




Once upon a time...the (hi)story of the concept of the *chaîne opératoire* in French prehistory

Christophe Delage 

Department of Prehistory, National Museum of Natural History, Paris, France

ABSTRACT

The concept of the *chaîne opératoire* was popularized in the English-speaking world for the first time in the *Archaeological Review from Cambridge* in 1990. At that time, the history of the integration of this concept into French prehistory had begun. It would take a few years for this process to be successfully completed and more years for the history of research in lithic technology to take this into account. However, the concept and its history have, since the 1990s, been the subject of particularly intriguing writing and rewriting issues. This article presents the state of knowledge on this matter 1) by exposing what could be called the 'official' version of this history and 2) by correcting it with concrete historiographical facts gathered in the literature. In doing so, it also speculates on the context and motivations of scholars involved in these projects of writing the concept of the *chaîne opératoire*.

KEYWORDS

Chaîne opératoire; operational chain; lithic technology; French prehistory; Leroi-Gourhan

Introduction

In the 1970s in France, the study of lithic assemblages was dominated by a well-entrenched way of working and thinking, namely 'morphological typology' (*typologie morphologique*) with its set of analytical methods, including the type-list of retouched tools and the cumulative chart (Bordes 1950). François Bordes, of the University of Bordeaux, was the founder and one of its leading advocates. Yet not long after, in the late 1970s, a novel approach emerged, which involved various levels of analysis, aiming at finding humans behind the stone artefacts. This trend was accompanied by the enthusiastic development of new concepts and methodological tools to meet its ambitious goals. These prehistorians then discovered and became aware of the potential of the concept of the *chaîne opératoire* (operational chain) recently redefined and applied by ethnologists in line with André Leroi-Gourhan who had invented the concept in 1964. From that moment, the *chaîne opératoire* concept established itself as a rich means of investigation for studies of lithic assemblages (Karlin and David 1999, 35) and its transfer from ethnology to prehistory represents a milestone in the history of our ideas.

The concept of the *chaîne opératoire* is now well-known among prehistorians, even in the English-speaking world (Schlanger and Sinclair 1990; Tostevin 2011; see also Karlin 1992; Karlin and Julien 1994; Schlanger 1994, 2005; Sellet 1993). It provides an analytical framework through which the observer tries to bring together, within the technical time frame (from the procurement of a raw material to the abandonment of an object-tool), materials, tools and actors and their actions. A

CONTACT Christophe Delage  delage.chris@laposte.net  Department of Prehistory, National Museum of Natural History, 1, rue René Panhard, 75013 Paris, France

© 2017 Informa UK Limited, trading as Taylor & Francis Group

further step is to connect each technological (sub)system to other aspects of the socio-cultural environment.

It is perfectly normal that ideas in prehistory, behaving like fashions, as in most scientific disciplines, often fade away and are suddenly replaced by other trends. So it is not an unknown phenomenon that researchers discover specific concepts in another discipline and borrow them. Yet what is surprising is how this process took place with the *chaîne opératoire* concept. As will be seen in this paper, André Leroi-Gourhan, after the Second World War, made gradual changes in his research, increasingly focusing on prehistory rather than ethnology. If Leroi-Gourhan did not apply the concept of the *chaîne opératoire* himself – too busy with his various scientific and academic activities – why did his students and direct heirs not move in this direction before the 1980s? What was research like in the early 1980s at the time of appearance of the *chaîne opératoire* concept in prehistory? What was Leroi-Gourhan's role in the invention of this concept in the 1930s–1960s? In addition what was the evolution of this concept in the 1970s–'80s? How can we interpret recent patterns of the development of this concept from the 1990s onwards?

These intriguing questions prompted me to resume reading the literature. The approach that I chose at the start of this project was constantly to question the sources, to read as many publications as possible and eventually to question witnesses from the time. In this vein, a different reading combined with a critical analysis of the literature allowed the re-opening of the discussion by providing some new historiographical elements that shed light on these particularly crucial years; it is a different reading because official and consensual discourses on the history of this concept were rejected. New facts then appeared that altered the level of previous understanding of the scenario and that revealed a greater complexity to this history of the concept of the *chaîne opératoire*. However, this reading has raised even more questions than answers. Certain facts had been forgotten, changed or retracted. Besides these already intriguing absences, wilful behaviours of collective manipulation and falsification of the recent past can be also highlighted. Furthermore, this history of the *chaîne opératoire* concept has been associated on several occasions with convergence in the development of concepts and ways of thinking. Finally we may uncover some underlying mechanisms of French research in prehistory through the very distorted and sanitised version of a story that is now accepted by all. Since the 1990s, we have been asked to believe that there is a direct link in the concept of the *chaîne opératoire* from Leroi-Gourhan to his disciple anthropologists (notably Balfet's team, 'Comparative Technology: Materials and Manners' – 'anthropologists' throughout this paper are 'cultural anthropologists') and an indirect affiliation with his disciple prehistorians (Karlin 1992, 108). But nothing is less certain.

The time frame underlying the questions used to address this topic was followed from a more detailed and critical angle. This paper reviews first the 1980s when the concept of the *chaîne opératoire* appeared in prehistory, borrowed from ethnology; then, we follow its history through to the present; finally, we plunge back into previous decades to explore the origins and evolution of the concept in the first half of the twentieth century. Throughout the paper, we follow André Leroi-Gourhan's career, which provides a guide.

Appearance of the *chaîne opératoire* concept in archaeology/prehistory

Starting in 1986, French prehistorians described how they borrowed from ethnology the concept of the *chaîne opératoire* (Karlin, Pelegrin and Bodu 1986; Karlin, Bodu and Pelegrin 1991; Pelegrin, Karlin and Bodu 1988; see also Karlin 1992; Karlin and Julien 1994; Texier and Meignen 2012). However, this is the 'official' version. It seems that the term quietly appeared in the literature in

1979–80. One can only be amazed at the uncertainties and contradictions surrounding how this concept emerged in prehistory.

In order to try to see things a little more clearly, we take a step back and explore the decades before the 1980s, following our guide, André Leroi-Gourhan. In 1964, the Magdalenian site of Pincevent was discovered south of the Paris Basin. Leroi-Gourhan was going to devote his time and efforts to the scientific exploration of this site. A multidisciplinary group of researchers, who would take the name of *Ethnologie préhistorique* ('Prehistoric Ethnology'), created by Leroi-Gourhan in 1967 (see Baffier et al. 1988; Karlin, Pigeot and Ploux 1992; Valentin et al. 2015) was recruited to assist him and Michel Brézillon (Leroi-Gourhan and Brézillon 1966, 1972). The person in charge of the technological aspects in the study of the lithic industry was Claudine Karlin. Pincevent offered a major advantage over many other archaeological contexts of the time. Embedded in very fine and undisturbed archaeo-stratigraphic levels, *in situ* clusters of knapped flints were dug up as if the knapping activity had taken place the day before. Such a sedimentary context allowed Leroi-Gourhan to develop his 'horizontal' approach and, as a corollary, to apply fully a whole series of conceptual and methodological tools, such as spatial analysis and lithic refitting.

