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Why the Neolithic is (r)evolutionary

Despina Catapoti and Maria Relaki

Introduction

In this article we focus on the issue of whether the Neolithic should be maintained as an analytic category in order to redefine the role of technics in the construction of archaeological narratives about the past. Given that archaeology works with the material remains of human activities, the technical processes that generated these remains have always held a central part in archaeological discussion, utilised variably to herald transitions, evolutions or revolutions in the ways in which the conditions of human life were constituted. Indeed, the Neolithic is a representative example of this mode of thinking with technical practice often being the key signifier of social change. Traditional accounts have seen the onset of the Neolithic exemplified in the combined appearance of permanent habitation, crop cultivation and ceramics, all considered technical thresholds that revolutionized pre-existing lifeways (Barker, 2006; Childe, 1951; 1958; Cole, 1965; Flannery, 1973).

Despite numerous critiques to Childe's original model (Braidwood, 1973; Gamble, 2007; Renfrew, 1973) only in the last few decades has research specifically focused on challenging the tripartite combination of sedentism, pottery and agriculture, on both empirical and theoretical grounds. On a theoretical level, scholars have questioned the coherence and independent validity of sedentism and mobility, in terms of both their temporal and spatial configurations and the significance of ensuing material traces for making distinctions between hunter-gatherers and agriculturalists (e.g. Bailey et al., 2005; Cummings and Harris, 2011; for a recent update see Robb 2013). Efforts to sidestep the problematic equation of domestication with crop cultivation (Cassidy and Mullin, 2007; Snir et al., 2015; Verhoeven, 2004) also foregrounded a diversity of habitation and subsistence patterns, ranging from sedentary or semi-sedentary sites without evidence of agriculture (Boyd, 2006; Marshall, 2006), to communities consistently propagating wild and semi-domesticated crops and rearing animals without a clear commitment to sedentism (Arranz-Otaegui et al., 2018: 1; Asouti and Fuller, 2012; Bogaard and Jones 2007; Colledge and Conolly, 2010; Dow and Reed, 2015; Kennett and Winterhalder, 2006; Kuijt, 2011; Tinner et al. 2007; Thomas 2007).

Similar complex patterns are also reflected in the reconsideration of pottery as an integral part of this traditional scheme. Functionalist perspectives assumed that heavy ceramic pots would inhibit the mobility of hunter-gatherer groups (Hommel, 2013: 669; Jordan and Zvelebil, 2009a; Rice, 1999), while the temporal requirements of pottery production and the supposed more intensive material and symbolic investment necessitated by this practice took sedentism as a prerequisite. Even approaches suggesting that pottery represented a prestige goods technology (e.g. Hayden, 1995), intimately linked such aggrandizing strategies to social processes that could only have emerged as a result of sedentary lifestyles. However, building

on ethnographic work on pottery-producing hunter-gatherers (Eerkens et al., 2002; Rice, 1999), recent archaeological research has demonstrated that both some of the earliest ceramics ever produced were made by foraging groups across Eurasia (Craig et al., 2013; Hommel et al., 2016; Jordan and Zvelebil, 2009b; Nowak 2001), and that many settled agriculturalists did not make pottery (Hoopes and Barnett, 1995; Knappett et al., 2010: 583), thus significantly disengaging habitation and food production systems from the invention of pottery. In addition, several studies have underlined the uses of clay for purposes other than making vessels (e.g. lining hearths, pits, or ovens [Karkanas et al., 2004]; making figurines [Budja, 2009; Gamble, 1999]) in the periods prior to the Neolithic, further disrupting the temporal unity of this traditional scheme.

Taken altogether these reconsiderations of the emergence of the Neolithic as a phenomenon highlight the difficulty of pinning down an incipient moment of 'Neolithisation' (Hodder, 2018: 156; see also Fowler et al., 2015; Hadjikoumis et al., 2011) or a coherent 'package' of innovations that must be found together in order to give validity to the process (Bailey and Whittle, 2005; Barrett, 2011; Robb 2013; Thomas 2015; Watkins, 2013). However, a crucial contradiction arises in that, even though the Neolithic has been deconstructed, it appears to still operate as a dominant analytical category of current archaeological discourse. One could reasonably suggest, therefore, that either the Neolithic ought to be abandoned altogether, or, that it should be redefined in order to regain its explanatory potential, methodological rigour and above all, historical validity.

