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# Initialisation and progression of the core reduction process at Donnemarie-Dontilly (Seine-et-Marne, France), site of the Belloisian tradition

## New interpretative key for comparisons with contemporaneous industries and *Federmesser-Gruppen* assemblages

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**Abstract:** At the Pleistocene-Holocene transition, a very wide-spread phenomenon of 'technical globalization' (Valentin, 2008) is proposed by certain archaeologists, based on the strong analogies existing between geographically distant lithic productions ([Epi-]Laborian, Belloisian, Ahrensburgian or even Swiderian). Therefore, it is necessary to develop criteria to evaluate the actual degree of relatedness between these diverse traditions, which, nevertheless, differ sometimes in their lithic projectile implements. Do real similarities with regard to the knapping methods exist, what do they consist of, and what do they indicate as to the precise characteristics of the intended blades and bladelets? Moreover, in what way are these methods and intentions distinct from what is known in the Late *Federmesser-Gruppen* (cf. Late Azilian)? In this paper, we start describing the modes of initialisation and progression of the core reduction process in the Belloisian industries by re-examining in detail the lithic material recovered at Donnemarie-Dontilly, the study of which benefits from numerous refit complexes. At the beginning of the paper, we use this opportunity to briefly make some new palaeoethnographical comments that ask anew which function these curious Belloisian sites had. In order to study the industry from Donnemarie, we then propose a rigorous technological vocabulary which distinguishes between initialisation and progression of the reduction process and which takes into consideration the extent and the orientation of this progression. One hundred and eleven successful knapping operations are analysed from this perspective, with the most reliable information originating from quite complete refit complexes or cores the initial volume of which can be reconstructed. Rare but very significant strictly 'facial' core reductions, clearly enlarged and dissymmetric progressions that no morphological limitation imposed, very flattened flaking faces during the last sequences are all significant options. They have sometimes been applied at the physical limits of blank detachment showing that the knappers often sought for particularly thin blades and bladelets (and with a tapered extremity, considering the frequent use of two platforms rapidly alternating). These options can also be found in the Belloisian assemblages of the Somme valley and of Normandy, which we have started to examine. Manifest affinities also exist with the Post-Azilian industries in western Central France, published by N. Naudinot (2010 and 2013): incidentally, it is these observations that have inspired us to re-examine the Belloisian from this particular perspective. From now on, the study has to be continued well beyond that among other related industries of the Pleistocene-Holocene transition. In these industries, we wonder now if, in addition to their distal tapering, it is not the very frequent overall thinness of the regular blades and bladelets that is discriminatory. This quality would be related with both the enlargement towards flat surfaces and often very marginal detachments in contrast to the generally internal percussions in the Late *Federmesser-Gruppen*.

**Keywords:** Lithic technology, Late Palaeolithic, North-West Europe, terminology.

**Résumé :** Lors de la transition entre Pléistocène et Holocène, certains chercheurs soupçonnent un très vaste phénomène de « globalisation technique » (Valentin, 2008) vu les fortes analogies entre des productions lithiques géographiquement éloignées ([Épi-]Laborien, « Belloisien », Ahrensbourgien voire Swidérien). Il faut désormais trouver les moyens d'apprécier le degré de parenté réel entre ces diverses traditions qui diffèrent tout de même parfois par leurs armatures. Y a-t-il de réelles similitudes concernant les méthodes de taille, en quoi consistent-elles et qu'indiquent-elles sur les caractéristiques précises des objectifs laminaires et lamellaires ? En quoi ces méthodes et ces intentions se distinguent-elles par ailleurs de ce que l'on connaît dans l'Azilien récent (cf. *Späte Federmesser-Gruppen*) ? Dans cet article, nous commençons à décrire le mode d'initialisation et de progression du débitage dans les industries belloisiennes en réexaminant en détail celle qui a été recueillie à Donnemarie-Dontilly et qui a fait l'objet de nombreux remontages. Au

tout début de l'article, on en profite pour quelques nouvelles brèves remarques palethnographiques reposant la question de la fonction de ces curieux gisements belloisiens. Pour aborder l'industrie de Donnemarie, on propose ensuite un vocabulaire technologique rigoureux distinguant initialisation et progression et prenant en considération l'amplitude et l'orientation de cette progression. Cent-onze opérations de taille réussies sont analysées sous cet angle, les informations les plus fiables provenant de remontages assez complets ou bien des nucléus dont le volume initial peut être restitué. À quelques très remarquables exceptions près – quelques exploitations strictement faciales – l'initialisation a généralement lieu sur la partie la plus étroite des volumes, ce qui est normal pour des productions de lames et de lamelles. Ensuite, la progression diffère selon le matériau concerné. Sur les volumes en silex tertiaire à section plano-convexe, la progression est vite élargie, très souvent de façon dissymétrique, par conséquent vers une surface large s'aplatissant vite. Or une progression symétrique était parfaitement possible sur un certain nombre de volumes s'ils avaient été mis en forme pour cela, si bien que le choix inverse prend valeur d'option avec comme conséquence la minceur des lames et lamelles les plus régulières. Sur les volumes en silex secondaire à section ovalaire, c'est une progression symétrique qui prédomine largement, ce qui est parfaitement logique, mais il y a tout de même plusieurs cas de nette dissymétrie à laquelle la morphologie initiale n'incitait pas du tout. Il existe aussi un certain nombre de nucléus sur lesquels nous n'avons pas pu reconstituer le mode de progression : ce qui est alors remarquable c'est l'aspect très aplati des surfaces de débitage lors des dernières séquences, celles-ci fournissant donc, quel qu'ait été le mode précédent de progression, des lames ou lamelles minces quand la percussion reste marginale. Ces dernières séquences ont été réalisées dans des conditions limites pour des débitages de produits allongés, cet aplatissement augmentant le risque de réfléchissement ainsi que la sinuosité des nervures guides, et diminuant donc la productivité en lames et lamelles. Cette prise de risques et ce sacrifice relatif de productivité sur des nucléus pourtant traités avec soin renforcent à nos yeux le caractère optionnel et donc distinctif de cet aplatissement répété. Cette recherche fréquente de lames et lamelles particulièrement minces (et à extrémité effilée vu l'usage fréquent de deux plans de frappe en alternance rapide) se retrouve dans les assemblages belloisiens de la Somme et de Normandie que nous avons commencé à examiner en y reconnaissant de plus les grands principes en matière d'initialisation et de progression évoqués plus haut. Dans ce domaine, il existe aussi des parentés manifestes avec les industries post-aziliennes du Centre-Ouest de la France publiées par N. Naudinot (2010 et 2013) : ce sont d'ailleurs ses observations qui nous ont incités à réexaminer le « Belloisien » sous cet angle particulier. L'enquête doit désormais se poursuivre bien au-delà parmi d'autres industries apparentées de la transition Pléistocène-Holocène. Dans ces industries, nous nous demandons donc maintenant si, en plus de leur effilement distal, ce n'est pas la très fréquente minceur générale des lames et lamelles régulières qui est discriminante. Cette qualité serait liée à la fois à l'élargissement vers des surfaces plates et à des détachements souvent très marginaux par contraste avec des percussions généralement internes dans l'Azilien récent.

**Mots-clés :** Technologie lithique, Paléolithique final, Europe du Nord-Ouest, terminologie.

At present, certain archaeologists subsume under the designation 'Belloisian' (or 'Long Blade Industries') more than fifty assemblages, most of which were discovered between south-eastern England, the Loire valley and the northern Rhineland, and some of which were found beyond this zone in Northern English Yorkshire, in the French Cantal or even as far as Denmark (fig. 1, no. 1; e.g. Fagnart, 1988; Barton, 1989; Valentin, 1995, p. 568–763; Bodu et al., 1997; Fagnart, 1997; Jöris and Thissen, 1997; Barton, 1998; Barton and Dumont, 2000; Bodu, 2000; Brou, 2001; Surmely dir., 2003; Sørensen and Sternke, 2003; Froom, 2005; Cooper, 2006; Conneller, 2007; Valentin, 2008; Fagnart, 2009; Valentin, 2009; Biard and Hinguant, 2011; Lewis and Rackham, 2011; Leroy, 2013; Stapel, 2013a and b). The few assemblages that have been dated all indicate an origin at the transition from the Younger Dryas to the Preboreal (ca 9600 cal. BC). They have certain analoguous knapping methods and objectives of the reduction process in common: among other aspects, the scientists have thus far insisted a lot on the elaborate character of core preparations as well as on the frequent creation of two platforms, used rather rapidly alternating between them for the production of often long and regular blades. At first glance, these methods and objectives appear to be rather clearly distinct from those of the Late *Federmesser* Industries, although both were realized with the help of a soft hammerstone. However, the precise degree of this distinction has not been sufficiently defined yet, and an archaeological hiatus frequently separates the most recent *Federmesser* Industries from the Belloisian, making the emergence of the Belloisian difficult to envision. Moreover, the knapping methods of the Belloisian echo the approximately contemporaneous ones of the Ahrensburgian and the (Epi-)Laborian, the projectile implements of which are, in addition, identified in the Belloisian and sometimes found associated at one and the same site (e.g. Biard and Hinguant, 2011). The degree of relationship between these almost contemporaneous knapping methods also needs to be defined more precisely. For instance, is this relationship sufficiently close for classifying the assemblages with the label 'Epi-Ahrensburgian' instead of 'Belloisian', as J.-P. Fagnart (2009) suggests with the laudable aim of simplification? Is a different label necessary then for assemblages with (Epi-)Laborian projectile implements? How to account, at the same time, for the economic peculiarities justifying also the use, for want of a better expression, of the term 'Belloisian' in order to designate modes of occupation which frequently diverge at first glance from what is traditionally considered as a camp site (e.g. Fagnart, 1988; Valentin, 1995, p. 568–763; Bodu et al., 1997; Fagnart, 1997; Jöris and

Thissen, 1997; Froom, 2005; Fagnart, 2009): no or very few burnt objects, abundant debitage remains, generally few retouched tools, sometimes very rare projectile implements, occasionally many bruised elements apparently used in the context of flint knapping (Valentin, 1995, p. 669–671; Fagnart and Plisson, 1997; Jacquier, 2012)? Occasionally, blades are also carried away, which was once interpreted as an indication of the sites having principally the function of workshops providing camp sites with blades. However, such camp sites still have not been discovered in the regions concerned. Since all of the mentioned peculiarities occur, in addition, at multiple degrees, we have recently proposed the hypothesis of a highly variable economic status for these Belloisian sites (Valentin, 2008, p. 207–210): sites with primarily a butchery function, production places of butchery instruments destined for the preceding type of sites, sites with various degrees of aggregation. In order to be tested, these hypotheses require palaeoethnological analyses, complementing new technological observations which constitute the main subject of this paper. Donnemarie-Dontilly is nowadays considered as an intermediate station between two adjacent flint outcrops and one or several site(s) in the vicinity where game was killed as well as butchered.