Such an archaeological context and the intellectual milieu in which the new generation of researchers was trained were therefore particularly favourable to the development of technological studies. Besides the close collaboration with the *Patron* (Leroi-Gourhan's nickname within his school of thought), Karlin and some of her colleagues (e.g. Francine David) also appear to have gathered regularly with anthropologists of technology, most notably Balfet's team, in the basement of the *Musée de l'Homme* (Cousin 2010; David and Karlin 2010; Digard 1979). In the 1970s, this younger generation was made aware of research and publications in cultural technology (see below). Yet the studies of the lithic assemblages at Pincevent (and at other Magdalenian sites of the Paris Basin) do not document any conceptual change resulting from this exposure. The expression *chaîne opératoire* appears only once at the time – but with no consequence – in the effort at a synthesis of stone-tool terminology and typology carried out by Brézillon (1968; see Sellet 1993). The *Ethnologie préhistorique* team thus did not look at *Évolution et techniques* (Leroi-Gourhan 1943, 1945) or *Le Geste et la parole* (Leroi-Gourhan 1964, 1965) to develop from Leroi-Gourhan's conceptual "toolboxes" an innovative theoretical and methodological framework, including the *chaîne opératoire* concept as a grid for observation and interpretation of technical facts such as flint knapping. In the context of the time, it is therefore all the more surprising – and this fact is still unexplained – that the *Ethnologie préhistorique* team did not engage in reflections along the same line as the anthropologists of technology nor did they borrow conceptual tools such as the *chaîne opératoire* earlier in the 1970s.

So what really happened in the 1970s–80s? Besides Leroi-Gourhan's school in Paris, another school of thought was created in Bordeaux in 1956 by another great figure of French prehistory: François Bordes. Bordes focused on reforming the study of lithic industries, restructuring its terminology and defining a tool typology illustrated by type-lists and cumulative charts (the 'Bordes Method'; Bordes 1950). Whereas previously specific tool types were the focus, Bordes was urging prehistorians to take into account whole tool assemblages. This approach quickly became a dogma which had a huge influence on lithic studies for several decades.

Yet it seems that neither Leroi-Gourhan's nor Bordes's school was to initiate the theoretical move towards the concept of the *chaîne opératoire*. Another scholar, Jacques Tixier, later accompanied by a team of skilled lithic specialists named the *Préhistoire et technologie* (Prehistory and Technology) team, came closest to 're-inventing' the *chaîne opératoire* concept in the 1970s. But

this was completely independently of the main currents of thought. Far from this atmosphere of intellectual competition, Tixier developed an interest in prehistory in the 1940s, while relatively isolated in Algeria (before returning to France in 1962, attached to the Laboratory of Prehistory, National Museum of Natural History, under Lionel Balout). He was initially self-taught, without a lot of publications at his disposal to inform him. Throughout his professional career, he has never been inclined to take advantage of theoretical considerations to enrich his own thinking; he was instead rather 'hands on' (Tixier 1978). He believed that the best way to advance the study of lithic industries was in the experimental practice of flintknapping. The year 1964 marked a high point in his career, with his participation in the meeting on lithic technology at Les Eyzies-de-Tayac (France) with the most experienced knappers of the time (i.e. Don Crabtree and François Bordes). The following year he attended a symposium on African prehistory in Burg-Wartenstein (Austria) to present, for the first time, his dynamic and technological approach to the study of lithic industries (Tixier 1967). His colleagues considered, almost twenty-five years later, that this publication marked the founding moment in the renewal of studies of lithic assemblages (Perlès 1991a). His (second) doctoral thesis, defended in 1978 at the University of Paris X-Nanterre, was another opportunity for Tixier to expose at length his personal views of the study of lithic assemblages. According to him, it must be possible to retrieve techniques, actions, human choices and intentions from chipped flint artefacts.

The years 1979–86 represented a turning point with the appearance (finally) of the concept of the *chaîne opératoire* in the literature. In May 1979 Tixier organized a round-table (Tixier 1980). The starting point was the 'dehumanization' of typological studies of lithic assemblages. This select meeting allowed Tixier to rally other researchers (including H. Roche, M.-L. Inizan, C. Perlès, D. Binder, M. Otte, D. Cahen, L. Meignen) to his position on lithic technology. The *chaîne opératoire* concept appeared for the first time, but still timidly on this occasion. It continued to progress very quietly the following year, particularly from the pen of Belgian prehistorian, Daniel Cahen, who would be the main scholar to contribute to the diffusion of this concept in the literature at the time (Cahen 1980; Cahen and Karlin 1980). Yet the concept was still far from being accepted by all, and it was yet to become a key methodological tool for prehistoric research. Everything at the time was still debated; the terminology was in its infancy; the concepts were not yet fixed.

Some hypotheses to describe the context of the appearance of the *chaîne opératoire* concept in the prehistoric literature in 1979–80 will now be put forward. One may legitimately ask whether such a concept could not come naturally to the mind of an experienced flintknapper and/or to someone applying a dynamic and technological approach to lithic assemblages. In this way of thinking, any lithic specialist would attempt to order actions and objects in the technological time frame. When reading Tixier we come across expressions like '*chaîne des actions de fabrication*' ('chain of manufacturing actions'; Tixier 1978, 24), '*enchaînement des techniques*' ('sequencing of techniques'; Tixier 1978, 54) and '*la somme des actions techniques dans leur ordre chronologique*' ('the sum of technological actions in their chronological order'; Tixier 1978, 71); or in Michel Dauvois, '*ordre des gestes techniques*' ('order of technological gestures'; Dauvois 1976, 194), '*idée de succession des gestes techniques*' ('the idea of succession of technological gestures' (Dauvois 1976, 195, 201); or in Cahen, '*reconstituer la chaîne des opérations*' ('to reconstruct the chain of operations'; Cahen in Van Noten et al. 1978, 59). Do we need more examples to be convinced that this intellectual trend was in process and that it was close to reaching the famous expression? With Cahen in 1980, the final accomplishment was achieved: from '*reconstituer les séquences de production*' ('to reconstruct the sequences of production'; Cahen and Karlin 1980, 1261) to the '*reconnaissance des chaînes opératoires*' ('recognition of operational chains'; Cahen and Karlin 1980,

1261). I would argue here that these prehistorians, outside the two main scientific schools of thought, 're-invented the wheel'. They found the concept of the *chaîne opératoire* again through a different intellectual pathway, without any connection to or influence from ethnology.

Thus everything was going very well in the early 1980s on the path of renewal of lithic technology paved by Tixier and his colleagues (Bon 2009, 153, fn. 1). The new *chaîne opératoire* concept looked very promising as a powerful analytical tool in the study of lithic assemblages.

Yet in 1986, a different version of the history of this concept appeared in the literature. Two research teams were involved in this process: the *Ethnologie préhistorique* team with Claudine Karlin and Pierre Bodu, and the *Préhistoire et technologie* team with Jacques Pelegrin. These three scholars together exposed their conceptual innovation in two different contexts. First, they took part in a session of the French Prehistoric Society on the theme of prehistoric technology, organized in February 1986 near Paris (Karlin, Pelegrin and Bodu 1986; Pelegrin, Karlin and Bodu 1988). Second, Karlin was involved for several years in a working group on technology, headed by Balfet at the *Musée de l'Homme* in Paris, that led to the publication of a book where one can find one of the founding papers by our three authors on the application of the concept of the *chaîne opératoire* to prehistoric lithic assemblages (Karlin, Bodu and Pelegrin 1991). In both cases, these three researchers were rather sketchy concerning the circumstances that led to the transfer of the *chaîne opératoire* concept from ethnology to prehistory. They explained that they discovered the concept following a conference on 'Cultural Technology' organized in 1982 by some anthropologists of technology. In the *Proceedings*, they emphasized a paper by Pierre Lemonnier (1983a) which became a reference for their own thinking and that of others later on.

