

The *Chaîne Opératoire*: Past, Present and Future

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INTRODUCTION: THE REASON BEHIND THIS VOLUME

The *chaîne opératoire* was initially popularised amongst Anglophone academia in the Archaeological Review from Cambridge (ARC) in 1990 (Sinclair and Schlanger 1990). This volume laid the fundamental theoretical foundations for the *chaîne opératoire* in the Anglophone world. Since then, another volume of the ARC re-visited the concept in which Gravina (2006) and the edited collection of articles therein highlighted the development of the *chaîne opératoire* as a theoretical model with papers highlighting new approaches to the study of technology. In particular, the volume explored the post-processual influences upon technological studies and the application of the *chaîne opératoire* alongside alternative theoretical paradigms as well as the relationship between technological studies and practice theory, social agency and lived experiences. This current edition of the ARC (35.1) is significant in marking 30 years since the original Schlanger and Sinclair volume (1990); an apt time to revisit this concept in light of its current popularity and the development in its application toward archaeological material culture.

THE CHAÎNE OPÉRATOIRE: GENESIS AND PAST DEVELOPMENTS

The *chaîne opératoire* as a methodological concept stems from Mauss and Leroi-Gourhan (though see Delage 2017 for alternative views). Mauss (1872-1950) argued that technical gestures are conscious and deliberate, a transmitted *habitus* or a way of doing (Mauss 1936 [cited in Schlanger 1994: 144]) whilst maintaining that these gestures are socially and historically context-dependant and cannot be investigated in isolation from one-another (Martinón-Torres 2002: 30). He also asserted that magical/ritual acts should be classified as technical, as they are all “technical acts with tangible effects that can be assessed and described” (Mauss 1935; Cited in Warnier 2009: 460).

These initial discussions were taken up by Leroi-Gourhan (1911-1986) who introduced the term into French ethnography. He used the term ‘*chaîne opératoire*’ throughout the 1950s and in 1964 specifically defined the term as techniques which: “involve both gestures and tools, organised in a chain by a veritable syntax that simultaneously grants to the operational series their fixity and flexibility” (Leroi-Gourhan 1964: 164 [cited in Schlanger 2005: 27]). For Leroi-Gourhan, these *chaînes* constitute cultural building blocks, socio-culturally conditioned from a young age whereby repetition of motor actions become entrenched within the subconscious of the apprentice. Because these actions are culturally specific, they are a founding ideal for what archaeologists recognise as ‘style’, even when the user finds themselves transplanted into a different cultural environment (White 1993: xviii; Leroi-Gourhan 1964, 1993: 232).

The *chaîne opératoire* puts import upon the initial stages of the history of an artefact, particularly the sequential procurement of raw materials and the fashioning of them into finished objects with the human action upon these raw materials being the key aspect within this transformation (Schlanger 1994: 144, 2005). The focus upon the production stages of objects stood in contrast to more traditional Culture-Historical archaeologies which tended to focus upon the final artefacts (Martinón-Torres 2002: 31). Yet the biography of an artefact does not end with its completion. We must consider the successive re-use of these artefacts and the additional, subsequent steps in the *chaîne* (Martinón-Torres 2002: 33). For instance, the re-shaping of a lithic artefact, the re-shaping of old pottery sherds into spindle whorls or jar-stoppers, or even the grinding down of old pottery fragments into grog and their incorporation into new pottery vessels.

The 1960s to early 1990s saw the *chaîne opératoire* predominantly, though not exclusively, maintained within lithic-centred archaeologies within francophone academia (Balfet 1972; Cahen and Karlin 1980; Cresswell 1972; Pelegrin et al. 1988; Tixier 1978). Arguably this was due to the rise of new archaeology where material culture studies declined in popularity, and were criticised as normative approaches with technology viewed as an “extrasomatic means of adaptation” (Binford 1962).

