2 for length, 17 mm ± 1 for width and 7 mm ± 2 for thickness. The side scraper supports have an average length of 28 mm ± 4, a width of 19 mm ± 5 and a thickness of 10 mm ± 6. In addition to the above-mentioned raw flakes, the knappers also produce flakes of slightly longer. It is the latter that the knappers process into by-products. These products and by-products, small and flat or small and fairly flat, are characterized by complex (3/5) or smooth (2/5) platforms, variable shapes and distal feathery endings. The latter demonstrate the mastery of the tailors' percussion gestures. Indeed, this type of termination results from an energetic stability from the strike to the transfer on the surface of the nucleus. This results in the dissipation of energy at the distal end of the nucleus leading to the detachment of a normal flake or blade removal.

Secondary knapping is evident in the collection through the existence of one unretouched flake, one unretouched blade, three retouched flakes, one notch on flake and one side scraper on flake. Only one product (Fig. 4:12), with a cortex and rounded faces, suggests that some of the rough dies were pebbles. Direct mineral soft-hammer percussion was used to knap all the pieces from prepared striking planes as evidenced by the smooth (3/7: smooth flat or concave) or complex (4/7: faceted convex or concave) platforms they bear. The products obtained are often small and flat (4/7), sometimes fairly small and flat (1/7), fairly small and fairly flat (1/7) or small and thick. They measure on average 29 mm ± 6 for length, 21 mm ± 8 for width and 9 mm ± 4 for thickness. With the exception of the elongated blade, all other products have a variable general shape. These products are distinguished by distal endings that are generally feathery (5/7) and less often by hinged (1/7) or overshot (1/7) endings. The former terminations suggest mastery of the percussion gestures, whereas the latter suggest that they are accidents of size, probably due to the impropriety of the raw material. As for the hinge ending, it 'results from an inappropriate propagation of energy during the impact. Instead of the waves propagating in the desired direction downwards, they instead bounce outwards without reaching the target' (M. Matoumba, 2020a, p. 37).

The Tertiary knapping is highlighted by the presence of eight raw flakes, two raw blades, two retouched flakes and two side scrapers on flakes. During this sequence, direct percussion with the mineral soft-hammer remains widely used (12/14) to the detriment of direct hard-hammer percussion (2/14). The platforms, complex (8/14: 6/8 convex faceted, 1/8 concave faceted and 1/8 flat faceted) or smooth (6/14: flat smooth), attest that the products are knapped from prepared striking planes. The raw flakes are 26 mm ± 4 for length, 19 mm ± 4 for width and 8 mm ± 5 for thickness. The retouched flakes are 31 mm ± 3 for length, 21 mm ± 4 for width and 8 mm ± 2 for thickness. The blades are 27 mm ± 3 for length, 18 mm ± 5 for width and 7 mm ± 2. The side scrapers are 27 mm ± 4 for length, 20 mm ± 5 for width and 9 mm ± 6 for thickness. These products, all small, are more often flat (7/14) or fairly flat (4/14) and less often very flat (1/14), thick (1/14) or fairly thick (1/14). All of these products show variable shapes and especially distal feathery endings which remind us that during this sequence, the knappers had more control over the percussion gestures.

After knapping, the knappers retouch certain supports to obtain side scrapers, notches or retouched flakes.

The side scrapers' supports come from the three knapping sequences: two primary products, one secondary product and two tertiary products. These supports are small and flat (2) or small and very flat (1) or fairly small and flat. They are 30 mm ± 6 for length, 21 mm ± 8 for width and 8 mm ± 5 for thickness. The bifacial retouch, which is essentially irregular and subparallel, and more often grazing (4/5) than semi-abrupt (1/5), has made it possible to create side scrapers whose techno-functional unit is right lateral (3/5), left semi-peripheral (1/5) or right (1/5). The average invasion index of the retouch is 0.35 ± 0.15. The mean lengths of the arches (Arc), cords (Cord) and divergences[2] are 55 mm ± 34, 27 mm ± 10 and 15 mm ± 12 respectively.

The only notch found (Fig. 4:8) is based on a small flat flake of variable shape from the secondary knapping. The notch, located on the right edge in the distal part, is the result of a short and semi-abrupt mixed retouch.