Why such a turnaround in the writing of the history of the concept of the *chaîne opératoire*? What happened during this relatively short period from 1980 to 1986? The literature tells us very little about the exact circumstances of this transfer of the *chaîne opératoire* concept. Obviously, prehistorians discovered among ethnologists similar concerns to their own about the study of technology. They also discovered that it had a long anthropological tradition even if it was relatively marginal within this academic field (Digard 1979; Martinelli 1988; Pelras 1973). Prehistorians seemed particularly impressed by the extent of theoretical reasoning and informative achievements in the knowledge of technological matters among the anthropologists. The *chaîne opératoire* concept appeared sufficiently useful and reliable to prehistorians to be integrated within their own questions and approaches (Karlin and Julien 1994; Karlin, Bodu and Pelegrin 1991; Pelegrin, Karlin and Bodu 1988; see also Audouze 1999; Julien 1992). This concept also offered novel analytical perspectives for archaeologists. It suggested that any technological (sub-) domain (flint, bone, clay, etc.) interacts with other technological and socio-cultural areas in a systemic manner (Cresswell 1983; Lemonnier 1983a). Lemonnier (1989, 1992), among others, also emphasized another dimension – the technological representations in the actor's mind – that he considers as a fundamental feature to take into account in the understanding of any action on matter.

This atmosphere seemed very stimulating at the time. Some avenues explored by ethnologists were rapidly integrated into the field of investigations of prehistoric technologies. The papers by Karlin, Pelegrin and Bodu were supposed to illustrate this new step in the history of their discipline and to open a promising chapter in the application of the anthropological *chaîne opératoire* concept to prehistory. This trend was later illustrated by the works of Nicole Pigeot and Sylvie Ploux, who could be considered as the main scholars to carry on the theoretical framework initiated by the 1986 publications (e.g. Pigeot 1987; Ploux and Karlin 1994).

Since the 1990s

This trend, however, seemed to fade away in the early 1990s. Leroi-Gourhan retired in 1982 and died in February 1986 at the age of 74. On the ethnology side, Balfet retired in 1987; Cresswell followed in 1992. On the prehistory side, Bordes died in April 1981 at the age of 61 and Tixier retired in 1989, leaving the Parisian academic milieu suddenly and definitively. The 1980s were thus marked by the virtual disappearance of all the great figures of French prehistory. The schools of Bordeaux (Bordes) and of Tixier were particularly affected and did not survive well through these profound changes.

In October 1990, a major symposium in Antibes was organized around the theme of lithic technology (Perlès 1991b). It provided a good picture of the state of lithic research and it was supposed to become a reference point for decades and generations to come. It was organized exclusively by Tixier's team, as a gift for his retirement, and Tixier was indeed present for this great gathering of French prehistorians. Yet, beyond this pretext, it was Tixier's work and his dynamic and technological approach to lithic assemblages that were highlighted on this occasion. The organizers entitled this symposium: *25 ans d'études technologiques* (25 years of technological studies). They chose to trace the roots of modern studies of lithic technology to 1965 in a paper given by Tixier at the African prehistory conference in Burg-Wartenstein (Tixier 1967). The historical and theoretical foundations of this meeting therefore made no reference to Leroi-Gourhan and his reflections on technology.

In the early 1990s, the impact of research conducted by Tixier's team in the 1980s was still acknowledged – notably by the *Ethnologie préhistorique* team (Audouze 1992; Karlin 1992). The reference to these works quickly faded away, however, and disappeared almost completely after 2000. It seems almost inappropriate to remember that Tixier played a key role in the recent history of lithic technology (although see Audouze 2008); at most it is acceptable to mention his contribution to experimental flintknapping. One cannot help thinking that, since Tixier's retirement, his memory and work have not been valued as they should.

To the contrary, the academic context has not been the same at all regarding Leroi-Gourhan's school. In the years following his death in February 1986, numerous publications, as well as conferences, commemorated his life (e.g., Bernot 1988). Conferences and publications have also appeared occasionally since 2000. According to this literature, it appears that Audouze and Soulier for the prehistory side and Martinelli for the ethnology side are the most active 'heirs' to promote the memory of the *Patron* (Audouze 2002; Audouze and Schlanger 2004; Soulier 2015).

Anthropology of technology I: the years 1930–60

As we saw earlier, the consensual – and currently dominant – discourse tells us that Leroi-Gourhan proposed the term *chaîne opératoire* (Leroi-Gourhan 1964) as an analytical concept for the technological study of artefacts and actions (Bon 2009; Dobres 1999; Karlin 1992; Karlin and David 1999; Schlanger 1994).

Leroi-Gourhan explicitly used the term *chaîne opératoire* in *Le Geste et la parole*. Most scholars mention specifically the first volume *Techniques et langage*. Indeed it is a passage on page 164 which is regularly cited (e.g. Desrosiers 1991; Karlin 1992; Karlin and David 1999; Schlanger 1994, 2004, 2005). Here Leroi-Gourhan made the effort to propose a definition for the concept of the *chaîne opératoire*, but this was the only time in all of his work (Desrosiers 1991, 22; Karlin 1992, 108) Nevertheless, the term appears many times in the two volumes (particularly in Chapters VII

and VIII of Volume 2; Leroi-Gourhan 1965). An analysis of its various versions is rewarding. The word *chaîne* is not only used in relation to technological considerations; it appears fairly interchangeably with that of *enchaînement* (sequencing). Both terms imply a sequence, a link between different elements in the areas of human palaeontology, linguistics or cognition. They reveal a coherent rationale within Leroi-Gourhan's thinking regarding humans and humankind transcending the divisions between biology and culture or technology (Groenen 1996; Sackett 1981; Schlanger 1994).

Some scholars have subsequently tried to find an earlier anchor for the technological reflections developed in 1964 in *Le Geste et la parole*. According to Balfet, Leroi-Gourhan's assistant at the time, it seems that he had already proposed this concept of the *chaîne opératoire* in his 1952–4 courses at the *Centre de Formation aux Recherches Ethnologiques* (Balfet 1991). This view was later promulgated by scholars who had not followed his courses, but relied on Balfet's memory (Desrosiers 1991; Karlin 1992; Karlin and David 1999; Lemonnier 1992; Schlanger 2005). Was this adjustment done better to match a contemporary publication, *Guide d'étude directe des comportements culturels* (Maget 1953), interesting (but poorly known) for its methodology on – among other things – technology, objects and actions?

If some thinkers, like Marcel Mauss, one of Leroi-Gourhan's teachers, or Marcel Maget, were indeed very close to reaching the 'magic' formulation of this expression, it is particularly difficult now to prove their influence on Leroi-Gourhan. First, he was an essentially self-taught thinker (Leroi-Gourhan 1982). Thus he was not necessarily aware of all the ideas proposed by previous researchers. On this matter, he honestly believed he repeatedly reinvented the wheel. He described himself as a 'detestable bibliographer' (Leroi-Gourhan 1982); that is to say, he rarely quoted his sources or acknowledged the influence of previous researchers (Martinelli 1988; Sigaut 2010, 2012). This attitude towards his sources of inspiration has sometimes been interpreted as if Leroi-Gourhan made a clean sweep of previous knowledge and was solely responsible for the thoughts and ideas he advanced (Sigaut 1990).