Additionally, lithic studies focussed upon the ‘reduction sequence’ – the removal of matter, which is inappropriate for other material culture where adding material is part of the production process (Audouze 2002: 287). Many *chaîne opératoire* studies of this period were primarily concerned with ascertaining the steps within a linear decipherment of the operational sequence, and highlighting the constraints within which the manufacturing process was contained (van der Leeuw 1993: 238). However, *chaînes* are non-linear (Schlanger 2005: 28), and are often interlinked within the *chaînes* of other material culture (Cresswell 1983, Lemonnier 1983 [both cited in Delage 2017] Shimada 1999 [cited in Sillar and Tite 2000]). It is only through realisation of this, and a consideration of the overall context, that the technological choices and these *chaînes* may be explainable and understood (Sillar and Tite 2000: 4).

Schiffer’s behavioural chain (1972; 1976) has very close affinities with the *chaîne opératoire*. Despite separate inventions of both concepts, one originating from processual archaeology and the other from ethnology, it is clear that the two methodologies feature similar approaches and outcomes yet differ in their theoretical stance and their application (Sellet 1993: 107; Skibo 2013: 8). Both approaches focus upon artefact production. However, the *chaîne opératoire* is primarily concerned with material sourcing and the manufacturing process alongside the transmission of inherited knowledge whilst the behavioural chain includes aspects of artefact use, reuse and discard to thus create an artefact biography (Skibo 2013: 8).

The publication of *Technological Choices* (Lemonnier 1993) marked a significant coming together of the different strands within *chaîne opératoire* studies following the division of material cultural variability and studies into discrete realms of

technology, function and style under the New Archaeology (Stark 1998). Lemonnier differentiated between the branches of the *chaîne opératoire*, highlighting the ‘strategic tasks’; those fundamental aspects related to the completion of the craft, and ‘technical variants’ which held socio-culturally embedded importance, yet which were subjective to the completion of the manufacturing process. Broadly however, the volume argued that technological choice and technological style cannot/should not be studied in isolation, but are inextricably connected, complementary techniques and thus gives the technique a more central role within archaeological research.

The concept of ‘technological style’ (Lechtman 1977) is closely linked with the *chaîne opératoire*. Here, ‘style’ is present within each stage of the technological process, which in itself can be applied to understand material reflections of a group/individual identity (Stark 1998) through aspects relating to distinctions/similarities in their habitus through the transmission of esoteric knowledge. This connectedness of technological choice and technological style was also becoming clear following the upturn in ethnographic work since the 1980s (Longacre 1981; Stark 1995, 2003) and contributing to the discourse whereby the dichotomous separation of technology, function and style does not work and there is substantial blurring of these boundaries (Schiffer and Skibo 1987, 1997; Skibo 2013): Such choices are representative of socio-culturally informed actions and a shared understanding of practice (Stark 1998: 5), and are also affected by physio-functional constraints as well as material properties (Schiffer and Skibo 1987; 1997).

The emphasis of a socio-centric approach to technology (see Lemonnier 1992, 1993 and chapters therein; Sillar and Tite 2000), alongside the transmission of inherited knowledge which the *chaîne opératoire* tends to favour, lends itself to integrated studies which include agency-based approaches to technology (Dobres and Robb, 2000, 2005) or communities of practice (Lave and Wenger 1991; Wenger 1999) and group/individual identity (Pétrequin 1993; Stark 1998) amongst others. This integrated approach has huge potential to unlock material culture-based studies “by balancing a focus of purely ideational and symbolic considerations with the recognition of the more mundane material aspects of every day undertakings” (Schlanger 2005: 28). Both these facets are fundamentally interconnected by their physical properties and the cultural perception of the availability of other options, as well as the wider socio-economic practices and norms which affect both the individual and their community (Sillar and Tite 2000). As such, the *chaîne opératoire* developed from a static linear description of stages to transform raw material into a useable object (as per Cresswell 1976, 1990) and gave real consideration to the socio-contextual importance, limitations, constraints and possibilities of the process, those individuals involved and their influence upon one-another (Sillar and Tite 2000: 4): “choices build upon choices” (Skibo 2013: 13).