The collection does not contain any retouched primary flakes. The retouched flake supports appear to have been selected mainly from secondary (3/5) or tertiary (2/5) knapping. These retouched flakes are 30 mm ± 5 for length, 20 mm ± 4 for width and 9 mm ± 5 for thickness. For these flakes, the average invasion index of the retouch is 0.325 ± 0.165.

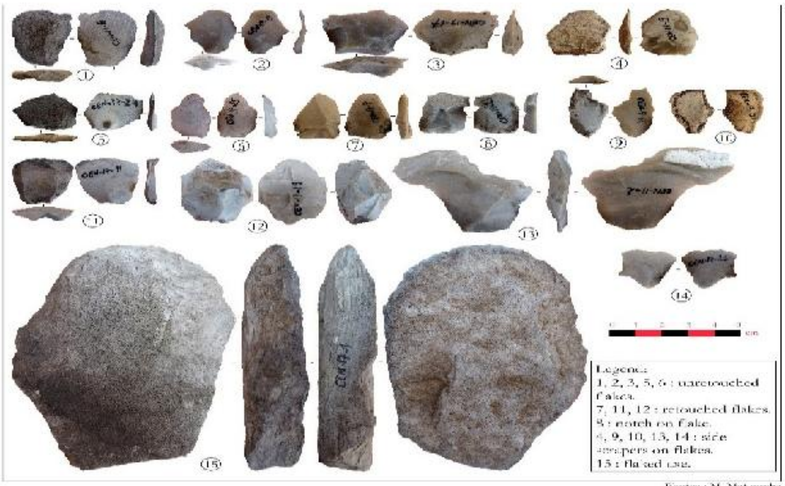



Fig. 4. Lithic tools of La Centrale

### 2.1.2. Shaping

The proof of the existence of a reduction sequence at La Centrale site lies in the presence of a flaked axe (Fig. 4:15). The diachronic technical reading of this biface allows us to highlight the stages of acquisition of the raw material (stage 0), shaping of the supports in order to obtain predetermined volumes (stage 1), shaping (stage 2), and reworking (stage 3). Stage 0 is marked by the selection of tabular cherts as raw matrices to produce axes. The supply site remains an enigma for the time being. The choice of tabular cherts seems to have been guided by the search for matrices whose morphology was close to the projects of axes to be cut, favouring a less

[2] «Arc: Periphery of the convex edge displaying removals/retouch. Cord: Shortest distance from the initial point of the modified area to its termination. Divergence: Widest extension of the deviation of the arc from the cord » (D. Barsky, 2015, p. 7).

laborious shaping. Stage 1 corresponds to the transformation of the tabular cherts into a preform. Negatives curved with very flat distal parts and noted on the witness confirm the practice of convex shaping. This suggests that a series of removals were prepared on the edges of the tabular cherts in order to establish denticulations and to obtain small beaks that served as striking planes following a tangential gesture during shaping. The preparation of the tabular cherts to add the very open angles to the percussion is shown by the presence of micro negatives of chips on the edges. These modifications, mainly located in the mesial and distal parts, do not alter the general morphology of the tabular raw material. The largest removals are 24 mm for length and 40 mm for width. These removals do not reach the centre of the surfaces of the faces. They leave large areas of cortex in place. The result is a preform with two almost biconvex surfaces whose intersection creates a techno-functional unit limited to the distal and mesial portions. Stage 2, known as retouching, is highlighted by the presence of very small, thin negatives that have reduced the contour of the axe without altering its volume. This bifacial, semi-abrupt and subparallel retouching is confined to the limits of the techno-functional unit.
The analysed witness suggests that, after shaping, the result is large, flat axes that do not have indentations. They have an asymmetrical convex bevel with a symmetrical convex knapping edge at the top, and partially shaped flanks, as they still contain at least 50% cortex.

### *2.1. Neolithic operating chain*

The lithic material from Landfarming shows a operating chain of knapping, some of whose products decline into by-products, and a reduction sequence of shaping. Flint is the only raw material used on this site.

#### 2.1.1. Knapping

The lithic collection does not include any untested or tested whole matrices that were used as raw materials or as hammers. The knapping reduction sequence is present in the collection through the presence of cores with four blades or one flake, twenty-four raw flakes, four proximal flake fragments, three mesial flake fragments, one distal flake fragment; ten unretouched blades; knapping by-products consisting of one notches on flake, one borer on proximal flake fragment, seven retouched flakes, one retouched proximal flake fragment, one retouched blade, height side scrapers on flakes including one denticulated.