In seeking a way out of this conundrum, this paper attempts to reinstate the macro-scale in archaeological discourse and demonstrate that it does not merely constitute an analytic convention. Although current interpretive models rightly emphasize that the more detail we encounter, the finer grained our analysis becomes, we contend that broader analytical categories are not only effective, but in fact indispensable research tools. Even the postmodern turn in archaeology, which has put diversity and micro-scale at the forefront of analysis, concretized as a theoretical stance by setting itself against a broad category, i.e. the paradigm of modernity. If, therefore, current theoretical schemata in archaeology accept the ontological and epistemological validity of modernity (glossing over the complexities, variations and diverse readings that it encompasses), what is it precisely that prevents us from constructing broader paradigms for the more distant past (Catapoti, 2006: 210)? Why should we sacrifice the grand scale (spatial or temporal), in favour of a "myopic localism" (Barth, 1990: 641) instead of looking at their interplay? By the same token, and returning to the initial question of this paper, why might it not be a worthwhile analytical task to seek for a 'Neolithic' and elaborate on the criteria that bring it into being?

In what follows, we will argue that the Neolithic is indeed a category to be maintained, and that its analytic consistency can be guaranteed through a radically reconfigured approach to material culture that takes as its point of departure the notion of technics as *poesis* (Heidegger, 1977), in other words, as a way of thinking, being in and engaging with the world. In order to demonstrate how this approach may be translated in practice, we will begin from a simple observation: that the main material testimonies of the three hallmarks of Neolithisation, namely cereal cultivation, ceramics and permanent habitation (cf. Robb 2013: table 2) may have been conventionally understood as distinct analytic categories, but in fact

can be linked by the production of *dough-based* tangible objects that share almost identical chaînes opératoires. Our present analysis is inevitably restricted to a limited range of such products due to constraints of space, but our aim is to demonstrate that the technical affinities we observe encompass a much wider scope of the things that make the Neolithic. Thus, we use *bread* as a shorthand for the variety of flour-and-water foodstuffs deriving from cereal processing; *pottery*, to indicate one of the main artefacts emerging out of working clay (which includes a broad range of other items, such as figurines, clay sickles, house models etc); and *mudbricks* to represent the huge variety of earthen architecture characterising the Neolithic (e.g. mud walls, wattle and daub, plasters, floors, storage pits etc; Kloukinas 2017; Nanoglou 2018; Stevanović 1997). Drawing upon the early 20th c. philosophy of technology and particularly the works of André Leroi-Gourhan (Leroi-Gourhan, 1943; 1945; 1993) and Gilbert Simondon (2005; [1958] 2017), our analysis will suggest that an understanding of material culture which only defines itself through the study of finished products generates a particular kind of discourse that not only prioritises *being* (i.e. an object) over *becoming* (i.e. a process), but also privileges what is distinct (diverse material outcomes) over what is shared (similar technics). By extension, we will argue that this emphasis on "sharing" may offer us the opportunity to explore what we think is a new avenue of interpretation of the Neolithic, re-addressing the prominence of techniques in creating and transforming the conditions of human life but also in the very shaping of history.

On technical ensembles

In the writings of Andr*é* Leroi-Gourhan (1993), a chaîne opératoire is defined as an operational sequence, "the different stages of tool production from the acquisition of raw material to the final abandonment of the desired and or used objects" (Bar-Yosef and Meignen, 1992: 165). Leroi-Gourhan was "mostly interested in grasping the processes of interaction and articulation among different levels (cultural upon natural, functional upon physiological, symbolic upon functional, figurative upon symbolic" (Stiegler, 1992: 34). Audouze (2002: 282) cites a comment from Lévi-Strauss, his by far more popular contemporary, which perfectly encapsulates the significance of this cross-cutting approach in Leroi-Gourhan's theoretical work: "… the key idea that governed his thinking was always to study *the interrelations between things rather than the things themselves*, to try to reduce the chaotic diversity of the empirical data to invariant relations and to use ... a method of transformation" (Lévi-Strauss, 1988: 203-4 emphasis added).