THE CHAÎNE OPÉRATOIRE: PRESENT SITUATION

The early 2000s have seen amongst the most dramatic developments in the chaîne opératoire and its application within archaeology, particularly following the concepts of ‘technological styles’ (Lechtman 1977) or ‘technological choices’ (Lemonnier 1993; Sillar and Tite 2000) and the merging of these divergent trajectories following Lemonnier (1993).

The integration of the *chaîne opératoire* alongside material science (as per Sillar and Tite 2000) has encouraged real interdisciplinarity amongst *chaîne opératoire* investigations. The *chaîne opératoire* provides a testable, complimentary framework to material science (Martinón-Torres 2002: 38). Such an integrated approach has produced numerous studies of archaeometry within a framework of established archaeological theory (Martinón-Torres and Killick 2015). Sillar and Tite (2000: 16) encouraged that material scientists give greater consideration to the socio-ideological aspects related to technological choice, beyond mere functionalism.

This certainly seems to have been heeded; the plethora of investigations which follow this combined framework in recent years on a whole range of material culture is testament to this. One only has to browse the archives of the *Journal of Archaeological Science*, *Journal of Archaeological Science: Reports*, or *Archaeometry* for numerous examples of such.

Furthermore, the realisation that the *how* of making any form of material culture is informed as much by technological considerations as cultural ones has meant that the *chaîne opératoire* approach is now used to infer more socially and culturally dependent aspects of material culture. This is also very much a result of the material turn (for example Ingold 2007) and the shift in perception of the relationship between ‘things’ and people, where artefacts are given more importance and agency (Gell 1998; Knappett 2008), are seen as co-actors in network theories (for example Knappett 2011) or are even placed on equal footing. In other words: we are shaped by things as much as we give shape to them (Ingold 2013).

This has interesting theoretical implications for the concept of the *chaîne opératoire*: if materials and people are together constantly in a process of ‘becoming’, where agency is not asserted one-way from person to material, to what extent can we apply this concept which presupposes, at least in large part, a linear process? Perhaps, this somewhat explains the frequent use of the term ‘object biographies’ (as introduced by Kopytoff in Appadurai’s seminal 1986 book: *The Social Life of Things*). However, this can be problematic, especially in prehistoric contexts, because the ability of reconstructing a full biography depends on the quality of information available. Furthermore, as anthropology has demonstrated: life biographies of similar objects can vary greatly, and this is impossible for us to reconstruct, working backwards from the artefact we find at the ‘end’ of its ‘life’ (Joy 2009: 543).

Recent work undertaken by Coupaye should also be cited here as examples of the present-day applications of the *chaîne opératoire* to material culture within

anthropological settings (as opposed to archaeology). Coupaye argues we must move beyond thinking of objects as inert ‘things’ and that an object can be argued as a living being with its own sense of agency which we should seek to untangle (Coupaye 2016). *Chaînes* are seen as an aspect of a lived reality in which both “social and material domains are entangled” and act upon one-another (Coupaye 2015: 69).

The *chaîne opératoire* is now used amongst a wide variety of archaeological materials as the articles within this volume clearly demonstrate. Despite divergences early on between the *chaîne opératoire* and the behavioural chain (Sellet 1993: 108) much of the current research featuring the *chaîne opératoire* includes aspects of both approaches whereby (whether explicitly or not), the *chaîne opératoire* does not finish with an object’s manufacture. The two once separate practices have been deconstructed, and refashioned into something of hybridised methodology whereby the two techniques have become assimilated, a feature demonstrated by many of the papers within this volume. This assimilation has facilitated investigation into more than just the operational sequence and deposition of an artefact, but has encouraged studies which investigate the *chaîne opératoire* as part of a socio-culturally, economically, politically and ideologically rooted phenomenon and unlocked the potential of a wide range of *chaîne opératoire* studies (Martín-Torres 2002: 33).