The collection does not contain raw matrices. These are approximated on the basis of cores, products and by-products of knapping. Disregarding undifferentiated matrices, these records indicate that matrices were introduced to the site more often as tabular cherts (18/36) or pebbles (15/36) and more rarely as flakes (3/36).

Direct mineral soft-hammer percussion seems to have been more popular (34/51) than direct vegetable soft-hammer percussion (15/51) or direct hard-hammer percussion (2/51). On the knapping products, diffuse bulbs and the absence of lips confirm the first technique; bulbs and pronounced lips prove the second; and prominent bulbs and the absence of lips confirm the last.

The cores are derived from raw matrices introduced to the site as pebbles (3/5) or tabular cherts (1/5). The raw matrix of a final nucleus is undifferentiated. These raw matrices are exploited on the basis of a longitudinal volumetric design. This is distinguished by the unipolar knapping of products on the large faces of the dies or in the longitudinal plane of symmetry, more often from a single striking plane; sometimes from two opposing striking planes. These striking planes are cortical (2/5), smooth (1/5) or faceted (2/5). This knapping is also distinguished by the exclusive production of blades whose organization on the core is characterized by negatives parallel to the longitudinal axis. This knapping, often stopped after obtaining a blade on each of the large faces, gives rise to prismatic cores measuring on average 35 mm ± 10 for length, 22 mm ± 8 for width and 9 mm ± 5 for thickness; i.e. cores that are more often quite small (4/5) or small (1/5) and are very thick (2/5), flat (2/5) or fairly flat (1/5).

Three knapping stages are evident at the Landfarming site.

The primary knapping emerges thanks to the raw products (10 flakes, 2 proximal fragments of flakes, 1 mesial fragment, 1 distal fragment, 2 blades) and the by-products (2 retouched flakes, 1 proximal fragment of retouched flake, 1 notch, 3 side scrapers, 1 borer). This material shows that the raw matrices were introduced to the site in the form of tabular cherts (15/24), less often as pebbles (8/24) and more rarely as flakes (1/24). During this stage, matrices are knapped preferentially by direct soft-hammer percussion (16/17) or more rarely by direct hard-hammer percussion (1/17). In direct soft-hammer percussion, the mineral soft-hammer appears to be predominant (10/16) compared to the vegetable soft-hammer (6/16). The six unretouched flakes, the proximal fragment, the two unretouched blades and the side scraper that attest to the existence of mineral soft-hammer percussion are characterized by the absence of a lip on the proximal part and the presence of diffuse bulbs and platforms measuring 16 mm ± 10 in width and 7 mm ± 6 in thickness. Vegetable soft-hammer percussion is evident by the existence of three unretouched flakes, two retouched flakes and a proximal flake fragment. These artefacts show diffuse or diffuse splintered bulbs; they do not have lips and have platforms of 16 mm ± 10 in width and 7 mm ± 5 in thickness. direct hard-hammer percussion is evidenced by a unretouched flake with no lip and a prominent bulb with a platform 13 mm for width and 4 mm for thickness. Accidental breaks, i.e. frank transverse, oblique or slash breaks, appear during this knapping stage. At first glance, these breaks appear relatively large (6/24).

The secondary knapping is highlighted by a raw flake, a unretouched proximal fragment of flake, three unretouched blades and a retouched flake. The knapping is mainly carried out by direct mineral soft-hammer percussion (4/6), occasionally by direct vegetable soft-hammer percussion (1/6) and by direct hard-hammer percussion (1/6). Direct percussion with soft-hammer or hard-hammer is carried out from generally prepared striking planes, as evidenced by the presence of platforms that are more often complex (4/6) or smooth (1/6) than cortical (1/6). The anterior abduction negatives are unidirectional convergent (4/6) or unidirectional parallel (2/6). These orientations indicate the use of unipolar knapping from a single striking plane. These small (4/6) or fairly small (2/6) flakes are distinguished by variable shapes with rectilinear profiles; mesial, proximal or regular asymmetry; and more often feathery than hinged terminations. These terminations suggest that the knappers had some control over the force applied to obtain the desired products.

Tertiary knapping is evidenced by the presence of thirteen unretouched flakes, four retouched flakes, one proximal flake fragment, two mesial fragments, five unretouched blades and one retouched blade, side scrapers on flakes. Here, direct soft-hammer percussion is the only technique used, with a dominant intervention of the mineral hammer (20/28) and a discreet action of the vegetable striker (8/28).