Although Leroi-Gourhan developed the concept of the chaîne opératoire as early as the 1940s, its earliest applications in Anglophone scholarship appear at the beginning of the 1990s (with the publication of a special issue of Archaeological Review from Cambridge, vol 9.1, *Technology in the Humanities*, with many contributions deploying chaîne opératoire in their analysis of technics). From then onwards, significantly aided by the publication of Leroi-Gourhan's seminal work *La Geste et la Parole* in English in 1993, the concept has made an immense contribution to various subfields of the humanities and particularly archaeology (Conneller, 2006; Dobres, 1999; Gosselain 1998; Ingold, 1999; Lemonnier, 1993; van der Leeuw, 1993[1]). However, although Leroi-Gourhan (1993: 114, 230-34) perceived a crucial aspect of the chaîne opératoire to be that "techniques are at the same time gestures and

tools, organized in sequence by a true syntax which gives the operational series both their stability and their flexibility", essentially highlighting the common ground between conventionally different techniques, the sharing aspect of the concept, what Audouze describes as "comparative technology" (2002: 282-286; see also de Beaune 2011: 3) has been less popular in archaeological accounts. By contrast, most emphasis has been given so far to Leroi-Gourhan's understanding of the chaîne opératoire as "operational autonomy" (i.e. as a step-by-step production sequence), and less as a *technical ensemble* that brings different techniques together, what Massumi (2009: 40) describes as an underlying "operational solidarity". Even though the latter term does not feature in Leroi-Gourhan's work, the following quotes describe what can effectively be understood as an operational solidarity between different techniques:

> The fact is that there are not techniques but *technical ensembles* commanded by general mechanical, physical, or chemical knowledge (Leroi-Gourhan, 1993: 41 emphasis added).

> Each tool, each weapon, each object in general, from the basket to the house, responds to an architectural plan of equilibrium whose outlines give a purchase to the laws of geometry or rational mechanics. There is then a whole side to the technical tendency involving the construction of the universe itself… (Leroi-Gourhan, 1945: 338; translation by R. Beardsworth and G. Collins in Stiegler [1998: 59]).

Building on these ideas, we will first address in detail the *operational affiliations* that we observed in the triad of bread-, pottery- and mudbrick-making (broadly understood to represent the wide variety of artefacts that can result from the processing and manipulation of dough, as underlined above) and interrogate on what grounds we may suggest that these techniques constitute a largely shared technical regime.

Pots, bread, mudbrick

Unsurprisingly, a level of variation is present in all the steps of the chaînes opératoires we examine, but this ought not to divert from the impressive operational solidarity linking them. Pots, bread and mudbricks (see Table 1) start with harvesting dry raw materials and their subsequent processing in order to make them suitable for forming a soft dough. Although the processing of clay and cereals begin with a sorting stage that separates the different particles of the raw materials (the grain from the chaff and the clay from any unnecessary inclusions) whereas mudbrick production necessitates the addition of non-plastic components, the latter practice is also common in the later stages of pottery production, where a variety of organic and inorganic materials can be added to the clay body as temper. The most common non-plastic ingredient added to clay and earthen mixtures has been chaff, the vegetal by-product of cereal processing, deriving from the de-husking of cereals first used as a food source (Love, 2013; Kloukinas 2017: 173-14; Nodarou et al., 2008: 2999; Stevanović: 359; Vandiver, 1987; Wilcox and Stordeur, 2012: 110).

Different kinds of grains may require relatively different processing steps, however, the basic stages involve harvesting, separating the grain from chaff and fodder by threshing and winnowing (whether by beating and shaking, or by beating and wind winnowing and sieving; pounding using mortar and pestle, a technique central in the processing of clay, has also been reported for de-husking grains [Wilcox and Stordeur, 2012: 110; Wright, 1994: 242-3]) and

finally grinding and pounding to produce different meal textures (Fuller et al., 2010). Ironically, the variability in the processing of cereals, whether dependent on the type of grain used, (e.g. wheat and barley cereals are usually processed by sieving rather than winnowing [Harvey and Fuller, 2005: 743]), or the condition of the grains (e.g. dry grains, as opposed to grains soaked in water, are better suited to grinding for preparation of a fine meal for bread-making [González Carretero et al., 2017: 425-6]), further underscores the technical solidarity of the ceramic, mudbrick and bread making chaînes opératoires, since they all involve a range of sieving and grinding techniques.