Was Leroi-Gourhan really aware of the methodological potential and the heuristic value held by the concept of the *chaîne opératoire*? In retrospect one must doubt it. His major works are full of ideas and reflections related to a multitude of fields, which all have in common the focus on humans. Therefore, Leroi-Gourhan had 'lucky' visions: he initiated many promising avenues of research and he condensed many ideas and thoughts in his writings (Mahias 1994, 189; Martinelli 1988, 62, 63, 85). However, he never had the time or the opportunity to explore fully all of his many insights (Desrosiers 1991; Hall 2011; Lemonnier 2011). It is also possible, as some have suggested, that he did not perceive the heuristic potential of many of the concepts that he 'threw' in the 'mix of a page' (David and Karlin 2010, 153; Karlin 1992, 108).

Leroi-Gourhan clearly promulgated the term *chaîne opératoire* in 1964. We should also accept the fact that he had started to use the expression a decade earlier, in the early 1950s. Yet are these arguments sufficient for some contemporary scholars to claim that he is solely responsible for the authorship of this concept? This question is all the more justified now that some voices have questioned this position or have suggested it should be more nuanced, highlighting other possible contemporary thinkers and their ideas. At the time, and more generally through to the 1960s, other scholars were involved in studies of technology. Bertrand Gille's contribution was highlighted by Lemonnier (1983b); Sigaut (1987, 1993, 2012) acknowledged Reuleaux's work (and his 'kinematic chain') in the late nineteenth century and that of Haudricourt in the twentieth century (among others); Marcel Mauss is also now emphasized thanks to Schlanger (1991), Dobres (1999) and Sigaut (2012); Desrosiers (1991) gave some credit to Marcel Maget, who had previously

been mentioned by Balfet (1975) and, briefly, by Karlin and her colleagues (1986, 1991). As François Sigaut regularly notes, further historiographical research is needed to clarify the contribution of each thinker and their relationships, and possibly to discover other scholars.

What to think then of all the foregoing considerations? Is the *chaîne opératoire* really a great idea conceived by a brilliant thinker (Leroi-Gourhan), as the current literature leads us to think? Some divergent opinions now provide clues that the situation might be more complex than it seemed at first. Another, more critical reading of the literature would be required to contextualize Leroi-Gourhan's role in the invention of the *chaîne opératoire* concept and, beyond, better to define the intellectual atmosphere surrounding his work in the years 1930–60. Nevertheless, if other thinkers had, independently, come up with quite a similar dynamic vision of the study of technology through different intellectual and academic pathways, then we are entitled to ask why the currently dominant discourse needs a single iconic figure as anchor to its history and why it attributes the concept of the *chaîne opératoire* retrospectively only to Leroi-Gourhan. We shall try further to explore what Leroi-Gourhan implemented that made his work in particular stay alive and last.

Anthropology of technology II: the years 1960–80

We shall now try to trace the evolution and descent of this concept over the years 1960–80. To do so, let us again go back a few decades for context. The Second World War caused a great fracture in the French academic world with the death of many intellectuals and a profound halt to the transmission of collective memory. In 1945, former students of Marcel Mauss, including Claude Lévi-Strauss, Georges-Henri Rivière, André Leroi-Gourhan, Michel Leiris and Georges Balandier, meant to have careers as honourable as that of their teacher. Leroi-Gourhan, who was 34 years old, saw himself as an actor in this renewal, an actor who had an ambitious plan (Cleuziou et al. 1991). He divided his time between Paris and Lyon, and between different institutions: the University of Lyon and the *Musée de l'Homme*. Thus his life and career were very busy. He finally returned to Paris in 1956 to teach first at the Institute of Ethnology at the University of Paris and then at the Collège de France, from 1969 to 1982.

Among his most promising students from the start, Hélène Balfet seemed quickly to stand out. Leroi-Gourhan entrusted her with important professional and institutional responsibilities (Cousin 2010; Grognet 2010). Soon Balfet was virtually alone in carrying out Leroi-Gourhan's ethno-technology programme. Attached to the *Musée de l'Homme*, she led many distinct activities simultaneously: management of collections, preparation of exhibitions, preparation of the new hall on arts and technology (opening in 1959), teaching, study trips and research on pottery, cooking, clothing and basketry (Cousin 2010; Grognet 2010; Pelras 2010). In the early 1970s, she surrounded herself with scholars from diverse backgrounds but with similar concerns about ethno-technology to form a group that remained informal until 1984 (Cousin 2010; Pelras 2010).

Her first technological interest, in the years 1950–60, focused on pottery, from both archaeological and ethnographical viewpoints (Balfet 1965, 1966, 1973). Balfet mastered the description of the different steps of production and use of pots, as well as their more typological aspects. She spoke of 'manufacturing process' and 'technological processes'. The concept of the *chaîne opératoire* was not yet present in her writings. *Évolution et techniques* (Leroi-Gourhan 1943, 1945) was her main source of inspiration. Similarly, a 1973 article and her significant contribution on *Technologie* (Balfet 1975) illustrated Leroi-Gourhan's work and thinking. The *chaîne opératoire* concept appeared only in 1973; and as yet it was used quite timidly, associated with terms such as

chaînes techniques, opération technique, chaîne gestuelle (Balfet 1973, 120, 121, 1975, 52, 53, 66, 68; Pelras 1973). It was not yet the subject of distinct methodological or historical considerations.

At that same time the concept of the *chaîne opératoire* finally attracted the attention of other anthropologists of technology. One of the leading characters in this picture was the American anthropologist, Robert Cresswell, who chose to settle and live in France after the Second World War. He was also a former student and trusted colleague of Leroi-Gourhan (Bensa and Cresswell 1996; Guille-Escuret 1999; Jamard, Montigny and Picon 1999). In a seminal 1972 paper, he brought up the term *chaîne opératoire* on several occasions and provided a new definition for it (Cresswell 1972). In 1974 he founded his own research group *Techniques et Culture*, which also aimed at addressing the issue of technology concurrently with Balfet's informal group.

Why did it take decades of latency from the Second World War for Leroi-Gourhan's technology programme to be finally exploited? First, Leroi-Gourhan and Balfet were busy with a wide range of activities and working in locations remote from Paris (Lyon until 1956 for Leroi-Gourhan; Aix-en-Provence from 1969 for Balfet). Such a situation was unlikely to enhance significant methodological advances. In the same vein, Leroi-Gourhan's generation was the last one with an encyclopaedic mind, mastering extensive knowledge in several intellectual fields. Thus, if Leroi-Gourhan was passionate about technology and material culture, he also kept an open mind towards other areas of scientific thinking (biology, palaeontology, prehistory, art, linguistics and so on) (Groenen 1996; Schlanger 1994). By contrast, the following generation of researchers demonstrated a focus specifically on technology. In other words, their aims were to produce significant scientific advances, along with a focus on specific issues, and an environment conducive to debates and intense discussions, and, finally scientists. These conditions finally came together in the mid-1970s. In previous decades, the *Centre National de la Recherche Scientifique*, in particular, recruited many anthropologists. Thus the very exclusive and specialized field of cultural technology was set up in a configuration with two teams (Balfet's and Cresswell's; see Lemonnier 2011).