## THE BELLOISIAN OCCUPATION AT DONNEMARIE-DONTILLY: GENERAL CONSIDERATIONS AND A FEW PALAEOETHNOLOGICAL OBSERVATIONS

The, unfortunately undated, Belloisian occupation of la Fouillotte at Donnemarie-Dontilly (Seine-et-Marne) is situated on the edge of a plateau overlooking the river Seine at an average altitude of 131 m, in the vicinity of the famous Magdalenian site Pincevent (fig. 1, no. 2). From 1991 to 1994, we manually excavated 214 test pits making it possible to investigate ca 900 m$^2$ and to detect 5 loci of 90 to 170 m$^2$ size formed by scatters of lithic artefacts, some of which are burnt (fig. 2; Valentin, 1995, p. 592–680; Bodu et al., 1997). Each scatter comprises between 1,300 and 2,500 pieces which are sometimes concentrated in small packages rather than in true concentrations with superimposed objects. The protection of these scatters, and hence the partial preservation of the spatial structuring, [(1)] seems to have been guaranteed by the slight colluviation of a lœss ridge (cf. recent preliminary observations by Y. Le Jeune). However, this colluviation could not prevent some disturbance of the scatters to varying degrees by agricultural activities, manifested in a not insignificant amount of artefacts redeposited in the plough horizon or on the surface. The spatial analyses we attempt are affected by these circumstances, as they are by the absence of bones and microwear on the lithic artefacts. Thus, we will probably not advance very far in the reconstruction of the activities undertaken at Donnemarie. Nevertheless, several characteristics already observed for the locus 4 (Valentin, 1995) prove true on a large scale: absence of organised fireplaces, small number of retouched tools, extreme rarity of projectile implements, some outstanding performances of flint knapping, and removal of big regular blades from the site. However, it is clear the initially favoured idea that the main part of lithic production was destined for deferred use needs to be revised. In fact, objectives of knapping other than the production of regular blades exist: bladelets produced in small quantities but also more or less regular blades, which circulated on the living floors for probably immediate use. There are also several attempts at lithic production with vague or failed intentions, executed in such an unskilled way that the presence of children—and probably of entire family units—is certain.

At the same time, these recent studies result in important additions about the methods and objectives of the successful lithic productions, which is possible thanks to the numerous refits carried out at Donnemarie. And it is precisely these new observations to which the present article is essentially dedicated, in preparation for future comparisons on a large scale. It should be specified that we will not revisit here the frequent use of two platforms with rapid alternation between them in relation to the search for products with a tapered distal extremity (Valentin, 1995, p. 628–633). We will essentially concentrate on the brand-new results regarding initialisation and progression of core reduction. In fact, on these questions we already attained a more finely nuanced perception of the Belloisian methods than certain recent summaries, the deficiency of which consisted in overemphasising the completely rotating exploitation that had been observed on only a few volumes with the unintended result of minimizing the role of other far more relevant characteristics (fig. 3). Using certain exceptional lithic reduction sequences as a model represents a rather common methodological error we are well placed to criticise… since we made it in this case.

## INITIALISATION AND PROGRESSION: REVISION OF THE KNAPPING METHODS AT DONNEMARIE-DONTILLY

As a consequence of this error, comparisons based on the industries in western Central France with affinities to the Epi-Laborian and the Ahrensburgian, recently studied by Nicolas Naudinot (2010 and 2013), were temporarily set aside. These studies propose the hypothesis—mostly based on small cores in the state of abandonment and not on refit complexes—of a predominant ‘semi-rotating’ progression of the flaking face among the knapping methods in western Central France supposed to be sub-contemporaneous with the Belloisian (fig. 4). More precisely, this progression is ‘half-rotating’ and ‘dissymmetric’ (cf. infra). And this mode is much better represented at Donnemarie than the recent

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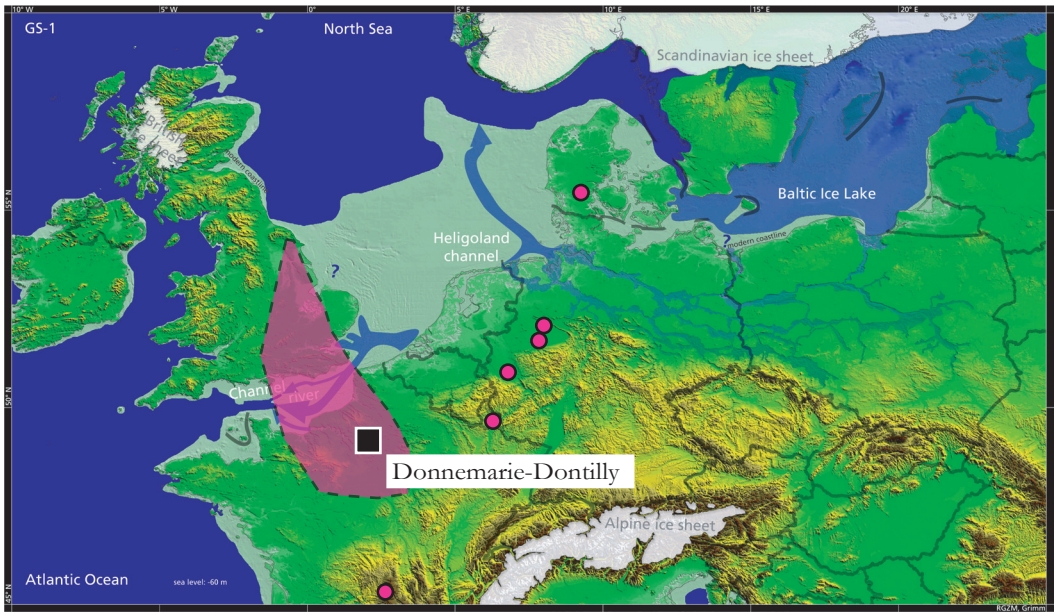


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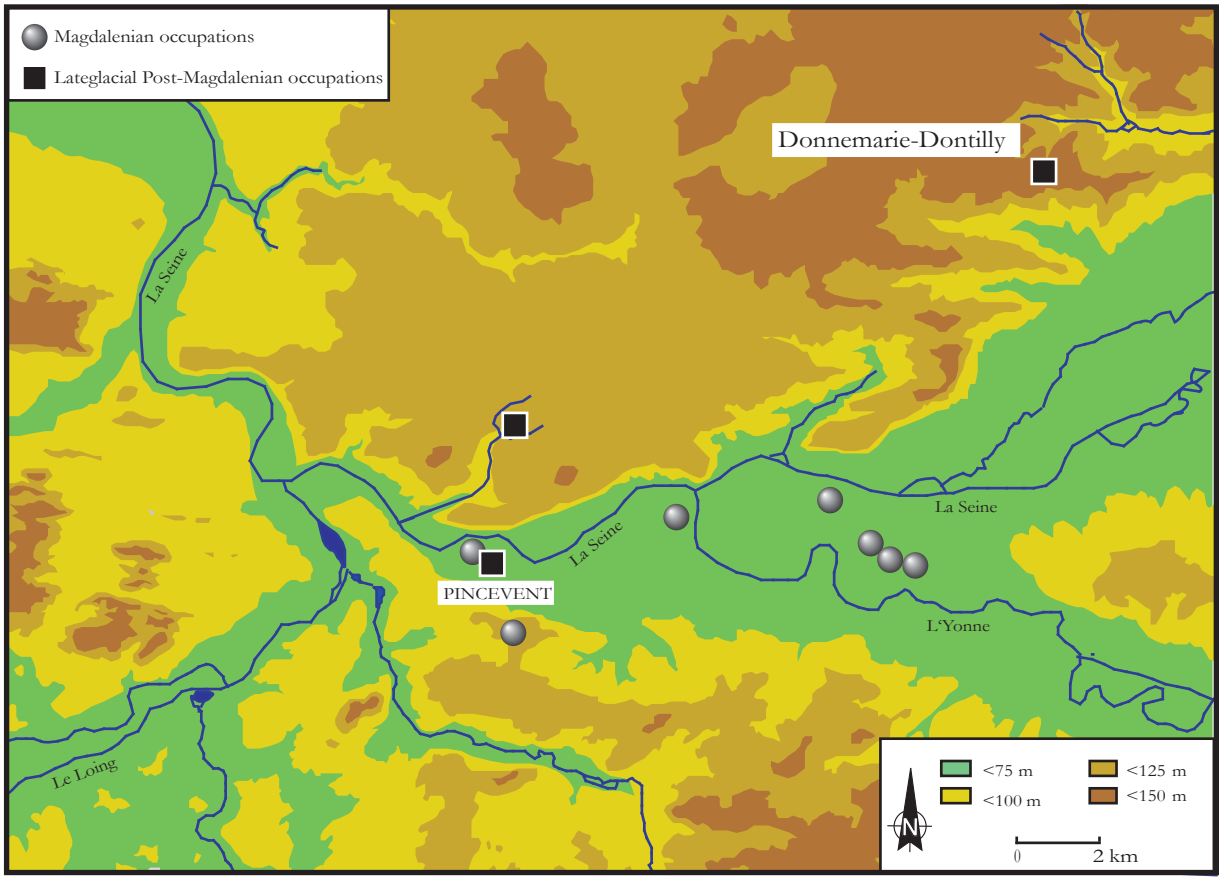


**Fig. 1 –** Donnemarie-Dontilly (Seine-et-Marne, France). 1: location of the site in its general archaeological context (basic map RGZM, Grimm, unpublished; compiled after Woldstedt, 1956; Björck, 1995; Konradi, 2000; Boulton et al., 2001; Lundqvist and Wohlfarth, 2001; Bourillet et al., 2003; Lericolais et al., 2003; Weaver et al., 2003; Clark et al., 2004; Ivy-Ochs et al., 2006; Gupta et al., 2007); 2: location of the site in its local context.

***Fig. 1 –*** *Donnemarie-Dontilly (Seine-et-Marne, France). 1 : localisation du site dans son contexte archéologique général (fond de carte RGZM, Grimm, inédit ; compilé d'après Woldstedt, 1956 ; Björck, 1995 ; Konradi, 2000 ; Boulton* et al.*, 2001 ; Lundqvist et Wohlfarth, 2001 ; Bourillet* et al.*, 2003 ; Lericolais* et al.*, 2003 ; Weaver* et al.*, 2003 ; Clark* et al.*, 2004 ; Ivy-Ochs* et al.*, 2006 ; Gupta* et al.*, 2007) ; 2 : localisation du site dans son contexte local.*

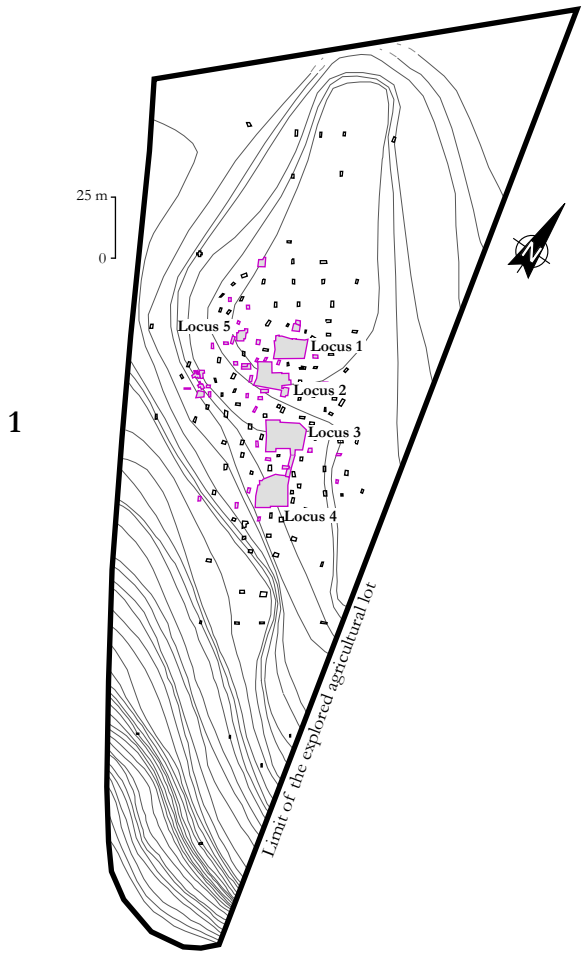


**Fig. 2 –** Donnemarie-Dontilly (Seine-et-Marne, France). 1: disposition of the 214 archaeological test pits at the edge of the plateau (in pink and grey the test pits yielding Belloisian industry); 2: distribution of lithic remains in the locus 4.