Before clay can be made pliable through the addition of water, it requires pounding or grinding in order to be broken up in small lumps to facilitate water absorption (Rye, 1981: 36). Sieving is commonly used to remove any excess rock fragments or plant remains from the clay body, while air separation or winnowing, even though more difficult and time-consuming, is also attested, particularly when the coarser fraction is required (Rye, 1981: 17-18; Rice, 2005: 118). Grinding is also vital for obtaining the fine powders needed for pigments and the painted decoration of pottery (Rye, 1981: 18), similarly to cereal processing. While the simple presence of grinding tools does not necessarily imply the production of the finer meals necessary for bread production, the gradual replacement of pestle and mortar tools common in many Near Eastern Late Epipaleolithic sites with grinding slabs and querns that dominate many Pre-Pottery Neolithic B assemblages (Wright, 2014: 25) may suggest that flour production was becoming more common. In fact, the large-scale proliferation of ground stone tools in the Neolithic has been linked to an expansion of crafts such as sculpting, plaster- and pottery-making (Wright, 2014: 3). Technological and use wear studies have also emphasized that the same suite of stone tools could have been used for processing clay (and other dry compounds) in exactly the same manner (Tsoraki, 2011: 17-8), highlighting even more dramatically the intimate solidarity of these operational sequences.

Dry components are then mixed with water to create the dough. *Dough* is the radical step in this sequence, the outcome of a dynamic operation which not only marks the moving from one state to the next (it is a product of transformation yet still 'raw' in its composition), but also links and simultaneously individuates a new spectrum of materialities in all these production chains, as neither pots, nor bread, nor earthen architecture can materialise simply from their dry parts, despite these being considered their defining characteristics in conventional archaeological and ethnographic categorisations. Taking dough as the starting point highlights a key characteristic of these products: their reliance on mixing, the absolute necessity of existing as a recipe combining a series of components that can range from simply two (flour and water – clay and water), but more often involving a host of other ingredients: dried fruit, seeds – non-plastic inclusions of various derivations, such as crushed pots (grog), shell, bone, chaff, different types of clays and soils (Love, 2013: 753-4; Rice, 2005: 118-9; Stevanović 1997).

The mixing process is very important in both practical and metaphorical senses; it constitutes a *metamorphosis,* a process whereby the different elements are moulded into a new unity, becoming what Leroi-Gourhan described as plastic solids [*solides plastiques*] which incorporate and amalgamate different parts (Leroi-Gourhan 1936, *L'Homme et la nature*, in de Beaune 2011: 213-214). The mixing of disparate components, each with their own qualities

and properties, becomes a new category that owes its defining characteristics not to any single one of these components, but to their combination in a specific ratio and co-existence as a whole. This 'whole' represents a new operational solidarity (Massumi, 2009: 39) that allows for the heterogeneity of each component, rather than subsuming the parts into the hierarchical arrangement of a systemic logic. The original ingredients thus resurface through the multi-sensoriality that is needed to grasp their mixing, their coming together in one, perceived through sound (crucial for checking the pot /mudbrick and crusty breads or rusks are 'cooked'), touch (testing the consistency, pliability and workability of the dough, how dry/wet are the shaped 'products'; whether they have the right texture) and possibly taste and smell, particularly during/after the 'cooking' process.

Kneading, the working of the dough to homogenize the different components, but also to release the different qualities of each and to prepare the mixture for baking, follows mixing and relies on gestures and processes shared across the three techniques (Rice, 2005: 119). This is a highly performative stage of the chaîne opératoire and the quality of the end product strongly depends on its correct execution. Kneading will determine the success or not of the mixture; whether the bread will bake evenly, whether the clay will be worked well enough to avoid any cracking during the drying (and the firing) process or to make the dough sufficiently pliable to form pots, or sufficiently homogenized to ensure the strength of the mudbrick body.

Shaping concrete objects may be seen as a divergent stage, as the three techniques are understood to produce different material forms. However, even at this level, where discrete items arise, the sharing of gestures and tools still reconfigures a coherent technical ensemble: for example, mudbrick shaping is executed mainly through sequential slab construction, a technique commonly attested in the production of some of the earliest Neolithic pottery in SW Asia, as well as being integral in creating other architectural features of Neolithic buildings, such as plaster floors (Vandiver, 1987). Similarly, the lining of walls of wood-framed houses with clays or loess soils, as widely attested in north and central Europe (e.g. Amkreutz, 2013; Stevanović 1997: 354), evokes gestures and practices common in the lining of storage pits, the construction of platforms or the laying of clay floors in Neolithic houses, while handmade mudbricks from Neolithic houses in Northern Greece have also been described as "loaf-shaped" (Kloukinas 2017: 176). Shaping a clay oven relies on the same principles as raising a pot, making flat breads uses gestures such as rolling, patting, and trimming, which are all part of the gestural repertoire of making pots.