We may assume thereby that this intellectual and academic emulation led to the revival of this sub-discipline. The *Techniques et Culture* team quickly took matters in hand. With this momentum, it created a journal of the same name. Three issues came out from 1976 to 1978. The first issue certainly impressed the small community of anthropologists of technology at the time, with several theoretical and methodological papers specifically on the *chaîne opératoire*. Cresswell's contribution offered the first operative definition – recognized as such by many (e.g. Karlin 1992; Lefebvre 1999) – of the concept of the *chaîne opératoire*. Thus Cresswell (and his team) should be clearly acknowledged for the methodological and theoretical developments underlying this concept (Guille-Escuret 1999; Jamard, Montigny, and Picon 1999; Schlanger 1994).

Historiographical patterns of a production of scientific knowledge: histories of the concept of the *chaîne opératoire*

Statement

Some would have us believe that there is a direct link of the concept of *chaîne opératoire* from Leroi-Gourhan ('founding father') to his disciple anthropologists (notably Balfet's team, *Technologie Comparée: Matières et manières*) and an indirect descent to his prehistorian disciples of the *Ethnologie préhistorique* team (Karlin 1992). However, as we have shown, the situation is actually much more complex. This story is already contradictory in itself for the prehistory side. Yet even on the ethnology side the connection is neither simple nor direct as we have seen. A concept of the

chaîne opératoire is reconstructed as appearing in a confusing academic context, disappearing for a decade, reappearing through the conjunction of two ehnology teams (not to disappear again in this branch), and being borrowed along the way by prehistorians very much attracted by such a powerful heuristic tool.

Project of rewriting of the concept history

To move forward, it may be advantageous here to perform a comparison of these two (hi)stories: the official and consensual version since the 1990s and the one reconstructed here, much more intertwined and complex. This revised version covers scholars of the first generation (ancestors, founding fathers) and the generations of disciples and heirs. By contrast, the official version is very simplified and this simplification goes along with a profound reductionism.

The impression can be gained that a new historiographical programme was gradually put together during the second half of the 1980s, and then implemented from the early 1990s (perhaps from 1992?). This project was carried on by some specific actors, namely disciples and heirs of Leroi-Gourhan's work and thinking, particularly those of the prehistory branch. This ambitious programme translated first into a writing project that applied specifically to the concept of the *chaîne opératoire* and to Leroi-Gourhan's place and role in its story.

Why did this *chaîne opératoire* concept arouse so much attention – perhaps even discomfort – in the milieu of French prehistory in the 1980s? Chipped flints, due to their hardness and resistance to natural agents, are the most common archaeological remains exhumed during fieldwork. Flint has thus acquired a value and an interest that may outweigh other remains in the training of researchers and in academia. In France, we find two major post-war figures who established their own 'school of thought' about the study of lithics: François Bordes and Jacques Tixier; Leroi-Gourhan held a very marginal position in this picture. While Tixier's colleagues paid tribute to his exemplary contribution to technological studies of stone industries at the 1990 symposium in Antibes and tried to demonstrate that this type of research was initiated twenty-five years earlier with Tixier's seminal publication, one may wonder if Tixier's team was not writing its own (hi)story, with its 'hero', its specific dates and events, its actors. Might we see here a means used by this team to keep some influence in the field?

If this was the case, the *Ethnologie préhistorique* team could not possibly agree. A different story of research on lithic assemblages was soon put forward, in which the concept of the *chaîne opératoire* and its 'inventor', André Leroi-Gourhan, held a key position. This new (hi)story developed at the expense of many actors, events, dates, ideas, etc. It was no longer a simple writing project, but an ambitious programme of re-writing the history of the concept of *chaîne opératoire*. In this context, one may wonder if research was not directed at the time towards the emphasis on a 'hero', and only one hero. This hero was particularly well embodied by Leroi-Gourhan. An exemplary personal life: orphaned, self-taught, embarking on working at the age of 14 and eventually reaching the highest peaks of French academia (*Collège de France, Institut*). Scientifically, he developed all aspects of French prehistory to turn it into a modern and more rigorous field: excavation techniques, spatial analysis, art and aesthetics, technology, ethnicity, evolution and so on. We might be dimly aware that he owed some debt towards this or that person or school of thought, such as the Soviet school of excavation for the *décapage horizontal*, or Max Raphaël and Annette Laming on Palaeolithic art, etc., but nobody now seems to want to hear about it. The truth is far less important than the narrative. In terms of technology and the *chaîne opératoire* concept, this official discourse was, in the 1990s, to relocate Leroi-Gourhan

centre-stage by giving him a unique place in the genealogy of thinkers on technology and the genealogy of this concept (Karlin, Bodu and Pelegrin 1991).

An interesting phenomenon in the history of science is the convergence of ideas and advances of research. In the history of the concept of the *chaîne opératoire*, as proposed here, we can recognize two moments – rare enough to be reported – of convergence of ideas and research on technology. Let us dwell a moment on the first of these moments (the other one being in 1979–80 when Tixier's team rediscovered the *chaîne opératoire* concept), which roughly corresponds to the early twentieth century. At that time, many thinkers on technology held views presenting similar concerns, notably a dynamic view on the technological changes that a material may undergo from its raw state to tools and their use. From this perspective, it is in fact wrong to look for the first author who put in writing the term *chaîne opératoire*. It is much more than an expression; it is about a vision – dynamic and systemic – of human behaviour, with a whole theoretical and methodological array of descriptive and analytical tools on all sorts of actions on matter. Thus it seems rather problematic to attribute the authorship of the concept of the *chaîne opératoire* to a particular person. A single scholar or a specific work alone cannot crystallize all the views available on technology. The era under consideration here appears in retrospect as an academic and intellectual environment particularly favourable to ideas on technology, from an ethnological, sociological or historical viewpoint (Karsenti 2011; Knittel 2011).

The project of rewriting the concept of the *chaîne opératoire* by the *Ethnologie préhistorique* team resulted in polishing and smoothing out the descent and evolution of this concept, and at the same time it erased these singular moments of convergence of ideas.

Conclusion

By investigating this history, I had no ambition other than to get acquainted with facts which I had not known in order to better understand the present state of research in lithic technology. It turned out that many stories existed about the concept of the *chaîne opératoire*, all more or less mutually consistent. I had never thought my reading would lead me to so many chronological and factual inconsistencies. The version of the (hi)story of the *chaîne opératoire* concept proposed here is based on a critical reading of the literature that helped single out several events spanning almost the entire twentieth century. As the facts that may interest us in particular are often unexpectedly present in the middle of a page, embedded in the body of the text, in footnotes, etc., there is no claim here to have covered the entire literature concerned with the topic.

One must be well aware that this is only a very preliminary approach to the history of this concept. Many gaps remain unfilled and therefore much research is still needed to present a more realistic and coherent story. In this sense, any reading of a newly located publication, which could contain additional information, is a test potentially to validate the scenario presented. So far each such test has been positive, allowing consolidation and deepening of the historical framework of the concept of the *chaîne opératoire*. One can thus be confident that the story, even if partial, is consistent with the reality of the events as they took place during the past century.