From prepared striking planes, attested by complex (17/28), smooth (8/28) or cortical (3/28) platforms, the knappers usually resort to unipolar knapping, less often to bipolar knapping and rarely to centripetal knapping. The first two types of knapping can be seen in the unidirectional parallel (13/28), unidirectional convergent (3/28) and bidirectional opposite (3/28) negatives on the upper surfaces of the flakes and blades. These two types of knapping imply that the knappers had a longitudinal volumetric conception of knapping. This conception is supported by the cores analysed above. The flakes and blades are obtained along the large faces of the cobbles or in the longitudinal plane. The cores are exploited from a single striking plane, from two opposite or crossed striking planes which produce flakes or blades parallel to the longitudinal axis of the dies. The third type of knapping is evident in the presence of centripetal negatives (5/28) on the reverse of the products. This knapping is the result of a 'volumetric design based on the virtual plane of the intersection delimiting two knapped surfaces' (G. M. Armentano, 2016, p. 77–82), results in predetermined products.

This tertiary knapping results in small rough flakes (L=30 ±6 mm; W=19 ±6 mm; D=6 ±3 mm), mostly small and rarely quite small blades (L=42 mm; W=11 mm; D=7 mm) or medium blades (L=61 mm; W=21 mm; D=8.5 mm). These products are very largely straight with mesial or proximal asymmetry or even regular (22/28) than straight with distal asymmetry (1/28) or curved with proximal asymmetry (3/28) or curved with distal asymmetry (1/28). The flakes have quite often feathered (8/19) or overshot (6/19) endings, less often hinged (4/19) and more rarely overhanging (1/19). As for the blades, they are largely feather-ended (6/7) and rarely hinged (1/7). These data indicate that the knapping appears to be more controlled for the blades than for the flakes.

Some of the products of the knapping process are retouched, which transforms them into side scrapers, notches, borers, retouched blades or retouched flakes.

The knappers singularly choose the primary flakes (3/8) and tertiary flakes (5/8) as supports for the side scrapers. The side scrapers were obtained by irregular subparallel retouching, usually flat and exceptionally fine. The side scrapers on primary flakes, of variable shape, quite small and quite flat for the first; small and quite flat for the second; small and quite thick for the last; measure on average 33 mm ± 7 in length, 24 mm ± 8 in width and 8 mm ± 4 in thickness. With invasion indexes of 0.187, 0.437 or 0.218, the retouching that made it possible to obtain these side scrapers is more often bifacial than direct. The side scrapers on tertiary flakes, which are medium to small and often fairly flat or flat rather than very flat, have an average length of 36 mm ± 13, a width of 26 mm ± 9 and a thickness of 10 mm ± 5.

The notch and the borer were made on primary knapping flakes. The notch is the result of a bifacial retouch made in the proximal part of the flake. The operation consisted of modifying the support by two large removals, one direct and the other indirect. A series of smaller bifacial removals then allowed the knapping edge to be refined. The distal part of the support also has bifacial retouching. The invasion index of the retouch on this notch is 0.281. The borer has a retouch invasion index of 0.5. This bifacial retouching, concentrated on the left edge and the proximal part, has made it possible to create a point in place of the platform.

For the retouched products, the supports derive more from tertiary knapping (5/9) than from primary (3/9) or secondary (1/9) knapping. The average invasion index of the retouch is 0.168 ± 0.222.

2.1.2. Shaping

Three operating chains were identified in the collection: one dedicated to bifaces, another to side scrapers and the last to end scrapers.