Baking is the final stage in the sequence and again crosscuts all three techniques. The surface colour and hardness of the earliest ceramics suggest that firing methods were rather irregular. Most commonly clay objects would have been baked in open bonfires (Moore, 1995: 47), something that has in many cases also been confirmed by scientific analysis (Rice, 2005: 152-8; Tomkins et al., 2004: 54; Vitelli, 1989), although new evidence for the use of kilns has recently come to light (Krahtopoulou et al., 2018; Laviano and Muntoni, 2006). In addition, clay ovens, probably used for baking bread and other foodstuff, are known from Pre-Pottery Neolithic in SW Asia (e.g. Tel Sabi Abayad II in Syria) (Akkermans et al., 2006), and lime kilns used for firing limestone or chalk to produce quick lime for constructing plaster floors and other architectural features common in Neolithic architecture (Moore, 1995: 45; Garfinkel, 1987: 71) have also been reported in the same area. While lime and gypsum plaster may not

readily appear as integral elements of the technical ensemble we are trying to pin down, they nevertheless share similar principles in harvesting, working and baking that make them part of the same '*software horizon*' (cf. Vandiver, 1987: 25) as pottery, mudbricks and bread, which helps *shape* the materiality of the Neolithic ('white ware' vases are also known from the 9th millennium BC, made of gypsum or lime plaster; Moore, 1995: 45). Mudbricks, on the other hand are not fired but sun-baked, however, this is also the first stage in the process of hardening ceramics and sun-baked pottery is known from some of the earliest Neolithic contexts (Vandiver, 1987: 10), while practices of intentional conflagration of entire mud-built houses are also common in various Neolithic sites (Stevanović, 1997; Tringham, 2000). In all, it seems that "the campfire would have offered a range of baking options" (Rubel, 2011: 19): the hot ashes could have been used to bake breads in different heat gradients; the embers could have been utilised as a griddle for baking in short-lived intense heat and the hot ground surface after the sweeping away of the fire would have offered a less intense but more sustained type of heat for baking. The same premises of heat controlling would be applicable to the baking of pottery, while parching cereal grains in preparation for grinding is also attested in various early Neolithic contexts (Valamoti, 2011). In that respect, baking completes the circle of technical solidarity of all three chaînes opératoires, truly constituting them as a technical ensemble.

	Harvesting	Processing	Forming/shaping	Baking/Firing
Pottery	Dry materials (clay)	Sorting –sieving Pounding Grinding Soaking Mixing with organic and inorganic material Mixing with water	*dough* Kneading (hand-foot) Shaping	Drying Baking: open fire oven sunbaking
Bread	Dry materials (grain)	Sorting –sieving Pounding Grinding Soaking Mixing with other organic material Mixing with water	*dough* Kneading (hand-foot) Shaping	Drying Baking: open fire oven
Mudbrick	Dry materials (soil)	Pounding Grinding Soaking Mixing with organic and inorganic material Mixing with water	*dough* Kneading (hand-foot) Shaping	Drying Sun baking Intentional burning of built structures

Table 1: The operational sequences of pottery, bread and mudbricks.

Technical lineages

With firing/baking the final concretization of new objects is achieved. And at this stage, classifications of material culture begin, which in archaeological studies are based either on raw material (stone, clay, metal etc.) or on the morphology/function of the finished products. Under traditional schemes of classification, technical associations, such as those observed for

bread, pottery and earthen architecture would simply elude us. Although recent scholarship has increasingly recognized the limitations of conventional categorisations of material culture and has emphasized some affinities crosscutting different material sets (e.g. Doonan and Day, 2007; Ingold, 2012; Knappett, 2005; Rebay-Salisbury et al., 2014; Relaki, 2018), what is so far lacking from this effort is a more systematic focus on the technical processes that operationalize these links. In other words, we should not only examine categorizations that set functional distinction and the morphologically concrete as their defining criteria, but also explore classifications that stem from technical ensembles and the broader idea of 'sharing' amongst techniques.