***Fig. 2 –*** *Donnemarie-Dontilly (Seine-et-Marne, France). 1 : implantation des 214 sondages archéologiques en bord de plateau (en rose et gris, les sondages livrant de l'industrie belloisienne) ; 2 : répartition des restes lithiques dans le locus 4.*

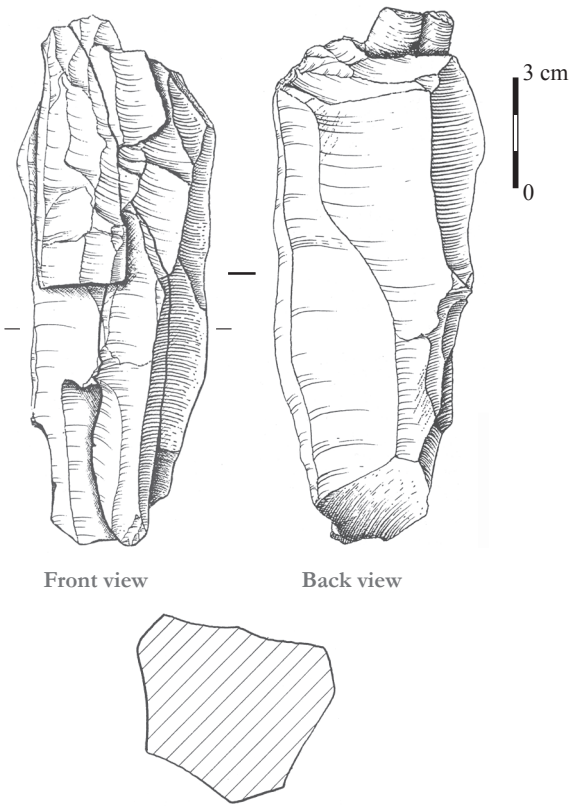


**Fig. 3 –** Donnemarie-Dontilly (locus 4): completely rotating progression for blade production on a volume of Tertiary flint.

***Fig. 3 –*** *Donnemarie-Dontilly (locus 4) : progression complètement tournante pour un débitage de lames sur un volume en silex tertiaire.*

syntheses, and even our very detailed study (Valentin, 1995, p. 592–680), which was lacking an interpretative key that Nicholas Naudinot's works helped us to discover, suggested.

It is worth noting that an analogous key has already served to describe the evolution of Magdalenian core reduction through the stratigraphy of Étiolles (Philippe, 2004, p. 61–62) as well as important contrasts within the Gravettian techno-complex (Klaric, 2003). This interpretative key has recently proved beneficial again to Morgan Roussel (2013) for describing the differences between the Châtelperronian and the Protoaurignacian, by revealing to what extent these modes of initialisation and progression could be distinctive, since they produced morphologically different blank spectra. We now think that notable dissimilarities also exist in this respect between the Late *Federmesser* Industries and the industries of the Younger Dryas-Preboreal transition and that the analogies among the latter should also be deciphered with the help of the same key.

## Terminological and methodological precisions

In order to facilitate these technological comparisons, a certain imprecision of the common descriptive vocabulary on knapping progression—the way of placing blades and bladelets within the knapped volume after the ini-

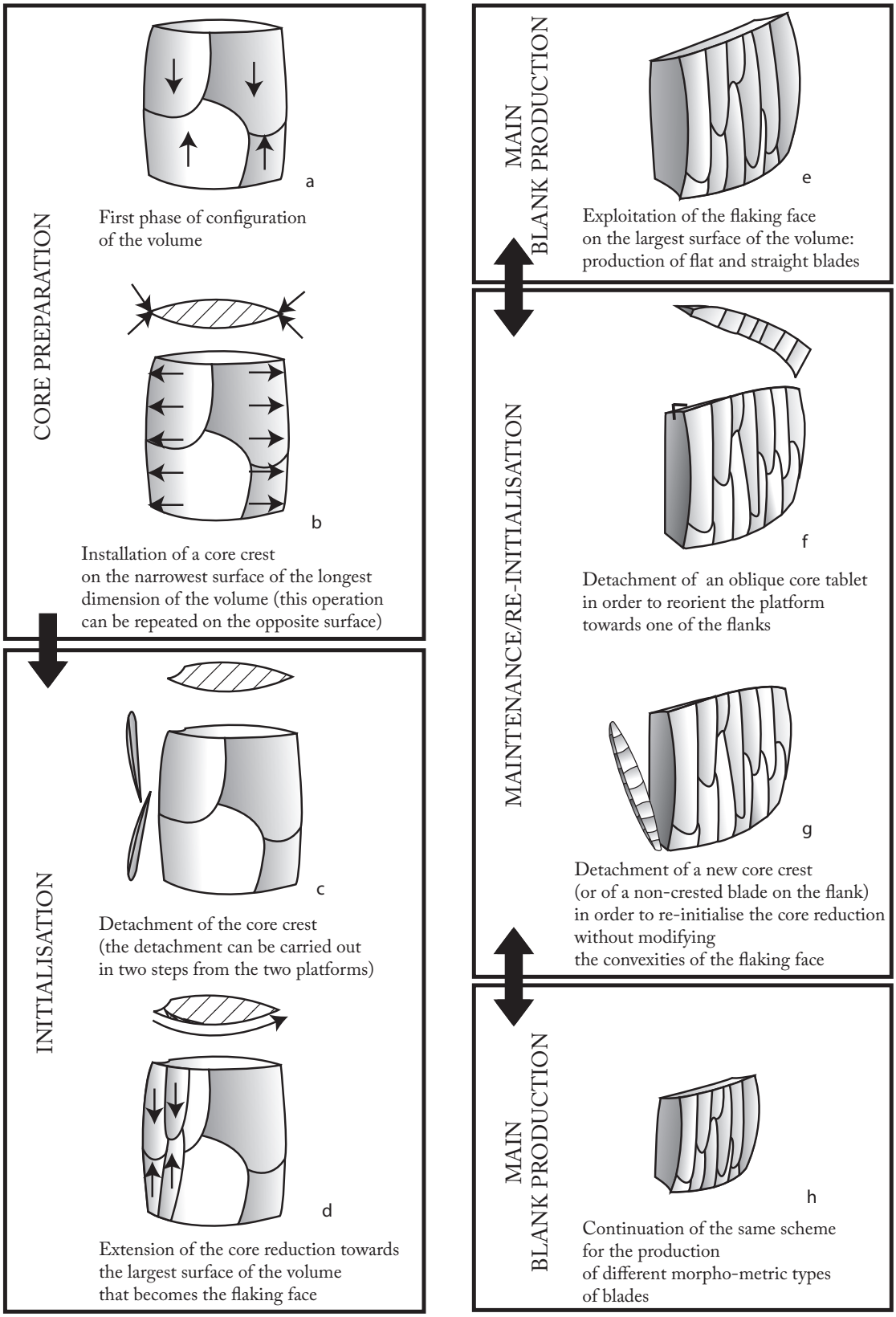


**Fig. 4 –** Model representing the initialisation and progression of core reduction in the industries from western Central France contemporaneous with the Belloisian (after Naudinot, 2013, p. 244, fig. 5). NB: the texts included in this figure have been translated into English by the authors.

***Fig. 4 –*** *Modèle concernant l'initialisation et la progression des débitages dans les industries contemporaines du Belloisien du Centre-Ouest de la France (d'après Naudinot, 2013, p. 244, fig. 5). NB : les textes inclus dans cette figure ont été traduits en anglais par les auteurs.*

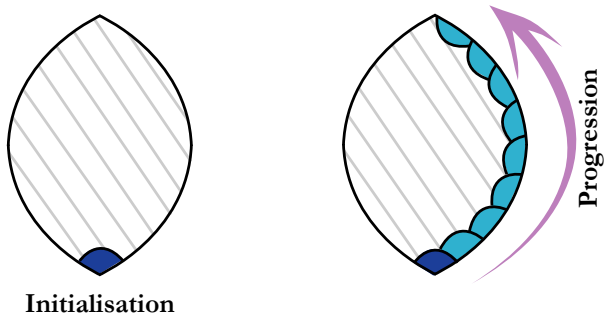


**Fig. 5 –** Initialisation and progression of blade and/or bladelet production: what is it all about? Sectional views of cores.

***Fig. 5 –*** *Initialisation et progression d'un débitage laminaire et/ou lamellaire : de quoi s'agit-il ? Nucléus vus en section.*

tialisation of the process (that is the detachment of the very first blades)—should first of all be clarified (fig. 5). The established terminology is unsatisfactory to our mind because it perpetuates a certain confusion between the initialisation of the process and the actual progression: thus, 'frontal' serves to designate both the detachment of the first blades on the most narrow surface of the volume and a rather restrained progression by planes that are almost parallel to this initial zone. To avoid this confusion, we propose to simply speak of initialisations on a narrow surface (fig. 6) and distinguish them from initialisations on broad surfaces (cf. 'facial' for certain authors: Pigeot, 1991). With respect to the progression in the case of an initialisation on a narrow surface, rather than distinguishing a so-called 'frontal' progression from all other modes summarized under the unique qualifier 'semi-rotating', we consider that all is a question of extent within a continuum, as, for the sake of maintaining the necessary latitudinal convexity of the flaking face *(cintre)*, the progression can, obviously, never be strictly parallel. In fact, it is always slightly rotating:

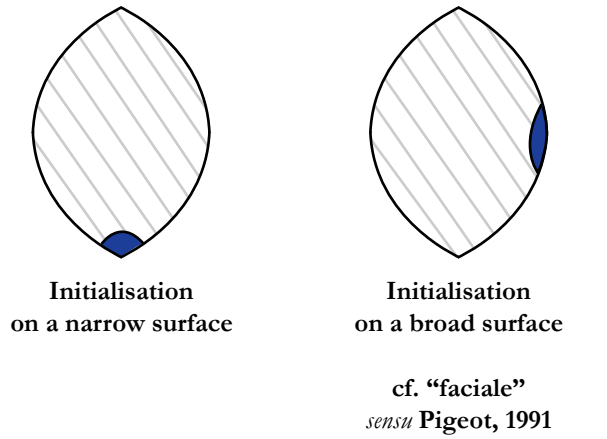


**Fig. 6 –** Two possible modes of initialisation of blade and/or bladelet production.

***Fig. 6 –*** *Deux modes possibles d'initialisation d'un débitage laminaire et/ou lamellaire.*

quarter-rotating if it is restrained and deviates little from the zone of initialisation; third- or half-rotating if it is little or much enlarged, hence creating a distance from the zone of initialisation. In addition, we would like to stress more precisely—and this is very important for our study on Donnemarie—that the enlargement can be of symmetric orientation if it develops to an equal extent on both initial flanks or dissymmetric if it covers predominantly or even exclusively one of the original flanks. In summary, in light of the precision nowadays aspired to in comparisons, 'semi-rotating'[(2)] has become too vague a term, since it encompasses diverse extents and orientations of the progression (fig. 7). The latter can be even

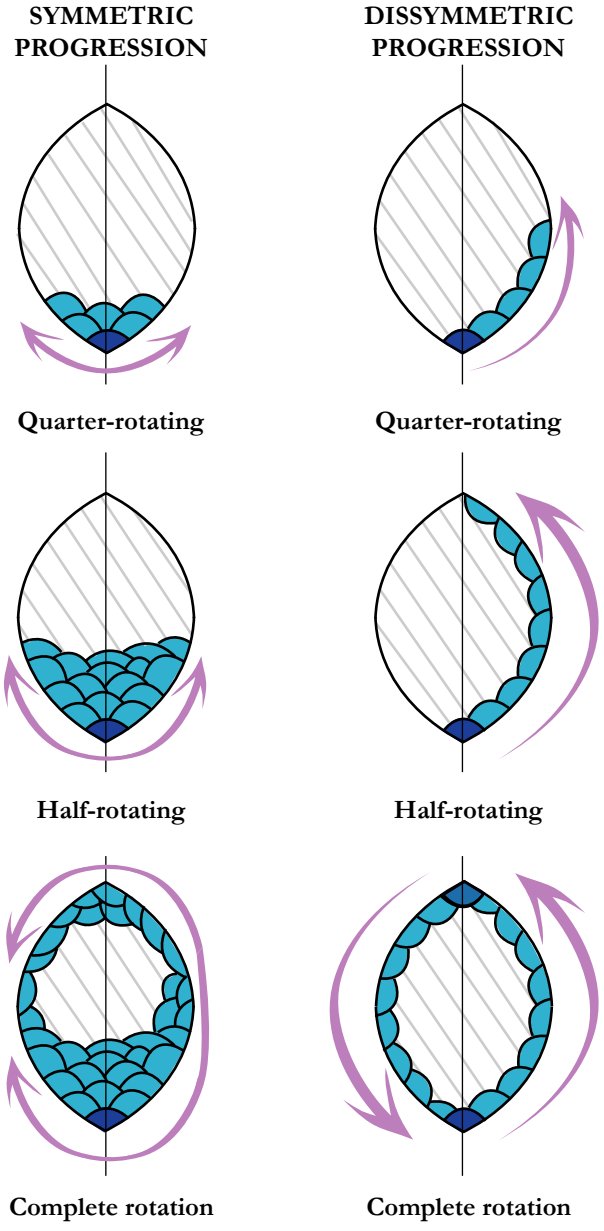


**Fig. 7 –** Different orientations and extents of the progression of blade and/or bladelet production.

***Fig. 7 –*** *Différentes orientations et amplitudes pour la progression d'un débitage laminaire et/ou lamellaire.*

more enlarged in case of a complete rotation thus attaining the initial back and second flank.

These extents and orientations can evidently change from one knapping sequence to the next: a restrained reduction in the first sequence can be enlarged afterwards, in a symmetric way or not (fig. 8). This fact causes analytical difficulties on significantly exploited large volumes, such as certain elements from Donnemarie, on which it is often impossible to reconstruct the changes in extent and orientation between sequences on the very reduced cores for which the zone of initialisation cannot be localised (fig. 9). Only comprehensive refit complexes or cores where the initial volume can be reconstructed from remnants of natural surfaces and/or of negatives resulting indubitably from configurating crests, make this recapitulation possible. Thus, we have given these most reliable sources more weight in our study at Donnemarie (cf. infra: 'Complete exploitations') and afterwards added some observations on very reduced cores (cf. infra: 'Last sequences') or, on the contrary, gained from those that have been reduced very little and that exclusively provide information on the beginning of the reduction process, as do certain refit complexes comprising only the first blades (cf. infra: 'First sequences').

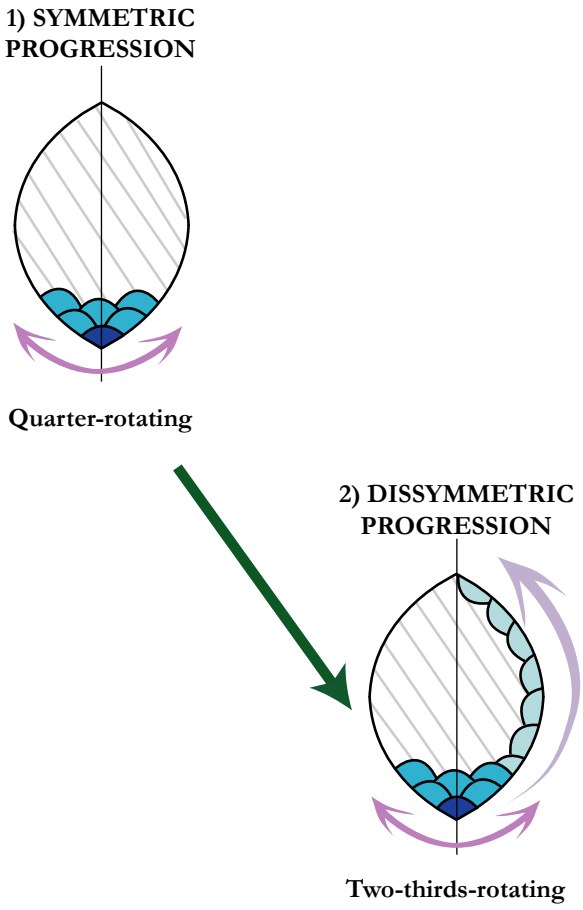


**Fig. 8 –** Change of orientation and extent during blade and/or bladelet production.

***Fig. 8 –*** *Changement d'orientation et d'amplitude au cours d'un débitage laminaire et/ou lamellaire.*

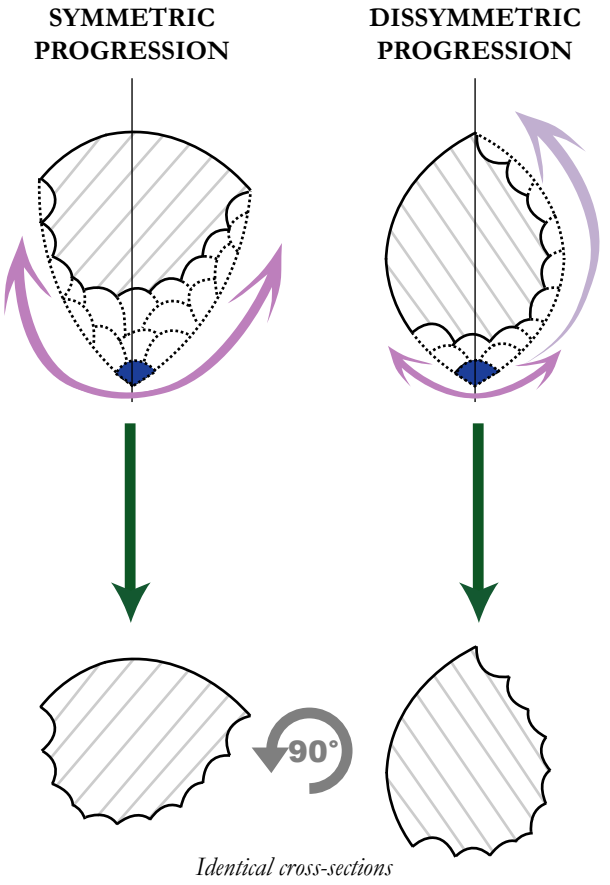


**Fig. 9 –** On very reduced blade and/or bladelet cores, the difficult reconstruction of changes of orientation and extent during the core reduction process.

***Fig. 9 –*** *Sur des nucléus à lames et/ou lamelles très débités, la difficile reconstitution des changements d'orientation et d'amplitude en cours de débitage.*

## First results from Donnemarie-Dontilly

The following study treats the entirety of the five loci and focuses on refit complexes as well as cores resulting from 129 knapping operations. Five core fragments and one volume abandoned while being tested have been excluded from our study. This is also the case for twelve very unskilled and non-productive operations that cannot assist in the goals of the present study which aims at the general norms of flint reduction. Hence, it included 111 successful exploitations, which yielded separately or continuously: firstly, large and long blades (± 8 to ± 15 cm), narrow and shorter blades (± 5 to ± 8 cm) or bladelets *sensu stricto*, the two latter categories probably corresponding to blanks for projectile implements; secondly, more irregular products: short blades or elongated flakes.

The entirety of the operations, be they successful or not, equally used materials from two local (less than 1 km) flint sources from which rather different volumes originate. From one of the outcrops on beds of Tertiary age (Eocene), the knappers gained geofacts of diverse dimen-

sions and generally with a plano-convex section (one plane or slightly concave natural cleavage face opposed to a cortical curvature). From the other source, situated in beds of Secondary age (Cretaceous), the knappers collected different volumes: more or less big but always elongated, generally completely covered in cortex, their section being, this time, rather oval (cf. *rognons*).

### *A large majority of initialisations on a narrow surface... and some remarkable exceptions*

Following core preparations of varying intensity—very far-reaching on the large Tertiary volumes; very limited, by contrast, on many of the naturally regular Secondary volumes—, the exploitations are almost exclusively initialised on a narrow zone (103 cases of 111 successful operations), for instance at the intersection of the flat and the convex surface on the Tertiary volumes. This is completely logical for the production of blades and bladelets, that is of narrow blanks, but this apparently trivial rule, nevertheless, knows some very remarkable exceptions in the form of eight short knapping operations exclusively carried out on surfaces with very unpronounced convexities. Three of them correspond to re-exploitations of ridges to produce one or two bladelets on the dorsal face of thick blades previously extracted at the beginning of the knapping process from large volumes (fig. 10, no. 1; cf. 'Kostienki method': e.g. Klaric, 2000; Pigeot, 2004, p. 83–84). The five other operations are even more remarkable because they concern the broad surfaces of volumes without ridges, in particular big flakes knapped in advance (fig. 10, no. 2). In consequence, all these 'facial' operations have a very limited productivity (one or two bladelets or elongated flakes with irregular outlines) as they take place at the limits of the morphological conditions necessary for the detachment of narrow products. Nevertheless, they are generally carried out very carefully implying marginal (i.e. at the platform edge) soft stone percussion preceded by a thorough abrasion of the platform edge.