The bifaces (Fig. 5:17, 18, 19, 21) show a multistage biface shaping process. Stage 0, corresponding to the acquisition of the raw material, suggests that the knappers selected tabular cherts (3/4) or pebbles (1/4) to produce the bifaces. The absence of raw matrices in the series collected suggests that these were collected off-site. At present, no deposits have been identified in the vicinity. Stage 1, which is equivalent to shaping the supports to obtain predetermined volumes, is carried out by removing the edges of both the slabs and the pebbles. The application of this shaping on the pebbles is explained by the morphology of the pebbles, which are more often quite large and especially quite flat. Stage 2, corresponding to shaping, is attested by the presence of curved negatives with flat end parts on both sides of the pieces. These negatives, an expression of convex shaping, suggest the existence of a shaping scheme consisting of generating preforms with a convex section. The shaping is rarely extended to the entire surface of both sides. These retain very large areas of cortex to the extent that they could be considered as unifacial pieces. Pieces with at least one side entirely covered with removals are as numerous (2/4) as those with large areas of cortex on both sides (2/4). Unfinished preforms are the main product of this stage. The unfinished preforms show a partially defined bifacial equilibrium plane, with often deep and localized shaping negatives. The shaping of these preforms was stopped earlier, probably due to alterations in the raw material. The raw material contains large diaclases (Fig. 5:17) or vacuoles (Fig. 5:21). These bifaces have two more or less convex surfaces delimited by an edge. Stage 3, dedicated to lateral retouching, is highlighted by the presence of thin, very small negatives that only reduce the outline of these preforms. They reveal that the preforms underwent a stage of bifacial edge retouching that resulted in a convergent tool (fig. 5:17), two side scrapers (fig. 5:18, 30) and a shapeless tool (fig. 5:21).

The side scrapers (fig. 5:39 to 43) show the existence of a operating chain dedicated to side scrapers. This reduction sequence comprises four stages. Stage 0, characterized by the acquisition of the raw material, shows that the knappers only chose tabular cherts to make side scrapers. The lack of raw tabular cherts in the series studied leads one to believe that they were derived from off-site collections. In stage 1, the tabular cherts are shaped by removing their edges. Stage 2, which corresponds to shaping, is remarkable for the presence of curved removal negatives, invading on the faces and presenting flat distal parts on some witnesses (fig. 5:42, 43); curved negatives more often for width and short and not invading on others (fig. 5:39, 40, 41). The invasion indexes of the removals, generally higher on the A side than on the B side, reveal that large removals are first generated on the first side; then the B side undergoes shorter removals, sometimes very short and limited to the edges that they seem to result from a retouching stage (fig. 5:40). Stage 3 concerns lateral retouching. It is evidenced by very small, thin negatives that reduced the outline of the side scrapers. Bifacial retouching resulted in side scrapers with edges that are generally lateral (4/5) convex (2/4), straight (1/4) or straight on the right side and convex on the left side (1/4). These side scrapers are sometimes with convex transverse knapping edges (1/5).

The end scrapers operating chain is attested by the presence of a single witness (Fig. 5:15). Stage 0 suggests that the knappers assigned certain pebbles to the production of end scrapers. In contrast to the supports for bifaces and side scrapers, the pebbles intended for the production of end scrapers do not undergo a shaping stage by removing the edges. The pebbles are directly shaped by removals measuring 14 mm ± 3 for length and 29 mm ± 8 for width on the most worked face; removals measuring 6 mm ± 3 for length and 18 mm ± 6 for width on the second face. The invasion index of these removals is 0.625 on side A and 0.375 on side B; 0.539 on the entire side scraper. A retouching stage is highlighted by the presence of thin, very small negatives that only modify the perimeter of the edge of the piece. Typologically, the only witness found on this site is a large, fairly flat end scraper on the end measuring 107 mm × 61 mm × 31 mm. It is distinguished by a convex knapping edge with an arc of 118 mm, a bead of 51 mm and a divergence of 45 mm.

## 3. Discussion

In this work, our ambition was to make visible the lithic reduction sequences of the LSA and the Neolithic at Batanga on the basis of the technological analysis of the lithic witnesses of La Centrale and Landfarming sites. Several lithic reduction sequences were highlighted.

At the LSA, two lithic reduction sequences emerge from the analysis of the knapped stones from the La Centrale site. In the first reduction sequence, dedicated to knapping, the knappers selected pebbles or plates which they knap mainly by direct percussion with a mineral soft-hammer and occasionally by direct hard-hammer percussion. Two volumetric designs of these pebbles and tabular cherts appear on this site. The longitudinal volumetric design which induces unipolar knapping with removals parallel or subparallel to the longitudinal axis. And the volumetric design from the virtual intersection plane delimiting two knapped surfaces which leads to centripetal knapping. Whatever the type of knapping, it is more often carried out from prepared striking planes. The existence of primary, secondary and tertiary sequences of knapping indicates that the knapping is local. Bifacial retouching, which is more often grazing than semi-abrupt, transforms certain knapping products into by-products such as side scrapers, notches or retouched flakes. In the second reduction sequence, dedicated to the shaping of flaked axes, the knappers choose inserts characterized by a morphology close to the projects of axes to be knapped. This probably avoids going through the shaping stage, which would consist in shaping the tabular cherts by removing the offcuts from the periphery of the tabular cherts. The processing of the tabular cherts is then the next stage. During this stage, broad rather than elongated blanks were knapped from the edge of the wafer to obtain volumes with a biconvex cross-section with a distal-proximal techno-functional unit resulting from the meeting of the two faces. The bifacial, semi-abrupt and subparallel retouching constitutes the final stage that refines the techno-functional unit. Flint is the only raw material exploited in these LSA workings at La Centrale, as it is in the Neolithic workings at Landfarming.