We must not forget that humans make history, their own history, a history written in the present. But humans and their societies are also interested in their past and often display selective memory. Do scholars act differently? Different views of science and scientists coexist at present. One of them, with which I concur, considers that researchers are not abstract beings, without feelings or religious, political, or cultural opinions. These intertwined aspects of a personality may shade and influence anyone's choices and feelings about research design or the paradigms

implemented in research. But can a scientist go any further? Would s/he be able to manipulate objective data for certain purposes? If so, which ones? What could justify the manipulation of data and writings about the past? This would necessitate correcting, rectifying a particular setting for it to become consistent with a particular view, advocated by one or more persons. In such cases it would be done in order to maintain a system of thought already existing in the academic and scientific world. The 'official' (hi)story of the concept of the *chaîne opératoire* now seems quite revealing of such practices. It is clear that we are dealing with a well-organized group with a celebrated ancestor, André Leroi-Gourhan, whose disciples and students must maintain and reproduce his memory and ideas. But ultimately to what end?

Acknowledgements

I would like to thank Matthew Spriggs and Tim Murray, coordinators of this issue, for their support and patience in the final stages of completion of this article. Matthew Spriggs, Louise Shewan and two anonymous reviewers helped considerably with their suggestions to improve my text. Sylvie Brignon also greatly helped with my writing by her presence and good humour. This is a difficult topic to deal with; thus the opinions expressed are solely mine and my full responsibility.

Disclosure statement

No potential conflict of interest was reported by the author.

Notes on contributor

Christophe Delage, PhD, 2001, University of Paris 1-Sorbonne, is a specialist in lithic raw material sourcing in the Southern Levant. He has been working for the past twenty-five years in Northern Israel (Galilee) and Jordan (Azraq Basin, Central Jordan Valley) on mapping chert sources, and, with that experience and knowledge, he has analysed archaeological lithic assemblages from the Acheulian (Gesher Benot Yaaqov) to the Neolithic (Munhata) with a strong emphasis on the Natufian (Hayonim, Eynan, Wadi Hammeh 27) for documenting strategies of lithic procurement through time in that specific region. He has edited two books (*The Last Hunter-Gatherers in the Near East*, BAR International Series 1320, Oxford: John and Erica Hedges, 2004; *Chert Availability and Prehistoric Exploitation in the Near East*, BAR International Series 1615, Oxford: John and Erica Hedges, 2007) and published various articles on these topics.

ORCID

Christophe Delage  <http://orcid.org/0000-0002-9707-2291>

References

- Audouze, F. 1992. "L'héritage de Leroi-Gourhan en préhistoire." *Les Nouvelles de l'Archéologie* 48–49: 48–52.
- Audouze, F. 1999. "New Advances in French Prehistory." *Antiquity* 73: 167–175. doi:10.1017/S0003598X00087986.
- Audouze, F. 2002. "Leroi-Gourhan, a Philosopher of Technique and Evolution." *Journal of Archaeological Research* 10 (4): 277–306. doi:10.1023/A:1020599009172.
- Audouze, F. 2008. "Trente ans après Leroi-Gourhan, où en sont les paléolithiciens?" *Archéopage* 9–11. Hors-série.
- Audouze, F., and N. Schlanger, eds. 2004. *Autour de l'homme. Contexte et actualité d'André Leroi-Gourhan*. Antibes: A.P.D.C.A.

- Baffier, D., F. David, G. Gaucher, and M. Orliac. 1988. "André Leroi-Gourhan et l'ethnologie préhistorique." In *Les voies de l'homme, hommage à André Leroi-Gourhan*, 27–49. Paris: Albin Michel.
- Balfet, H. 1966. "La céramique comme document archéologique." *Bulletin de la Société Préhistorique Française* 63 (2): 279–310. doi:10.3406/bspf.1966.4071.
- Balfet, H. 1973. "A propos du tour de potier. L'outil et le geste technique." In *L'Homme, Hier et Aujourd'hui. Recueil d'études en hommage à A. Leroi-Gourhan*, edited by M. Sauter, 109–122. Paris: Cujas.
- Balfet, H. 1991. "Des chaînes opératoires, pour quoi faire?" In *Observer l'action technique. Des chaînes opératoires, pour quoi faire ?* edited by H. Balfet, 13–19. Paris: Éditions du CNRS.
- Balfet, H. 1975. "Technologie." In *Éléments d'ethnologie. 2 Six approches*, edited by R. Cresswell, 44–79. Paris: Armand Colin.
- Balfet, H. 1965. "Observations ethnographiques en Afrique du Nord et interprétation archéologique." In *Ceramics and Man*, edited by F. R. Matson, 161–177. Chicago: Aldine.
- Bensa, A., and R. Cresswell. 1996. "À propos de la technologie culturelle. Entretien avec Robert Cresswell." *Genèses* 24: 120–136. doi:10.3406/genes.1996.1404.
- Bernot, L., ed. 1988. *André Leroi-Gourhan ou les voies de l'homme. Actes du colloque du CNRS, mars 1987*. Paris: Albin Michel.
- Bon, F. 2009. *Préhistoire. La fabrique de l'homme*. Paris: Éditions du Seuil. (L'Univers historique).
- Bordes, F. 1950. "Principes d'une méthode d'étude des techniques de débitage et de la typologie du paléolithique ancien et moyen." *L'Anthropologie (Paris)* LIV (1–2): 19–34.
- Brézillon, M. 1968. *La dénomination des objets de pierre taillée: matériaux pour un vocabulaire des préhistoriens de langue française*. Paris: Éditions du CNRS. (IVe supplément à Gallia Préhistoire).
- Cahen, D. 1980. "Question de contemporanéité : L'apport des remontages." *Bulletin de la Société Préhistorique Française* 77 (8): 230–232.
- Cahen, D., and C. Karlin. 1980. "Les artisans de la préhistoire." *La Recherche* 11 (116): 1258–1268.
- Cleuziou, S., A. Coudart, J.-P. Demoule, and A. Schnapp. 1991. "The Use of Theory in French Archaeology." In *Archaeological Theory in Europe. The Last Three Decades*, edited by I. Hodder, 91–127. London: Routledge. (Material Cultures).
- Cousin, F. 2010. "Le département de technologie comparée du musée de l'Homme et Hélène Balfet." In *Matières, manières et sociétés. Hommage à Hélène Balfet*, edited by F. Cousin and C. Pelras, 51–53. Aix-en-Provence: Publications de l'Université de Provence.
- Cresswell, R. 1983. "Transfert de techniques et chaînes opératoires." *Techniques et Culture* 2: 143–163.
- Cresswell, R. 1972. "Les trois sources d'une technologie nouvelle." In *Langues et Techniques. Nature et Société*, edited by J. Thomas and L. Bernot, 21–27. Paris: Klincksieck.
- Dauvois, M. 1976. *Précis de dessin dynamique et structural des industries préhistoriques*. Périgueux: Fanlac.
- David, F., and C. Karlin. 2010. "De l'ethnologie préhistorique à l'ethno-archéologie." In *Matières, manières et sociétés. Hommage à Hélène Balfet*, edited by F. Cousin and C. Pelras, 153–163. Aix-en-Provence: Publications de l'Université de Provence.
- Desrosiers, S. 1991. "Sur le concept de chaîne opératoire." In *Observer l'action technique. Des chaînes opératoires, pour quoi faire?* edited by H. Balfet, 21–25. Paris: Éditions du CNRS.
- Digard, J.-P. 1979. "La technologie en anthropologie : fin de parcours ou nouveau souffle?" *L'Homme* 19 (1): 73–104.
- Dobres, M.-A. 1999. "Technology links and chaînes: The processual unfolding of technique and technician." In *Making Culture: Essays on Technological Practice, and World Views*, edited by M.-A. Dobres and C. R. Hoffman, 124–146. Cambridge: MIT Press.
- Groenen, M. 1996. *Leroi-Gourhan. Essence et contingence dans la destinée humaine*. Bruxelles: De Broeck Université. (Le Point philosophique).
- Grognet, F. 2010. "Les deux "vies" de la salle des Arts et Techniques." In *Matières, manières et sociétés. Hommage à Hélène Balfet*, edited by F. Cousin and C. Pelras, 55–63. Aix-en-Provence: Publications de l'Université de Provence.
- Guille-Escuret, G. 1999. "Les verrous de la culture et la dérive des idées." In *Dans le sillage des techniques. Hommage à Robert Cresswell*, edited by J.-L. Jamard, A. Montigny, F.-R. Picon, and S. Fitoussi, 173–194. Paris: L'Harmattan.