Leroi-Gourhan’s interest and inspiration from natural evolution is clear within his own writings whereby cultural evolution mirrors biological evolution (Audouze 2002; Leroi-Gourhan 1964; Riede 2006). *Chaînes opératoires* represent a complementary pairing with Darwinian, evolutionary approaches to understanding cultural change, since many of the concepts applied to biological evolution can be applied to investigations of cultural change. Furthermore, it exhibits genealogical variation and inheritance (Mesoudi 2016). Production skills are transmitted whilst conforming to Darwinian evolutionary principles; although this is not just via vertical social learning through parents to offspring, but also includes horizontal social learning from master to apprentice and oblique social learning, from unrelated, older peers (Cavalli-Sforza and Feldman 1981; Riede 2006: 57). Such studies have increased in number in the last two decades (Manem 2020; Richerson and Boyd 2005; Roux 2019; Shennan 2002).

With the ever-expanding influence of video gaming and archaeology, it was not surprising that the *chaîne opératoire* would be applied here and the two integrated together. What is surprising perhaps is the length of time it took for this to happen. Examples include Sotamaa (2014) who investigated video games as symbolically and technologically charged artefacts whilst Tringham and Ashley (2015) explored the life histories of digital objects. Most recently, Aycock and Biittner (2019) applied a theoretically grounded framework, specifically featuring the *chaîne opératoire* to investigate computer games as both physical and digital artefacts.

Another recent overhaul of the *chaîne opératoire* features a sensory update which considers the importance of the human senses alongside skill and cognition. Here, an understanding of the behaviour and qualities of the materials used within the

chaîne opératoire are highlighted through sensory engagement to highlight craft-people's skill and to better understand how materials were experienced in the past, for example via archaeometric analysis of the material properties of the finished artefact. Metallurgical objects have featured such a sensory-based approach to the *chaîne opératoire* to highlight for example the importance of colour, touch and smell (see Kuijpers 2013, 2018). This updated focus upon sensory aspects of the *chaîne opératoire* are also transferable to other elements of material culture.

Although in their infancy, other studies utilising a sensory update include the investigation of bone instruments from Mesoamerica to investigate the sound properties of these objects (Bellomia 2020). The importance of the senses is also noted more widely; sound features within an ethnographic account of lace-making in Northeast Brazil (Brussi 2019) whilst Crowther (2018: 140) briefly highlights the “sensory notes of the cook” and the applicability of the *chaîne opératoire* within an anthropology of food and culinary traditions.

THE CHAÎNE OPÉRATOIRE: FUTURE TRAJECTORIES

The papers within this volume are all prime examples which demonstrate the future trajectories which we envisage *chaîne opératoire* studies taking. Amongst the key themes included are experimental archaeology, ethnographic studies, new and innovative techniques and analysis of legacy data. Beyond this, we would also emphasise the continued and future importance of archaeological science and its ongoing contribution to the *chaîne opératoire*. We also envisage that *chaîne opératoire* studies of specific classes of material culture, whether pottery, lithics, textiles, or any other, need to be integrated within *chaînes* of other classes of material culture to fully investigate and appreciate how they are all technologically, economically and socially interlocked practices within a broader landscape.

The first series of papers within this volume have looked at structures and environments as physical objects which can be read in much the same way as more typical categories of material culture. In this sense they have initiated the discussion for the ways in which the objects were used within the socio-environmental contexts of the wider landscape. Whether utilising experimental archaeology to investigate the manufacture of domestic structures (Rosińska-Balik and Dębowska-Ludwin this volume), sacred spaces (Monteith et al. this volume; van der Reijden this volume) or the intangible aspects of the environment (Lyons this volume). These papers feature phenomenological approaches which ‘read’ the architecture and the effect that this would have had as a sensory experience (van der Reijden this volume). Lyons (this volume).