### *A dissymmetric progression frequent on Tertiary flint and occasional on Secondary*

Following the initialisations on a narrow surface, which are by far the most frequent, the first production sequence is generally symmetric for all the flint volumes. Afterwards, the progression differs distinctly depending on the morphologies and, in consequence, the flint variety (table 1).

On the volumes of Tertiary flint with a generally plano-convex section, the progression is quickly extended, very often in a dissymmetric way (29 cases of 39 determined cases) and frequently reaching a half-rotating extent (15 cases of these 29). Unfortunately, none of the studied refit complexes is sufficiently complete to verify if, after a first dissymmetric extension, there was a return to the intersection of the broad and the narrow surface (cf. *débordement*) followed by a new extended sequence.[3] However, on these volumes with often originally plano-convex sections, the extension is rather directed onto the convex surface, which, at first sight, seems to be logical in light of the difficulty to knap on plane or sometimes even slightly concave surfaces (fig. 11). Nevertheless, on 23 particularly thick volumes among the 29 dissymetric ones, it would have been possible without effort, by a more extensive core preparation, to create a longitudinal and a latitudinal convexity on this originally plane surface (fig. 12) in order to exploit it if a symmetric progression would have been desired as is actually the case for a small number of volumes (fig. 13). Thus, the initial morphological characteristics of the Tertiary volumes have indubitably played a certain role in this strong tendency towards dissymmetry, but these characteristics could have been easily altered in a vast majority of cases. In the light of these 23 cases with a configuration reduced to the strict minimum, for which the dissymmetric progression can be considered optional in the end, one could even consider the possibility of an intentional selection of plano-convex morphologies encouraging this dissymmetry at the outcrop: unfortunately, the precise location of the sources and, in consequence, their actual potential remain unknown. Regardless, the exploitation of this type of volume with this frequent way of progression towards broad and quickly flattening surfaces as well as very marginal percussion[4] prepared by thorough abrasion yields rather long, large and proportionally thin blades and bladelets.[5] Furthermore, after the same type of progression, the knappers occasionally extracted on certain volumes in the end short, irregular and frequently thick blades[6] by performing internal percussions (i.e. at a certain distance from the platform edge) and hence doing without abrasion: these few final sequences lack care but remain nevertheless skillful.

On the volumes of Secondary flint, the situation after the initialisation appears to be almost the opposite since the symmetric progression largely predominates (27 cases of the 34 determined ones; table 1; fig. 14). Once again, considering the initial morphology with good convexities on all surfaces, the opposite would have been astonishing. The only surprising cases correspond to 6 dissymmetric progressions (among which are 4 half-rotating ones) that the initial morphology did not encourage in 4 of the 6 cases, including the already evoked consequences in terms of the quality of the production: particularly thin blades and bladelets if the percussion is marginal following abrasion; short, thicker and more irregular blades in more expedient final sequences (fig. 15).

### *Flaking faces which very often end up in a flattened state*

These blatant cases of optional dissymmetry on Secondary flint are, thus, rare (4 cases of 34) but it is not at all impossible that our caution slightly underestimates the importance of this progression mode, which is clearly optional since there is no particular natural inducement. In fact, there are several cases in our assemblage for which

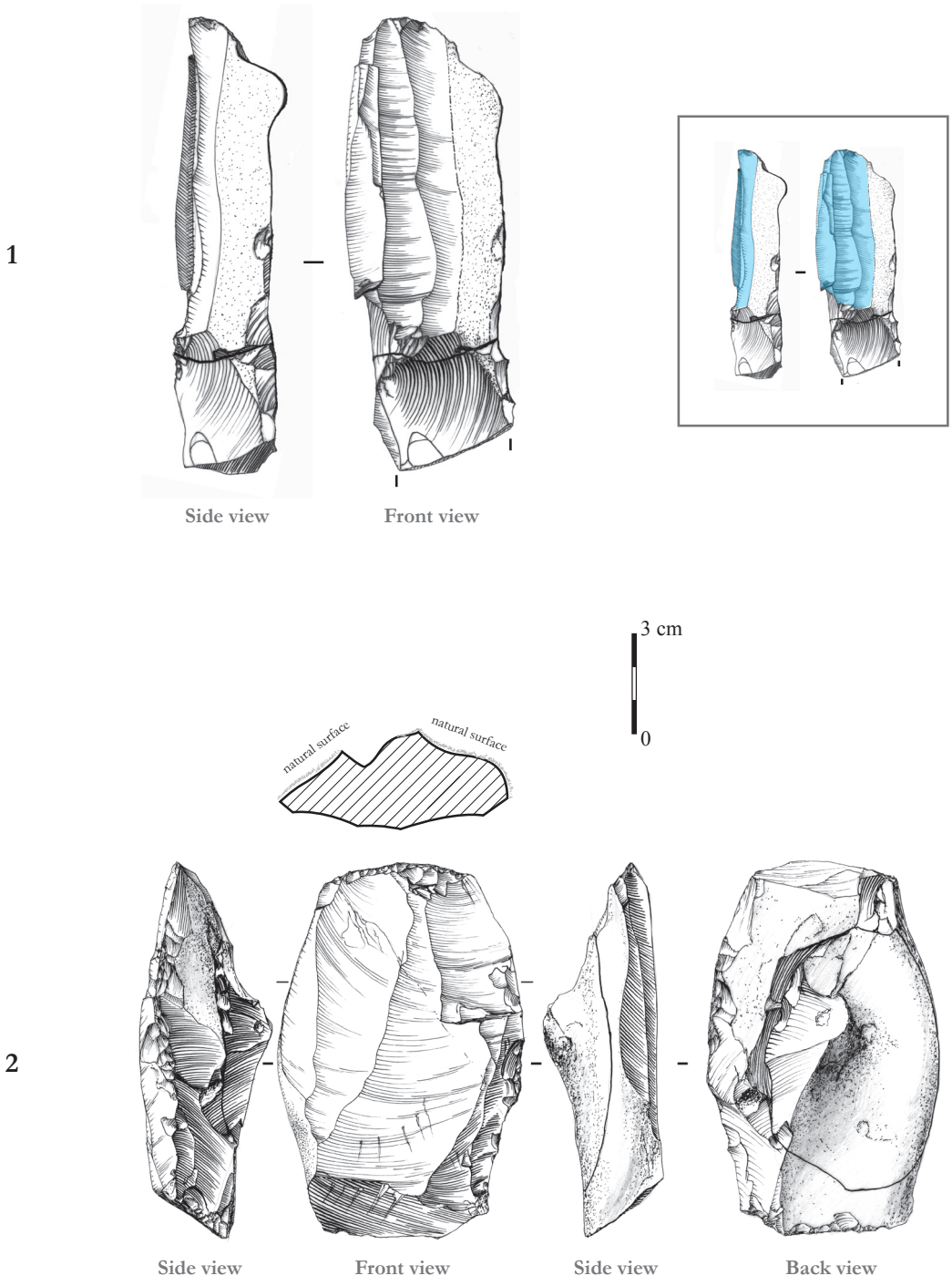


**Fig. 10 –** Donnemarie-Dontilly (locus 4 and 5): strictly 'facial' knapping operations. 1: exploitation of ridges on a thick Tertiary flint blade in order to produce bladelets (negatives highlighted in blue in the box on the right); 2: exploitation of a block of Secondary flint in order to produce elongated flakes (drawings M. Ballinger).

***Fig. 10 –*** *Donnemarie-Dontilly (locus 4 et 5) : des opérations de taille strictement faciales. 1 : exploitation des nervures sur une lame épaisse en silex tertiaire pour produire des lamelles (négatifs soulignés en bleu dans l'encart à droite) ; 2 : exploitation d'un bloc de silex secondaire pour produire des éclats allongés (dessins M. Ballinger).*

we did not comment on the initialisation and progression (cf. table 1: 'Undetermined'), in particular for cores on Secondary flint without refit and clues for reconstructing precisely the original morphology.

However, another remarkable fact should be stated with regard to these cores and others on Tertiary flint for which we were also not able to reconstruct the mode of progression: it is the very flattened state of the flaking faces in the last sequences, which, thus, yield thin blades or bladelets if the percussion stays marginal, independently of the previous mode of progression (fig. 16). Once again, the last sequences were carried out at the limits for the detachment of elongated products, as this flattening increases the risk of hinge terminations and sigmoid

| | | Tertiary | Secondary |
|---|---|---|---|
| Symmetric | First sequences | 4 | 4 |
| | Complete exploitations | | 10 |
| | Last sequences | 3 | 13 |
| | **Sub-total** | **7** | **27** |
| Dissymmetric | First sequences | 4 | |
| | Complete exploitations | 13 | 2 |
| | Last sequences | 12 | 4 |
| | **Sub-total** | **29** | **6** |
| Complete Rotation | First sequences | | |
| | Complete exploitations | | |
| | Last sequences | 3 | 1 |
| | **Sub-total** | **3** | **1** |
| Undetermined (flattened flaking face) | First sequences | | |
| | Complete exploitations | | |
| | Last sequences | 6 | 18 |
| Undetermined (non-flattened flaking face) | First sequences | 4 | 1 |
| | Complete exploitations | | |
| | Last sequences | 3 | 6 |
| **Total** | | **52** | **59** |

**Table 1 –** Donnemarie-Dontilly: Progression modes of blade and/or bladelet productions initialised on a narrow surface.

***Tabl. 1 –*** *Donnemarie-Dontilly : mode de progression des débitages laminaires et/ou lamellaires initialisés sur une surface étroite.*

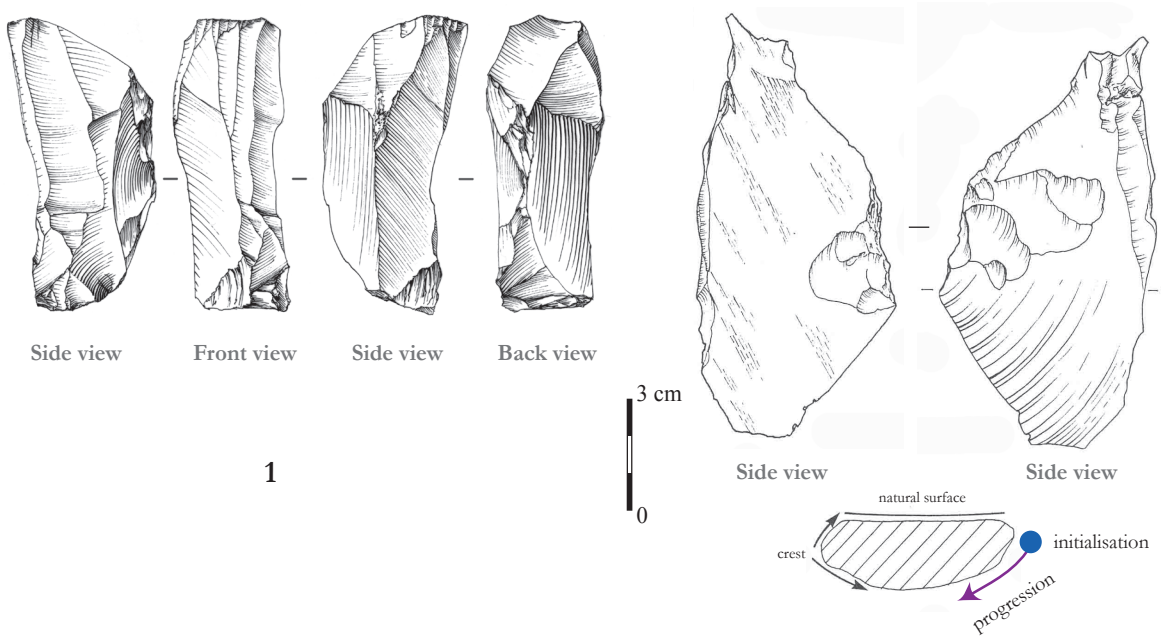


**Fig. 11 –** Donnemarie-Dontilly (locus 4): dissymmetric progressions on volumes of Tertiary flint that did not grant any other option. 1: quarter-rotating progression for the production of small blades on a geofact (drawing M. Ballinger); 2: quarter-rotating progression for the production of bladelets on a knapped flake (drawing D. Molez).