This mode of understanding directs attention to the identification of *technical lineages*, different materials, bodies, communities, values, gestures, rules, skills, experiences in orbit around a surface upon which a complex network of radial properties are played out, allowing the operation of its parts without giving up the 'whole' (Iliadis et al., 2016). It is this idea of the 'whole' that Leroi-Gourhan (1993: 41) wishes to unveil when he claims that "having the principle of the wheel gives one that of the chariot, the potter's wheel, the spinning wheel, the lathe" or that "with the mastery of compressed air comes the blowpipe, the piston lighter, the piston bellows, the hypodermic needle". Could these changing modes of reticulation, these broader technical tendencies (what Leroi-Gourhan [1993: 253] conceived as "*la tendance technique"*) – however sabotaged today by our accentuated interest for regional diversity and temporal variability in the archaeological record – be coupled with the operational solidarity at the level of technique and give the triptych we identified a particular historical and analytical weight?

What is the Neolithic?

If archaeology so evidently focuses on the 'concrete', it is because it is a discipline that works with material remains. It is on the basis of the material things unearthed that archaeologists (re)construct social categories and arrange them in time and space, creating spatiotemporal 'beginnings' and 'ends', chronological sequences, spatial distributions and cultural groupings, thus allowing us to speak of a Stone Age, a 'Neolithic culture' and so forth:

"Things are instrumental in the setting up of the world which we live though: they bring the past to mind, they are alongside us; they are implicit in the formulation of future projects. It is through our involvement with things... that we come to take a stand on ourselves" (Thomas, 1996: 78).

However, as Strathern has rightly pointed out, this mode of understanding sees the world as inherently divided into *monads*, distinct and bounded units. As she stresses, "the significant corollary of this view is that relationships appear as extrinsic to such units: they are a secondary way of connecting things up" (Strathern, 1990: 50). This *a posteriori logic* prioritizes objects over relations: first we identify entities and then we discuss the relations that develop between them. The way this logic works in the case of the Neolithic is to first look for the occurrence (or not) of 'cereals', 'pottery' and 'architecture' in the record, distribute them in time and space, investigate densities (their co-presences) in order to then argue (or not) for the 'existence' of a 'new' way of being. These visibilities are the criteria upon which the notion

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of the Neolithic is constructed and the mapping of these criteria/visibilities delineates not only its spatiotemporal framework (when and where), but also its very existence.

Already from the late 1950s/early 1960s, French philosopher Gilbert Simondon[2] had objected to a logic that "accords an ontological privilege to the already constituted individual" (Simondon 1992: 298) arguing instead that analysis should not begin from existence and individuation, but from the investigation of what he termed the 'pre-individual' matrices of existing, in other words, the conditions that make 'individuation' possible. To understand the 'individual' one must return to the 'pre-individual' state from which it arose; if we wish to approach the 'concrete' (physical, biological, social) then we have to move beyond 'stable being' to the very 'becoming' of individuated being (Simondon, ([1958] 2017). Thus, the Neolithic would be mapped, not by object appearances and/or densities, but by points of convergence between technical regimes that redefine the modes of being in the world by providing the conditions under which new 'objects' become possible. This, presupposes the rejection of traditional perceptions of individuation and stability and a return to "a state comparable to that of birth", in other words, "a state rich with potential, not yet determined, a domain for the new propagation of Life". (Simondon, 2013: 557; English translation by Mills 2016: 10). For Simondon, being is "more than a unity and more than an identity"; he claims that a process of individuation starts "from a pre-individual reality that sub-tends it" and therefore, "the perfect individual, fully individuated, substantial, impoverished and empty of its potential' is nothing more than an abstraction (Simondon 1964: 126, English translation by Mills 2016: 50). "*In reality, the unitary individual does not exist; there are only multiple processes of individuation.*" (Sauvanargues, 2012: 63-4 emphasis added).