These papers feature phenomenological approaches which ‘read’ the architecture and the effect that this would have had as a sensory experience (van der Reijden this volume). Lyons (this volume) uses the Middle-Late Kofun Periods in Japan as a case study which integrates the *chaîne opératoire* to explore the physical landscape as a space which is the product of, and strongly affecting human (inter)action within it. Monteith et al. (this volume) utilise a traditional *chaîne opératoire* methodology to analyse a decidedly non-traditional aspect of material culture; Buddhist Cave Temples in western China. In adopting such an approach, the authors decode

several aspects of choice, agency and symbolic value of the deliberate selection of specific raw materials to highlight the complexity of the numerous steps involved in the manufacture of Buddhist Cave Temples more broadly.

Rosińska-Balik and Dębowska-Ludwin (this volume) present the first of many papers featuring experimental archaeology. The results of this, and the other papers within this volume utilising experimental archaeology, are demonstrative of the ongoing importance of this methodology and important prospective outcome for generating new data when combined with the *chaîne opératoire*. The methodology which Rosińska-Balik and Dębowska-Ludwin apply provides valuable insights into the construction of domestic structures from Pre-Proto Dynastic Egypt with great potential for investigations into other mudbrick structures in the wider region. Experimental archaeology alongside communities of practice are central themes within Abu Jayyab and Handzuik's contribution (this volume). Their application and development of an experimental approach to replicate aspects of the *chaîne opératoire* of pottery from ongoing fieldwork in the Republic of Georgia is rooted within a didactic approach in order to teach archaeology students about ceramic manufacture and analysis. Using a similar pedagogical methodology, Ulanowska (this volume) uses experimental archaeology to investigate the *chaîne opératoire* of Middle Bronze Age loom weights and textile production from Crete. The author concludes that the loom weights were manufactured by professional potters and were interlinked within a complex socio-economic and symbolic network. Råhlander's contribution (this volume) also relies heavily upon results of experimental archaeology. Here, the author draws upon their own experience as a skilled glass-blower to investigate the production and categorisation of glass beads from the Scandinavian Iron Age.

We envisage that revisiting legacy data and museum collections will become a major focus of future *chaîne opératoire* studies. Enormous quantities of material culture languish in museum collections world-wide and require investigation. Casadei and Volpi (this volume) provide an excellent example of this need as they highlight the beneficial results of detailed cross-examination of museum collections. Their analysis demonstrates continuity in ceramic production across two archaeological periods, and highlights that such periods are often our own constructs, and, perhaps we should not be surprised where we observe continuity across artificially created boundaries? Kolbenstetter (this volume) also uses existent collections to examine the *chaîne opératoire* of pottery from archaeological assemblages of Honduras. The technological approach applied allows for an exploration of distinct communities of practice within the Gulf of Fonseca and their crafting networks.

Ross et al. (this volume) argue that for the *chaîne opératoire* to achieve its full potential, additional supporting techniques are needed. In their case study from the southern Levant, they argue that the current methods for *chaîne opératoire* studies require additional imaging protocols in order to process the vast amounts of data from a region whereby vast quantities of pottery characterise the majority of archaeological assemblages. Baldi's contribution (this volume) also looks at ceramics from the southern Levant, yet has made the *chaîne opératoire* the

main research focus from the very outset of archaeological excavations to examine the (re)-orientation of ongoing fieldwork which can occur based upon the results obtained from the initial observations of the pottery *chaîne opératoire*. An entangled technoscape is presented which features divergent *chaînes* in the pottery production with the author concluding by questioning the nature of these differences: human agency and cultural practice, or environmental factors?