***Fig. 11 –*** *Donnemarie-Dontilly (locus 4) : progressions dissymétriques sur des volumes en silex tertiaire qui ne permettaient pas d'autre option. 1 : progression quart-tournante pour un débitage de petites lames sur un géofact (dessin M. Ballinger) ; 2 : progression quart-tournante pour un débitage de lamelles sur un éclat débité (dessin D. Molez).*

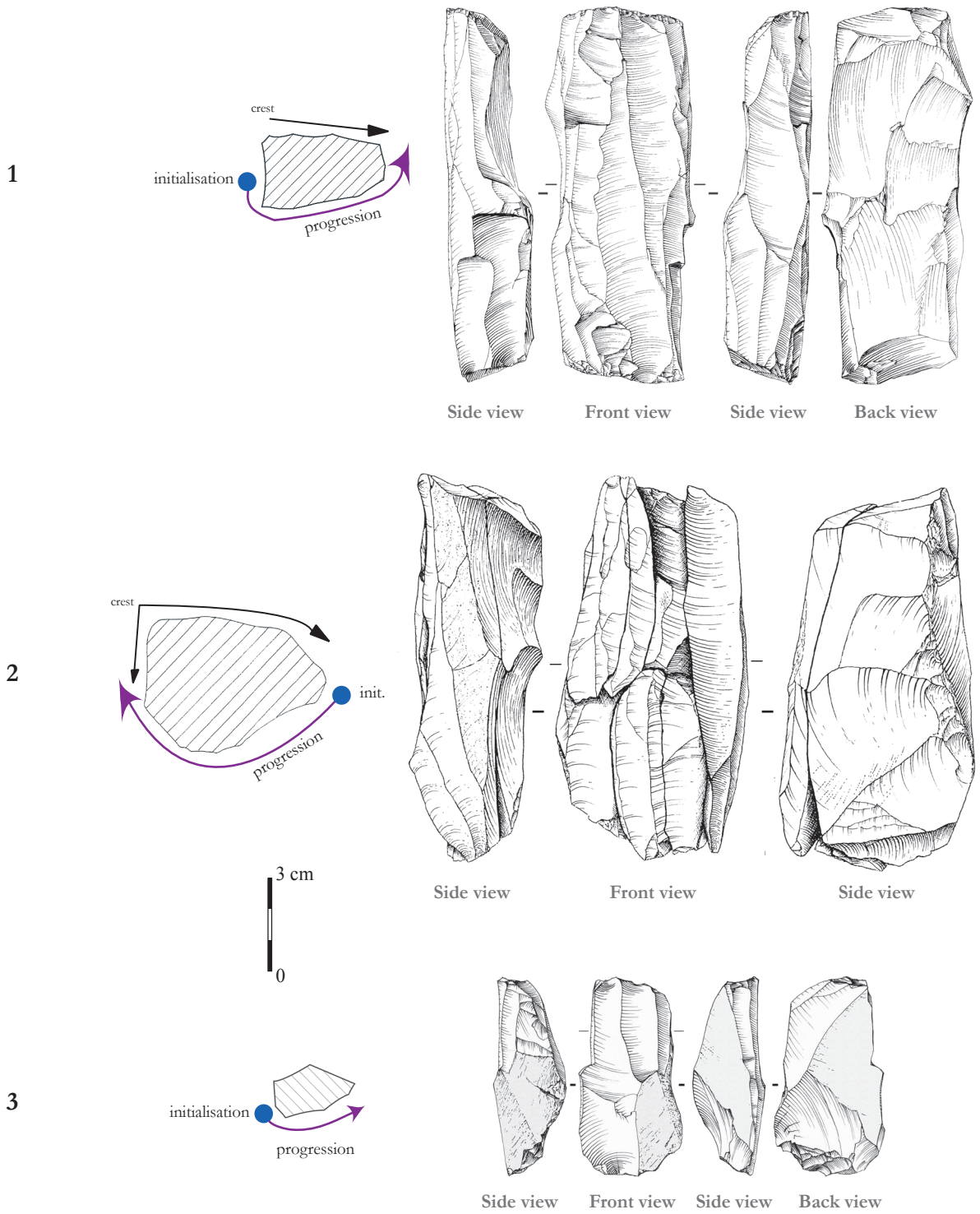


**Fig. 12 –** Donnemarie-Dontilly (locus 4): dissymmetric progressions on volumes of Tertiary flint that would have permitted symmetry if the core preparation had been more extensive. 1: half-rotating progression for the production of blades on a probable geofact (drawing M. Ballinger); 2: half-rotating progression for the production of short, irregular and thick blades on a probable geofact (drawing D. Molez); 3: half-rotating progression for the production of small blades and bladelets on a geofact of Tertiary flint (drawing M. Ballinger).

***Fig. 12 –*** *Donnemarie-Dontilly (locus 4) : progressions dissymétriques sur des volumes en silex tertiaire qui permettaient une symétrie si la mise en forme avait été plus poussée. 1 : progression demi-tournante pour un débitage de lames sur un probable géofact (dessin M. Ballinger) ; 2 : progression demi-tournante pour un débitage de lames courtes, irrégulières et épaisses sur un probable géofact (dessin D. Molez) ; 3 : progression demi-tournante pour un débitage de petites lames et lamelles sur un géofact en silex tertiaire (dessin M. Ballinger).*

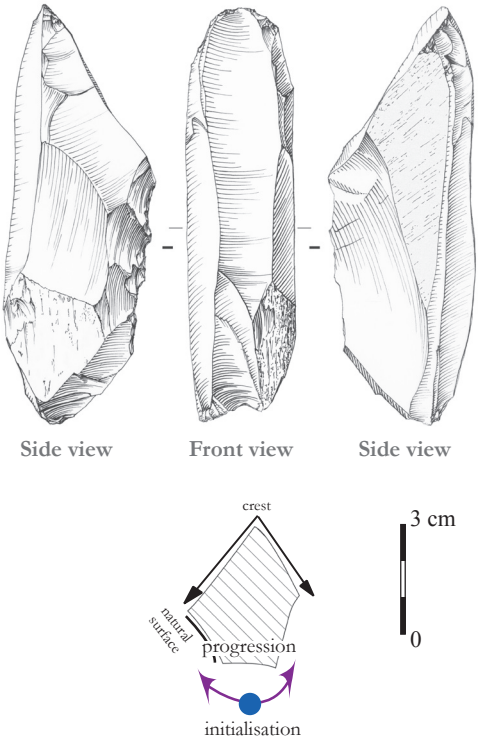


**Fig. 13 –** Donnemarie-Dontilly (locus 3): one of the few symmetric progressions for the production of small blades on a volume of Tertiary flint (drawing M. Ballinger).

***Fig. 13** – Donnemarie-Dontilly (locus 3) : une des quelques progressions symétriques pour un débitage de petites lames sur un volume en silex tertiaire (dessins M. Ballinger).*

guiding ridges and, in consequence, diminishes the output of blades and bladelets. This assumption of risk and the relative sacrifice of productivity on cores which were, nevertheless, handled with care reinforce in our opinion the optional and hence distinctive character of this frequent flattening.

### *Exceptional rotating progressions*

This does not apply to the rotating progressions, which are, finally, very rare but nevertheless striking (4 cases summing up Tertiary and Secondary flint; table 1 ; fig. 3). Producing, finally, slightly thick blades and bladelets, this very extended mode could correspond to the ultimate achievement of rather diverse progressions. It attests indeed to the quest for a particular output of rather regular products on certain volumes but the phenomenon is marginal adding another nuance to the idea that productivity has systematically been sought at Donnemarie: everything depends on the knapping operation. And this, finally, supports our general recent opinion about the Belloisian: "there are always a certain intra-site variability, and particularly contrasts between sites" (Valentin, 2008, p. 177; translation by authors).

## CONCLUSION AND PERSPECTIVES

Searching, of course, for a common norm behind these contrasts, we have begun comparisons within the Belloisian with some first observations on the eponymous site of Belloy-sur-Somme (Somme). In this very large and extensively refitted assemblage, the choices relative to initialisation and progression correspond well to those we have observed at Donnemarie, in particular on secondary flint. This is entirely logical in light of very similar initial volumes at Belloy, possessing rather oval sections. In this context, several manifest cases of a half-rotating and dissymmetric progression equally exist without the initial morphologies presenting a particular incitement to it (fig. 17, no. 1). There are even some 'facial' exploitations, that is, those initialised on the broad surface of big knapped flakes. Furthermore, the frequency of cores outside refit groups which are very flattened at the moment of abandonment is worth noting, sometimes being exploited in order to extract a few slightly thick and irregular blades in a rapid way. Thus, the output of regular blanks is far from systematic at Belloy. All this holds equally true for the small and extensively refitted assemblage from locus 1 of the Diguets site at Acquigny (Eure), showing once again the significant selection of half-rotating dissymmetric progressions that the original geometry did not impose on them at all (fig. 17, no. 2).

Following these very first revisions of the Belloisian, the analogies with the almost contemporaneous industries of western Central France appear to be stronger than our last conclusions suggested. However, it still needs to be established if these are true similarities: the half-rotating dissymmetric progressions exist indeed in the Belloisian but they seem to be less systematic than in N. Naudinot's (2010 and 2013) descriptions concerning the site of Camp d'Auvours (Sarthe). Is it a consequence of the larger average dimensions of the original volumes in the Belloisian? Is this unconformity rather only apparent due to the methodological problem created by the comparison between the partly refitted collections of the Belloisian and assemblages of western Central France which essentially consist of abandoned cores on which it is difficult to reconstruct the initialisation and progression preceding the last sequences on very flattened surfaces? In any case, this flattening represents an evident common feature with the Belloisian, and this is one of the remarkable achievements of these recent studies.

Thus, this return to Donnemarie, an emblematic site thanks to its refits, is instructive in many respects.

First of all, it makes it possible to become fully aware of the fact that on big volumes, initialisation and progression of the knapping are often difficult to reconstruct without rather comprehensive refit complexes. Comparisons that exclusively rely on abandoned cores are, in consequence, limited, even if the flattening could represent a significant clue in this context of the transition from Pleistocene to Holocene.