- Hall, I. 2011. "Invitation à suivre les ignames et les moutons." In *Penser le concert : André Leroi-Gourhan, André-Georges Haudricourt, Charles Parain*, edited by N. Barre and J.-F. Bert, 197–208. Paris: CreaphisÉditions. (Collection Silex).
- Jamard, J.-L., A. Montigny, and F.-R. Picon. 1999. "Préambule." In *Dans le sillage des techniques. Hommage à Robert Cresswell*, edited by J.-L. Jamard, A. Montigny, F.-R. Picon, and S. Fitoussi, 5–8. Paris: L'Harmattan.
- Julien, M. 1992. "La technologie et la typologie : du fossile directeur à la chaîne opératoire." In *La préhistoire dans le monde*, edited by J. Garanger, 163–193. Paris: Presses Universitaires de France. (Nouvelle Cléo: L'histoire et ses problèmes).
- Karlin, C., P. Bodu, and J. Pelegrin. 1991. "Processus techniques et chaînes opératoires. Comment les préhistoriens s'approprient un concept élaboré par les ethnologues." In *Observer l'action technique. Des chaînes opératoires, pour quoi faire?* edited by H. Balfet, 101–117. Paris: Éditions du CNRS.
- Karlin, C., and F. David. 1999. "Des chasseurs de rennes magdaléniens aux chasseurs de rennes sibériens ou de la chaîne opératoire à l'enquête ethnoarchéologique." In *La pierre taillée: ressources, technologies, diffusion. Séminaire du Centre d'Anthropologie, Toulouse, 1996*, edited by F. Briois and V. Darras, 35–42. Toulouse: École des Hautes Études en Sciences Sociales. (Archives d'Écologie Préhistorique).
- Karlin, C., and M. Julien. 1994. "Prehistoric Technology: A Cognitive Science?" In *The Ancient Mind: Elements of Cognitive Archaeology*, edited by C. Renfrew and E. B. W. Zubrow, 152–164. Cambridge: Cambridge University Press. (New Directions in Archaeology).
- Karlin, C. 1992. "Connaissances et savoir-faire : comment analyser un processus technique en préhistoire. Introduction." In *Tecnología y cadenas operativas líticas, reunión internacional, 15-18 enero de 1991*, edited by R. Mora, X. Terradas, A. Parpal, and C. Plana, 99–124. Bellaterra: Departament d'Història de les Societats Pre-capitalistes i d'Antropologia Social, Universitat Autònoma de Barcelona. (Treballs d'Arqueologia, 1).
- Karlin, C., J. Pelegrin, and P. Bodu. 1986. "Processus technique et chaînes opératoires : un outil pour le Préhistorien." *Bulletin de la Société Préhistorique Française* 83 (3): 66–67.
- Karlin, C., N. Pigeot, and S. Ploux. 1992. "L'ethnologie préhistorique." *La Recherche* 247 (23): 1106–1116.
- Karsenti, B. 2011. *L'homme total. Sociologie, anthropologie et philosophie chez Marcel Mauss*. 1st ed 1997. Paris: Presses Universitaires de France. (Quadrige).
- Knittel, F. 2011. "Histoire et agronomie. Une recherche pluridisciplinaire pour une histoire technologique de l'agronomie." In *Penser le concert : André Leroi-Gourhan, André-Georges Haudricourt, Charles Parain*, edited by N. Barre and J.-F. Bert, 129–146. Paris: CreaphisÉditions. (Collection Silex).
- Lefebvre, B. 1999. "Techniques, robots et chaînes opératoires." In *Dans le sillage des techniques. Hommage à Robert Cresswell*, edited by J.-L. Jamard, A. Montigny, F.-R. Picon, and S. Fitoussi, 333–347. Paris: L'Harmattan.
- Lemonnier, P. 1983a. "L'étude des systèmes techniques : une urgence en technologie culturelle." *Techniques et Culture* 1: 11–34.
- Lemonnier, P. 1983b. "À propos de Bertrand Gille : la notion de "système technique"." *L'Homme, Revue française d'anthropologie* XXIII (2): 109–115.
- Lemonnier, P. 1992. *Elements for an Anthropology of Technology*. Ann Arbor, MI: The University of Michigan, The Museum of Anthropology. (Anthropological Papers, 88).
- Lemonnier, P. 2011. "Fallait-il en passer par là ? Du grand silence des forces productives en anthropologie marxiste aux joies de la technologie culturelle rénovée." In *Penser le concert : André Leroi-Gourhan, André-Georges Haudricourt, Charles Parain*, edited by N. Barre and J.-F. Bert, 81–98. Paris: CreaphisÉditions. (Collection Silex).
- Lemonnier, P. 1989. "Bark Capes, Arrowheads, and Concorde: On Social Representation of Technology." In *The Meaning of Things: Material Culture and Symbolic Expressions*, edited by I. Hodder, 156–171. London: Unwin Hyman. (One World Archaeology, 13).
- Leroi-Gourhan, A. 1943. *Évolution et techniques. L'homme et la matière*. Paris: Albin Michel.
- Leroi-Gourhan, A. 1945. *Évolution et techniques. Milieu et techniques*. Paris: Albin Michel.
- Leroi-Gourhan, A. 1964. *Le Geste et la parole. I : technique et langage*. Paris: Albin Michel.
- Leroi-Gourhan, A. 1965. *Le Geste et la parole. II : la mémoire et les rythmes*. Paris: Albin Michel.
- Leroi-Gourhan, A. 1982. *Les Racines du monde. Entretiens avec Claude-Henri Rocquet*. Paris: Belfond.
- Leroi-Gourhan, A., and M. Brézillon. 1966. "L'habitation magdalénienne n°1 de Pincevent près Montereau (Seine-et-Marne)." *Gallia Préhistoire* IX (2): 263–385. doi:10.3406/galip.1966.1264.