It is precisely for this reason that Simondon invites us to cast a fresh look upon techniques. In his pioneering work *On the Mode of Existence of Technical Objects* ([1958] 2017), 'techniques' are portrayed as both process and association. By extension, under Simondon's analytical scheme, the Neolithic is not about technological innovation: for instance, the processing of grains, the shaping of clay, the solidification of things through fire were not techniques unknown prior to the Neolithic. Rather it is the bringing of these different operations together in a shared and structured technical framework which marks a novel and prominent way of engaging with material. Simondon describes how disparate elements come together in a new "regime of technical functioning" in his famous Guimbal turbine example:

> "[Simondon] links invention to an *action of the future on the present*. … The veritable moment of invention … is when a circular causality kicks in. In the case of the Guimbal turbine, it has to do with the potential for the oil in the turbine and the water around it to each play multiple roles. The water brings energy to the turbine, but it can also carry heat away from it. The oil carries the heat of the generator to the housing where it can be dissipated by the water, but it also insulates and lubricates the generator, and thanks to the pressure differential between it and the water, prevents infiltration. There are two sets of multi-functional potentials, one in the water and the other in the oil. *The moment of invention is when the two sets of potentials click together, coupling into a single continuous system*. A synergy clicks in. A new "regime of functioning" has suddenly leapt into existence. A "threshold" has been crossed, like a quantum leap to a qualitatively new plane of operation. The operation of the turbine is now "self-maintaining". It has achieved a certain operational autonomy, because the potentials in the water and in the oil have interlinked in such a way as to automatically regulate the transfer of energy into the turbine and of heat out of it, allowing the turbine to

> continue functioning independently without the intervention of an outside operator to run or repair it." (Massumi 2009 p. 39).

Following Simondon's example, if we describe the Neolithic as a new 'package', we maintain a monadological distinction between before and after, presence and absence, Mesolithic and Neolithic. Moreover, it is as if this package marks a new beginning, acting as the cause behind the Neolithic emergence. On the contrary, Simondon invites us to see relations and change in a different way. He claims that attention ought to be given not to form but "to the process of taking form as operation" (Simondon [1958] 2017: 248).

According to this line of thought, we could argue that techniques and materials might have already been available in the Mesolithic, but what essentially constitutes the Neolithic innovation is the way that these operations click together into a technical ensemble. Thus, what acquires dominance in the Neolithic is not a new range of products, as several scholars have indicated (Robb 2013), but instead, a common operational scheme that supported their individuation: a shared *modus operandi* based on the triptych of *synthesis* (mixing), *poesis* (forming) and *optesis* (baking). The fact that this triptych can apply to the working of many different raw materials does not give it a deterministic quality, but rather underlines its expansive properties. In other words, this technical prominence is not deterministic in nature, it is not deductive but *transductive*, i.e. characterised by immense flexibility that leads to a plethora of new potentials in working with things (from edible stuff to construction materials):

> "By transduction we mean an operation by which an activity propagates step-by-step within a given domain, and founds this propagation on a structuration of the domain that is realized from place to place: each area of the constituted structure serves as the principle and the model for the next area, as a primer for its constitution, to the extent that the modification expands progressively at the same time as the structuring operation. A crystal that, from a very small seed, grows and expands in all directions in its supersaturated mother liquid provides the most simple image of the transductive operation: each already constituted molecular layer serves as an organizing basis for the layer currently being formed. The result is an amplifying reticular structure. (Simondon, 1964:18, English translation by Mills 2016: 38)

Therefore, the Neolithic integrates a "flow of forces of differing viscosities, of formerly disparate things within a becoming-concrete system" (Goodman 2013: 2). Following this alternative path of interpretation, we effectively agree with Robb (2013: 660, following Zeder, 2009: 13) in arguing for the Neolithic as a *Bauplan* (a way of life), but we argue that this arises out of mutually reinforcing *technical* practices and material engagements that link "the scale of individual decisions … to the larger scale of historical patterns".

The choice to portray the Neolithic as a shared technical regime raises a series of new research questions that require further exploration, as for instance: a) the contrast between the *reductive* techniques of the Mesolithic (important for populations that travelled light and relied more on embodied skills than auxiliary media), and the *prosthetic* techniques of the Neolithic (e.g. relying on mixing, recipes, ratios, hybridisations); b) the high degree of visibility of production traces in Mesolithic objects (e.g. stone tools, indicating the story of their production, perhaps as a 'memory device', an itinerary that could be followed until a core was exhausted) as opposed to the almost cryptic transformation and concealment of such traces

through mixing and baking in the plastic solids of the Neolithic; c) the emergence of a 'thing-rich' environment in the Neolithic (Hodder 2018) as a sign of a different perception of time and materiality; in contrast to Mesolithic stone tools and basketry that allow renewal, mending or reworking, the Neolithic repertoire stems from a technical regime that leads to concretization through *optesis*, thus limiting the objects' life-span (ceramics are breakage-prone; bread necessitates short-term consumption; earthen architecture has high-maintenance requirements). This different sense of *finitude* creates different material conditions and different forms of interdependence between human and non-human actors during and beyond the technical process.