In contrast to the LSA at La Centrale, the Lanfarmaing Neolithic has more reduction sequences, in this case four, including one for knapping and three for shaping. However, this difference must be put into perspective insofar as it is above all an expression of the conditions of conservation and harvesting of witnesses.

In the knapping process, the knappers frequently choose tabular cherts, pebbles and hardly any kidneys as raw dies. These are commonly knapped by direct percussion with a soft mineral or vegetable hammer and rarely by direct percussion with a hard-hammer. In contrast to the LSA at La Centrale, the exploitation of the matrices here is based solely on a longitudinal volumetric design. This is reflected in the unipolar knapping of products on the large faces of the dies or in the longitudinal plane of symmetry, usually from one striking plane and occasionally from two opposite striking planes. These are more often prepared planes than cortical ones. As with La Centrale LSA, three operating chains (primary, secondary and tertiary) of knapping denote local knapping. Retouching usually converts the knapping into side scrapers or retouched products and exceptionally into notches or borers.

In the operating chains, one for bifaces, another for side scrapers and the last for end scrapers, the knappers more often choose plates than pebbles to produce bifaces; only plates to make side scrapers; pebbles to obtain end scrapers. In contrast to the dies for end scrapers, the dies for bifaces and side scrapers undergo a shaping stage by extracting removals from the edges. The following stages consist of a matrix transformation stage (shaping proper) and a retouching stage for all three shaping reduction sequences.

This article will have contributed to extending the knowledge related to ancient lithic technologies to a new territory of Gabon while following the technological studies of Maboué (R. Oslisly et *al.*, 2006, p. 189-198), Milolo, Sanga-forêt and Manfila (M. Matoumba, 2009; 2013), Nyafessa (M. Matoumba, 2020a, 18, p. 27–51). These studies, which focused on lithic technologies from the LSA, are extended to the Neolithic through the technological analysis of material from the Landfarming site. For all these sites, whatever the period considered, the knapping techniques consist of direct percussion with a mineral soft-hammer, direct percussion with a mineral soft-hammer or direct hard-hammer percussion. These techniques are sometimes combined in the same reduction sequence. In the LSA, as in the Neolithic, the populations of these sites very often exploited a knapping reduction sequences that adjoined one or more other lithic reduction sequences dedicated to the production of carved axes at Nyafessa; bifaces, core axes and picks at Milolo; choppers, burins, end scrapers, planes and bifaces at Sanga-forêt; picks and bifaces at Manfila. In contrast to the previous sites, the Banio 3 site appears to be specialized, as it has only one reduction sequence of knapping. Although the lithic material from the Nzogobeyok and Lac noir of Ndendé sites has not been clearly studied from a technological point of view, the composition of their lithic material leads us to believe that these sites were also specialized, as they only have knapping reduction sequences.

## Conclusion

During the *Late Stone Age* and Neolithic, ancient people occupied the Batanga territory and concomitantly exploited lithic reduction sequences for knapping and shaping. Lithic evidence from La Centrale and Landfarming sites attests that these ancient populations used their technical skills to produce supports and tools in lithic operating chains from local flint. The objects, the succession of gestures and the specific knowledge that characterize these lithic reduction sequences do not seem to have undergone any particular evolution between the LSA and the Neolithic. However, there is probably a more marked heterogeneity in the lithic reduction sequences for shaping in the Neolithic than in the *Late Stone Age*, which results from the greater diversification of projects for the types of tools to be produced. These initial observations, based on material from surface collections, need to be deepened by conducting more extensive surveys followed by test pits and even excavations at Batanga. In the new material, studies that follow will be interesting to favour a techno-economic approach likely to shed light on the dynamics of raw materials and space management.

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