- Leroi-Gourhan, A., and M. Brézillon. 1972. *Fouilles de Pincevent. Essai d'analyse ethnographique d'un habitat magdalénien (La section 36)*. Paris: Éditions du CNRS. (VII^e Supplément à Gallia Préhistoire).
- Maget, M. 1953. *Guide d'étude directe des comportements culturels*. Paris: Civilisations du Sud. (Ethnographie métropolitaine).
- Mahias, M.-C. 1994. "Façonnage de l'argile et de la société en Inde. Une approche ethnologique des techniques." In *De la préhistoire aux missiles balistiques. L'intelligence sociale des techniques*, edited by B. Latour and P. Lemonnier, 187–201. Paris: Éditions La Découverte. (Recherches).
- Martinelli, B. 1988. "Après André Leroi-Gourhan: les chemins de la technologie." In *André Leroi-Gourhan ou les voies de l'homme. Actes du colloque du CNRS, mars 1987*, edited by L. Bernot, 62–89. Paris: Albin Michel.
- Pelegrin, J., C. Karlin, and P. Bodu. 1988. "Chaînes opératoires : un outil pour le préhistorien." In *Technologie Préhistorique*, edited by J. Tixier, 55–62. Paris: Éditions du CNRS. (Notes et Monographies Techniques, 25).
- Pelras, C. 1973. "Technologie, ethnographie, ethnologie..." In *L'Homme, Hier et Aujourd'hui. Recueil d'études en hommage à A. Leroi-Gourhan*, edited by M. Sauter, 715–729. Paris: Cujas.
- Pelras, C. 2010. "Sur "le chemin des autres". Hélène Balfet (1922-2001), ethnologue au musée de l'Homme." In *Matières, manières et sociétés. Hommage à Hélène Balfet*, edited by F. Cousin and C. Pelras, 15–35. Aix-en-Provence: Publications de l'Université de Provence.
- Perlès, C., ed. 1991a. "Introduction." In *25 ans d'études technologiques en Préhistoire: bilan et perspectives. Actes des rencontres 18-19-20 octobre 1990*, 7–10. Juan-les-Pins: Editions APDCA. (XI^e Rencontres internationales d'archéologie et d'histoire d'Antibes).
- Perlès, C., ed. 1991b. *25 ans d'études technologiques en Préhistoire : bilan et perspectives. Actes des rencontres 18-19-20 octobre 1990*. Juan-les-Pins: Editions APDCA. (XI^e Rencontres internationales d'archéologie et d'histoire d'Antibes).
- Pigeot, N. 1987. *Magdaléniens d'Etiolles. Economie de débitage et organisation sociale (l'unité d'habitation US)*. Paris: Éditions du CNRS. (XXV^e Supplément à Gallia Préhistoire).
- Ploux, S., and C. Karlin. 1994. "Le travail de la pierre au Paléolithique. Ou comment retrouver l'acteur technique et social grâce aux vestiges archéologiques." In *De la préhistoire aux missiles balistiques. L'intelligence sociale des techniques*, edited by B. Latour and P. Lemonnier, 65–82. Paris: Éditions La Découverte. (Recherches).
- Sackett, J. R. 1981. "From de Mortillet to Bordes: A Century of French Palaeolithic Research." In *Towards a History of Archaeology, Being the Papers Read at the First Conference of the History of Archaeology in Aarhus, 29 August-2 September 1978*, edited by G. Daniel, 85–99. London: Thames and Hudson.
- Schlanger, N. 1991. "Le fait technique total. La raison pratique et les raisons de la pratique dans l'oeuvre de Marcel Mauss." *Terrain, Carnets du patrimoine ethnologique* 16: 114–130.
- Schlanger, N. 2004. "Suivre les gestes, éclat par éclat : la chaîne opératoire de Leroi-Gourhan." In *Autour de l'homme : contexte et actualité d'André Leroi-Gourhan*, edited by F. Audouze and N. Schlanger, 127–147. Antibes: A.P.D.C.A.
- Schlanger, N. 2005. "The Chaîne Opératoire." In *Archaeology: The Key Concepts*, edited by C. Renfrew and P. G. Bahn, 25–31. London: Routledge.
- Schlanger, N. 1994. "Mindful Technology: Unleashing the Chaîne Opératoire for an Archaeology of Mind." In *The Ancient Mind: Elements of Cognitive Archaeology*, edited by C. Renfrew and E. B. W. Zubrow, 143–151. Cambridge: Cambridge University Press. (New Directions in Archaeology).
- Schlanger, N., and A. Sinclair, eds. 1990. "Technology in the Humanities." *Archaeological Review from Cambridge Special Issue* 9 (1): 1–186.
- Sellet, F. 1993. "Chaîne Opératoire: The Concept and Its Application." *Lithic Technology* 18 (1–2): 106–112. doi:10.1080/01977261.1993.11720900.
- Sigaut, F. 1990. "De la technologie à l'évolutionnisme : l'oeuvre de Pitt Rivers (1827-1900)." *Gradhiva* 1990-8: 20–37.
- Sigaut, F. 2012. *Comment Homo devint faber. Comment l'outil fit l'homme*. Paris: CNRS Éditions. (Collection "Biblis", Série "Le passé recomposé").
- Sigaut, F. 1993. "How Can We Analyse and Describe Technical Actions?" In *The Use of Tools by Human and Non-Human Primates. A Fyssen Foundation Symposium*, edited by A. Berthelet and J. Chavaillon, 381–397. Oxford: Clarendon Press. (Symposia of the Fyssen Foundation).

- Sigaut, F. 1987. "Haudricourt et la technologie." In *La technologie, science humaine*, edited by A.-G. Haudricourt, 9–34. Paris: Éditions de la Maison des Sciences de l'Homme.
- Sigaut, F. 2010. "Postface." In *Des gestes aux techniques. Essai sur les techniques dans les sociétés pré-machinistes*, edited by A.-G. Haudricourt, 217–224. Paris: Éditions de la Maison des sciences de l'homme/ Versailles: Éditions Quae.
- Soulier, P., ed. 2015. *André Leroi-Gourhan « l'homme, tout simplement »*. Paris: Éditions de Boccard. (Travaux de la Maison Archéologie & Ethnologie, René-Ginouvès, 20).
- Texier, P.-J., and L. Meignen. 2012. "Soixante années de technologie lithique : étapes marquantes, apports et écueils." In *François Bordes et la préhistoire*, edited by F. Delpech and J. Jaubert, 133–139. Paris: Éditions du C.T.H.S. (Documents préhistoriques, 29).
- Tixier, J. 1978. "Méthode pour l'étude des outillages lithiques." PhD Thesis. Paris: University of Paris X-Nanterre.
- Tixier, J., ed. 1980. *Préhistoire et technologie lithique. Journées du 11-13 mai 1979*. Valbonne: Éditions du CNRS. (Publications de l'URA 28, cahier 1).
- Tixier, J. 1967. "Procédés d'analyse et questions de terminologie concernant l'étude des ensembles industriels du Paléolithique récent et de l'Épipaléolithique dans l'Afrique du Nord-Ouest." In *Background to Evolution in Africa. Proceedings of the Symposium "Systematic Investigation of the African Later Tertiary and Quaternary", Held at Burg-Wartenstein, Austria, 1965*, edited by W. W. Bishop and J. D. Clark, 771–820. Chicago: University of Chicago Press.
- Tostevin, G. B., ed. 2011. "Special Issue: Reduction Sequence, Chaîne Opératoire, and Other Methods: The Epistemologies of Different Approaches to Lithic Analysis." In *PaleoAnthropology Special Issue 2011*: 293–389.
- Valentin, B., M. Olive, F. Valla, F. Audouze, S. A. De Beaune, and P. Soulier. 2015. "Où en est l'ethnologie préhistorique?" In *André Leroi-Gourhan, « L'homme, tout simplement »*, edited by P. Soulier, et al. Paris: Éditions de Boccard. (Travaux de la MAE, René-Ginouvès, 20).
- Van Noten, F., D. Cahen, L. H. Keeley, and J. Moeyersons. 1978. "Les Chasseurs de Meer." *Dissertationes Archaeologicae Gandenses*, XVIII. Brugge: De Tempel.

Copyright of World Archaeology is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.