Already at this stage, this return to Donnemarie and the careful re-reading of the methods in light of the preliminary model established in western Central France

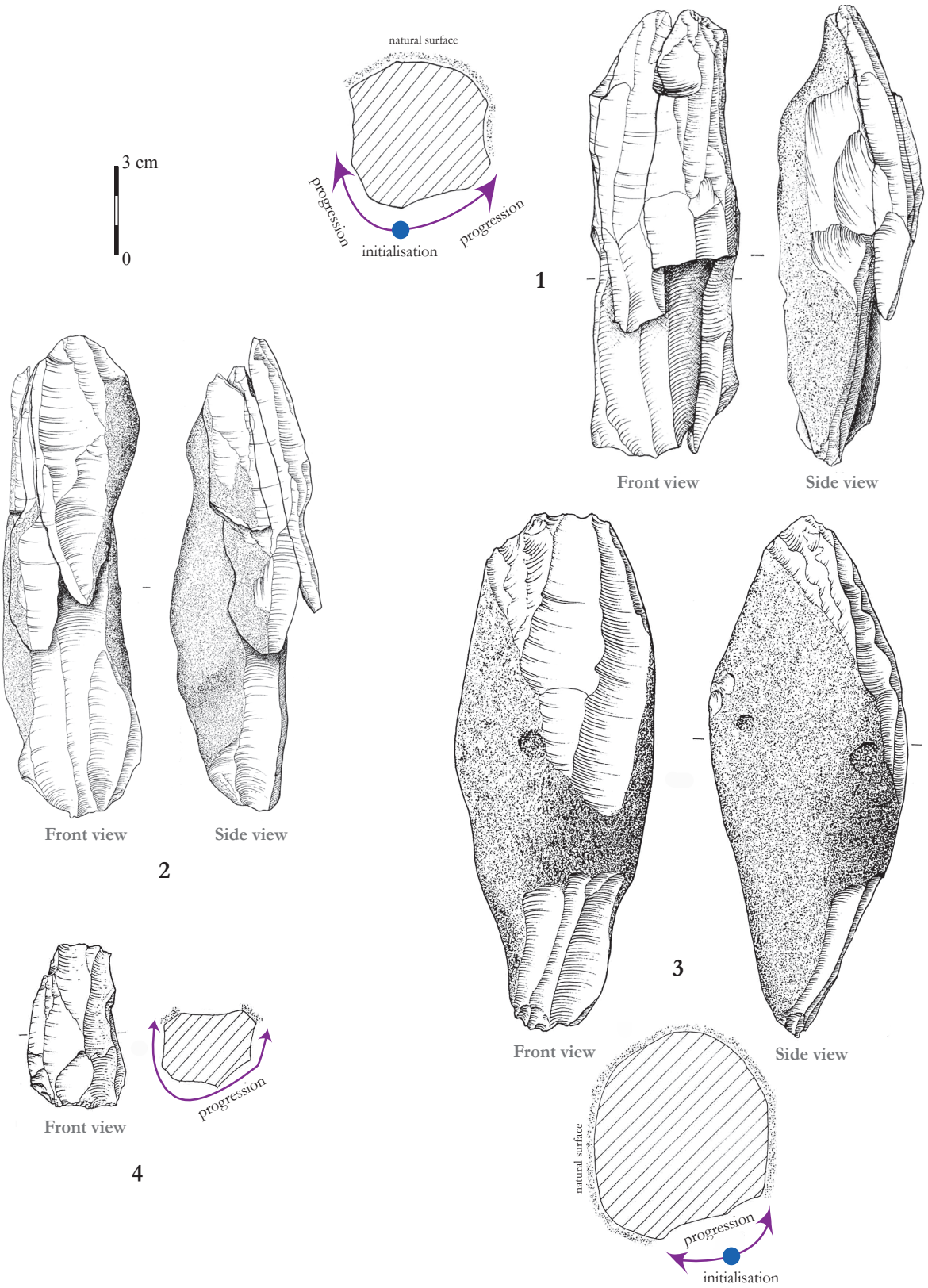


**Fig. 14 –** Donnemarie-Dontilly (locus 4): symmetric progressions on nodules of Secondary flint. 1: third-rotating progression for the production of blades; 2: quarter-rotating progression for the production of blades; 3: quarter-rotating progression during the first sequences of a quickly abandoned blade production; 4: two-thirds-rotating progression for the production of bladelets. NB: the initialisation zone cannot be precisely situated on this core (drawings D. Molez).

***Fig. 14 –*** *Donnemarie-Dontilly (locus 4) : progressions symétriques sur des rognons en silex secondaire. 1 : progression tiers-tournante pour un débitage de lames ; 2 : progression quart-tournante pour un débitage de lames ; 3 : progression quart-tournante au cours des premières séquences d'un débitage de lames vite abandonné ; 4 : progression deux-tiers-tournante pour un débitage de lamelles. NB : la zone d'initialisation ne peut pas être précisément située sur ce nucléus (dessins D. Molez).*

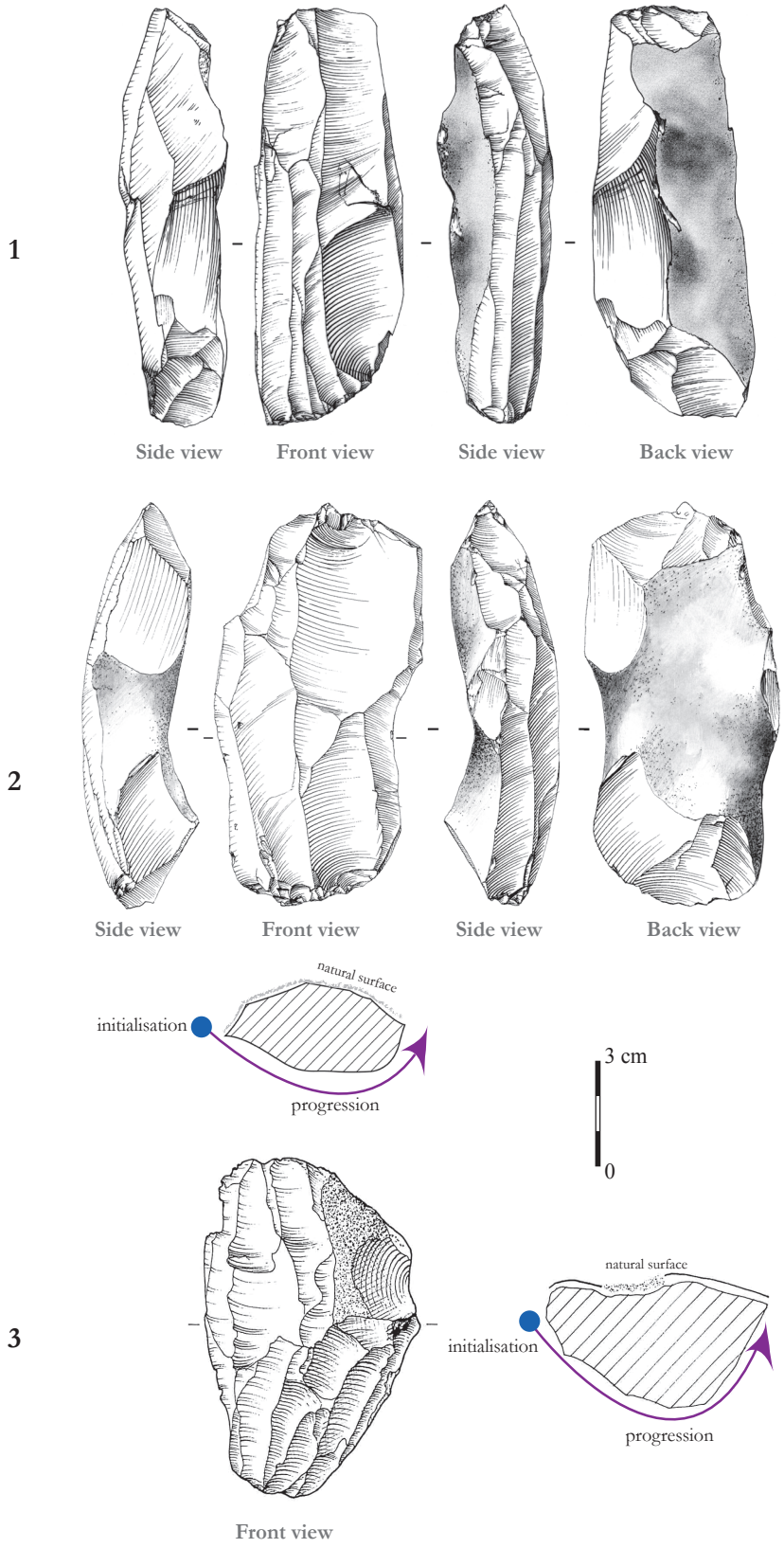


**Fig. 15 –** Donnemarie-Dontilly (loci 3, 4 and 5): dissymmetric progressions on nodules of Secondary flint. 1: half-rotating progression for the production of blades (drawing M. Ballinger); 2: half-rotating progression for the production of short, irregular and thick blades (drawing M. Ballinger); 3: half-rotating progression for the production of short blades and bladelets. NB: the last bladelet sequence detached from the lower platform is entirely 'facial' (drawing D. Molez).

***Fig. 15 –*** *Donnemarie-Dontilly (locus 3, 4 et 5) : progressions dissymétriques sur des rognons en silex secondaire. 1 : progression demi-tournante pour un débitage de lames (dessin M. Ballinger) ; 2 : progression demi-tournante pour un débitage de lames courtes, irrégulières et épaisses (dessin M. Ballinger) ; 3 : progression demi-tournante pour un débitage de petites lames et lamelles. NB : la dernière séquence lamellaire extraite à partir du plan de frappe du bas est pleinement faciale (dessin D. Molez).*