The application of ethnography has a long history of use alongside the *chaîne opératoire* and the inclusion of two such studies herein (M'Mbogori et al.; Li this volume) demonstrate the continued importance of such investigations. M'Mbogori et al. follow suit from previous ethnographic *chaîne opératoire* related research (e.g. Gosselain 2018; Gosselain and Livingstone-Smith 2013; Hegmon 2000; Longacre 1991; Stark 2003) in their analysis of pottery manufacture amongst the Mbeere People in Central Kenya. Changing socio-economic conditions and technological change are documented alongside the (re)-negotiating relationship between the potters, markets and society around them. Li (this volume) also applies an ethnographic methodology, this time to understand the manufacture of Heirloom Ge Ware from China. Through interviews with a modern potter and glazer, Li is able to recreate the *chaîne opératoire* and offer new insights into this pottery.

Despite the longevity of *chaîne opératoire* studies of lithics, it is curious that there is only one such paper within this volume. Nevertheless, within this important contribution, Sponza (this volume) applies the *chaîne opératoire* to ground-stone tools from sites around the South China Sea to reveal a busy, interconnected maritime network.

THE STRUCTURE OF THIS VOLUME

This volume highlights the multitude of different current uses of the *chaîne opératoire* within contemporary archaeological studies, and also demonstrates how far this technique has come since its inception. The inclusion within this volume of contributions which cover Europe, Africa, the Middle East, East Asia and Central America highlights the spread of the *chaîne opératoire* as a globally recognised and applied methodology within archaeological studies.

The contributions have been grouped into a series of comparative, similar sections which concentrate upon distinct aspects of material culture and the *chaîne opératoire*. The volume opens with a note to the application of the *chaîne opératoire* to a historical ecological framework. The second section features authors dealing with physical spaces and buildings as artefacts themselves and how an understanding of the *chaîne opératoire* permits us to investigate their construction and use, and importantly, the lives of those people who interacted with them in the past. The range of outcomes of the *chaîne opératoire* in the next section, dealing with pottery is a testament to how malleable the *chaîne opératoire* has become within archaeology. Papers here deal with reconstructing crafting networks, the capabilities of the *chaîne opératoire* to inform us about past communities, influence excavation strategy, new techniques to investigate the pottery *chaînes* and how experimental archaeology can be used as a teaching device to inform both ceramicists and students alike. The final three papers feature lithic production

and use, the production of glass beads and textile production and continue many of the threads from previous sections of the volume.

CONCLUSIONS

It goes without saying that a theoretical methodology/paradigm such as the *chaîne opératoire* will have its flaws and anachronisms. Yet the renewed maintenance of the *chaîne opératoire* within archaeological studies in recent years demonstrates its ongoing importance to the study of material culture and past societies. The application of the *chaîne opératoire* enables archaeology to move beyond the study of material culture as solitary objects and enables discussion of new interpretations for a whole range of archaeological questions. Originally, the *chaîne opératoire* followed a relatively formal, rigid structure in its application whereas at present, a large number of studies such as those presented within this volume have taken the methodology as an adaptable concept and manipulated and combined it with other complementary methodologies and so maximising the information obtainable through the *chaîne opératoire* approach. We argue that it is this flexibility or hybridity which has allowed the *chaîne opératoire* to become such a popular and widely used methodology, and will ensure its continued application in future archaeological investigations.

ACKNOWLEDGEMENTS: Our thanks go to the contributors of this volume for their contributions. The variety of topics, geographical regions and approaches to the *chaîne opératoire* have helped forge an interesting melting pot of ideas and new directions. Furthermore, we are very grateful to the many anonymous peer reviewers for their time, their constructive feedback and their guidance for the papers which follow. Thank you. Many thanks to our friends within the Archaeological Review from Cambridge committee for copy editing the (many) articles we have compiled here. Thank you also to Nadeshda Bladt Knudsen and Tatjana Bladt-Cohen for designing, drawing, producing and painting the front cover image for the volume. Finally, we would like to thank Marcos Martín-Torres, James Barrett and the McDonald Institute of Archaeology staff for their help and support from the outset of this volume.

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