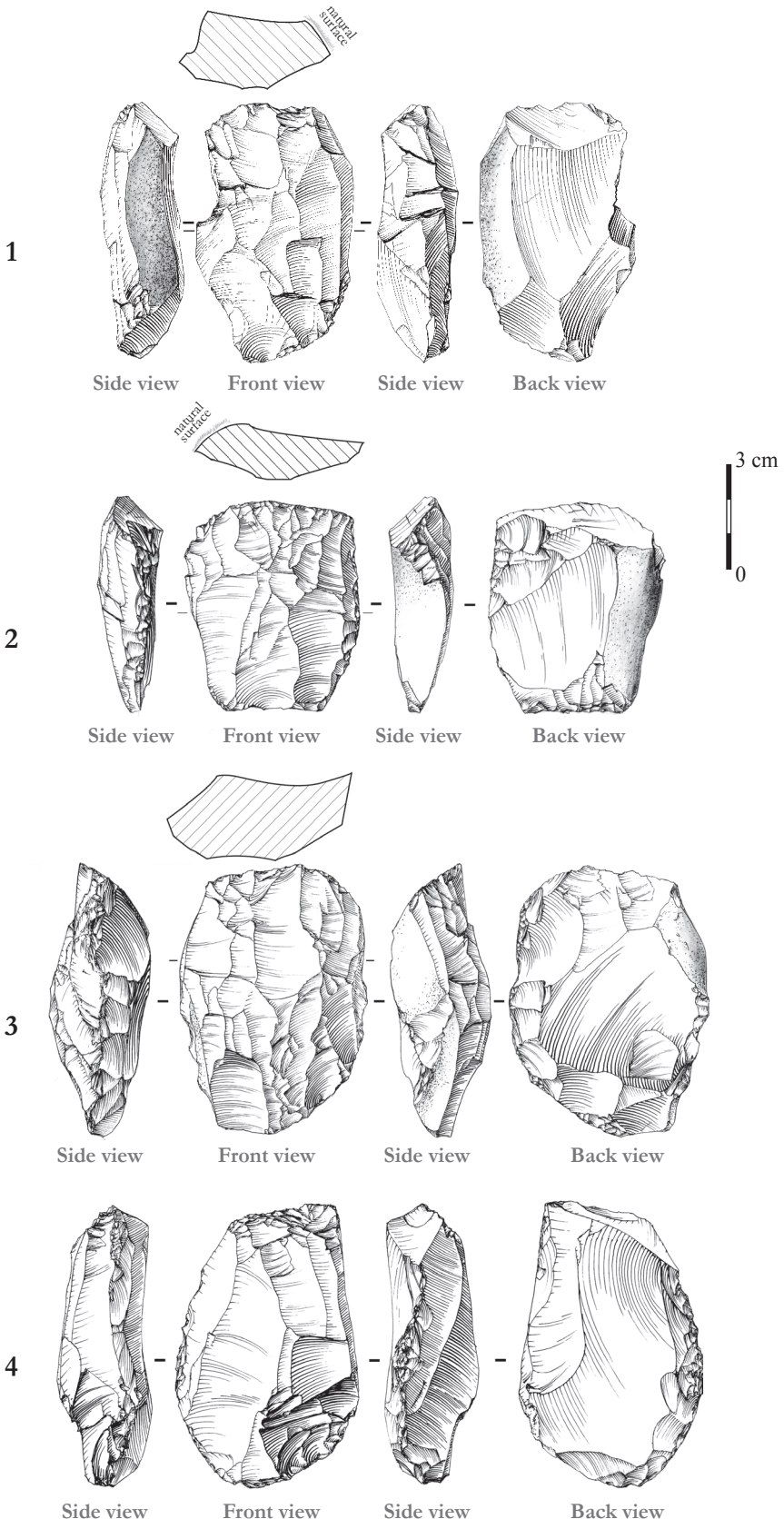


**Fig. 16 –** Donnemarie-Dontilly (locus 3 and 4): cores of Secondary flint with very flattened ultimate flaking faces on which initialisation and progression remain undetermined. NB: nos. 1 and 4 have probably been the object of unskilled re-use (drawings M. Ballinger).

***Fig. 16 –*** *Donnemarie-Dontilly (locus 3 et 4) : nucléus en silex secondaire aux dernières surfaces de débitage très aplaties et sur lesquels initialisation et progression restent indéterminées. NB : les n^os^ 1 et 4 ont probablement fait l'objet de reprises malhabiles (dessins M. Ballinger).*

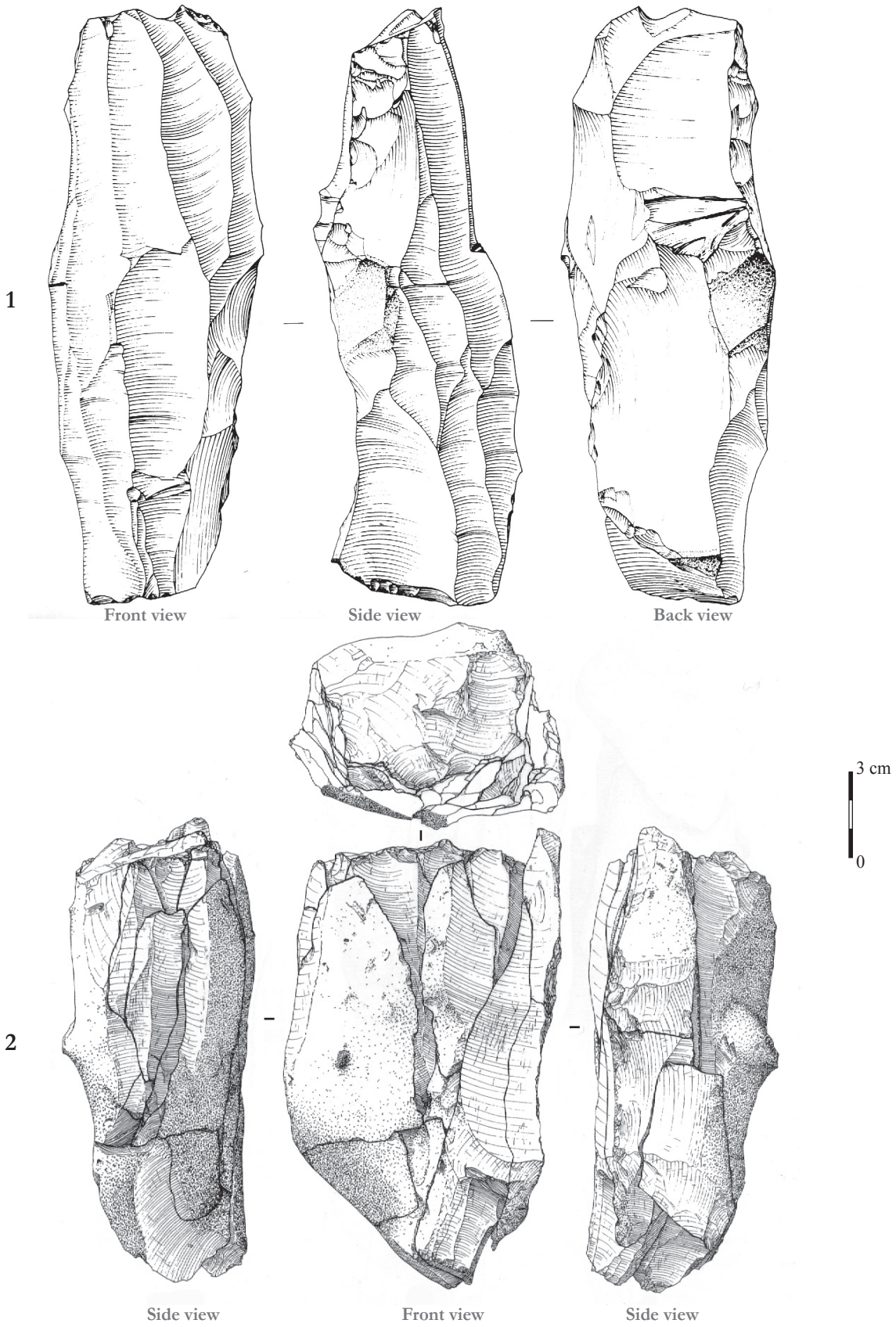


**Fig. 17 –** Half-rotating dissymmetric progressions on nodules of Secondary flint. 1: Belloy-sur-Somme, la Plaisance (after S. Lancelot in Fagnart, 1997, fig. 59); Acquigny, les Diguets (after P. Forré in Biard, Hinguant, 2011, fig. 112).

***Fig. 17 –*** *Progressions dissymétriques demi-tournantes sur des rognons en silex secondaire. 1 : Belloy-sur-Somme, la Plaisance (d'après S. Lancelot* in *Fagnart, 1997, fig. 59) ; Acquigny, les Diguets (d'après P. Forré* in *Biard, Hinguant, 2011, fig. 112).*

provide new keys for future comparisons that need to be extended further in the direction of the (Epi-)Laborian (Langlais et al., 2014)(7), towards the Ahrensburgian and even up to the Swiderian. We should not forget the Late Epigravettian either, where one finds: 1) exploitations on extremely flat surfaces (e.g. Montoya and Peresani, 2005; Tomasso et al., 2014; Fornage, 2013); 2) projectile implements presenting indubitable affinities with certain (Epi-)Laborian types sometimes found in the Belloisian (cf. 'pointes des Blanchères': Valentin, 2008, p. 187).

In addition to these synchronic comparisons, this re-reading of the Belloisian also encourages new comparisons with the preceding Late *Federmesser-Gruppen* Industries in order to more fully understand what the apparent contrasts rely upon. Is it only the average productivity of long and regular blanks, knowing now that it varies anyway from one knapping operation to the other in the context of the Belloisian and considering equally that short irregular blades and elongated flakes are sometimes part of the objectives? Is not, in addition to to their distal tapering, the very frequent overall thinness of the regular blades and bladelets a very distinctive feature, this quality being linked to both the extension towards flat surfaces and often very marginal detachments in contrast to generally internal percussions in the Late *Federmesser-Gruppen* Industries? Confrontations of this nature, which should also concern the initial Mesolithic following the Belloisian, will enrich the reasoning on potential common intentions reinforcing the long-distance analogies between industries of the Pleistocene-Holocene transition. Should one subsume them under one single technocomplex despite the probable differences from one region to another? Can one already talk of the 'Laborian-Belloisian-Ahrensburgian (LBA)' complex even though the degree of analogy is not precisely defined yet? Should one rather refer to 'Straight Blades and Bladelets Industries' (Naudinot, 2010 and 2013; Fornage, 2013)? However, is the straightness of the profile—a consequence of the use of the soft hammerstone—really discriminant? Thus, should one prefer 'Regular Blades and Bladelets Industries', as one of us had proposed (Valentin, 2008, p. 204)? Finally, we doubt henceforward that the regularity is the right criterion to highlight exclusively. In our current opinion, it is, hence, rather a particular search for regularity *and* thinness—in particular of the distal extremity—which would constitute the originality of a good part of the blades and bladelets in the Belloisian and the related industries, without neglecting the fact that these characteristics are not systematically sought for in the case of expeditious production.

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## FOOTNOTES

(1) This is suggested by the first spatial analyses showing differential distributions which cannot be explained by taphonomic phenomena and which, hence, certainly result from functional causes. It is equally confirmed by a fabric analysis recently carried out by A. Lenoble.

(2) Moreover, it should be remembered that this notion of semi-rotating progression has been defined in the exceptional context of the Magdalenian dwelling U5 at Étiolles (Essonne, France) in order to characterise exploitations on which: "the two flanks are occupied equally without modifying the basic organisation of the core" (Pigeot, 1987, p. 51; translation by authors). In this context, this notion hence exclusively designated strictly restrained progressions.

(3) Solely one refit complex, not taken into account because it consisted only of two big platform rejuvenation flakes (cf. *tablettes*), indicates—without being able to certify it—a return to the intersection preceding a new extension.

(4) The impact is situated at a distance of only 0.2 to 0.4 cm from the platform edge.

(5) On a small sample of refitted products: length: ± 5 to ± 15 cm; width: ± 1 to ± 4.5 cm, and thickness: ± 0.4 to ± 1.2 cm.

(6) On a small sample of refitted products: length: ± 8 to ± 15 cm; width: ± 2.5 to ± 3.5 cm, and thickness: ± 0.7 to ± 2 cm.

(7) This rich synoptic article focusing on the eponymous site La Borie del Rey (Lot-et-Garonne) contains succinct technological descriptions as well as views of cores with a very flattened flaking surface that strongly arouse our curiosity.

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