Epilogue

The first part of our argument exemplified how three material categories that are normally treated as distinct have almost interchangeable creative stages, despite notable variations. We then investigated what could be accomplished through this shift of analytical emphasis to becoming and sharing, particularly in the context of the so-called Neolithic. We suggested that the identification of common technical biographies is not an intellectual exercise of formalist (hence ahistorical) nature, isolating the study of the networked character of technical processes from an associated context. Instead, we stressed that such technical networks bear historical significance, i.e. they mark new ways of being, they signal the operation of different kinds of engaging with the world in different periods of the past (see also Haudricourt 1969; Gosselain, 2000). Particularly with regard to the Neolithic and its validity as an analytical concept, we argued that such questions cannot be easily answered through spatio-temporal distributions based on the presence (or absence) of finished, concrete objects. We proposed instead to also take into serious consideration the processes behind the concrete.

An easily anticipated criticism at this point would perhaps be that 'process' is by no means a new word for archaeology. Nevertheless, looking at the dominant interpretative models of the Neolithic, we could argue that 'process' in those cases operated under a general rule of 'enclosure', either in a linear fashion (as cause and effect) or through binary oppositions. Thus, sedentism and agriculture have been either portrayed as a structural transformation resulting from economic processes of resource optimization (Halstead, 1989a; 1989b); or interpreted as signifying a new kind of *ideology* of dwelling and nature, encapsulated by the concept of the 'Domus' (Hodder, 1990; see also Cauvin, 2000; Thomas, 1991; Whittle, 1996). Under such schemas, the triggering of the Neolithic phenomenon has been presented as the concretization of either economic or ideological choices, with both interpretative stances relying on binary oppositions (human vs. nature, ideology vs. economy, thought vs praxis etc). Admittedly, these dualisms have been heavily critiqued in recent years (Barrett, 2011; Descola and Pálsson, 1996; Ingold, 1992; Macnaghten and Urry, 1995; Verhoeven, 2004) but alternatives have not gone beyond the maintainenance of a now 'deconstructed' (and hence, only conventional) Neolithic. Here, we sought to do more than acknowledging a 'fuzzier' condition that eludes effective categorizations; we suggested in particular that archaeological interpretation could be profoundly reconfigured if we focused on *becoming* as an ontological condition and investigated its analytical potential more systematically.

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At the same time, we decided to focus our investigation on techniques *because* they constitute 'fuzzy' categories, i.e. modes of becoming, intersections between subjects and objects, the mental and the material, the tangible and the intangible, humans and nature. Moreover, although techniques may establish specific production sequences, they also allow the sharing of common principles thus producing wider processual networks, within which life is experienced and made possible. As such, sharing in cereals, clay, and mud in the case of the Neolithic is not just a simple way of working with material that brings different forms of technics together; this shared vocabulary is a way of working with material which ends up producing a *technical prominence* in the Neolithic landscape for it filters a very substantial part of life, ranging from dwelling to subsistence. Of course, other techniques are also at work, but human experience at that stage is largely *formed* with these materials. In a way, Neolithic life is 'processed' through the working of these materials, enabling the development of diverse tropes of being but also structured by the radial tempo established by these tropes.

This is precisely what sustains the Neolithic as an analytical category: it is not a concrete entity (neither spatially nor temporally), but an *interface* (Galloway 2012), a shared canvas upon which maximum openness may be achieved at the level of working with material (as evident by the ensemble we examined in this paper, but also able to incorporate further dough-based techniques). The Neolithic triptych of *synthesis* (mixing), *poesis* (forming) and *optesis* (baking) allows the actualization of a technical regime, an "operational closure" (Mills 2016: 61), whose effectiveness is borne out of the fact that it is so *open* so as to accommodate the production of different things, and yet so *structural* that it establishes a new material existence, a novel space for manoeuvre, which radically alters prior spatiotemporal perceptions and experiences (Harding 2005; Robb, 2013: 672; Simondon, [1958] 2017: 13; Thomas 2015). This understanding of the Neolithic makes it both evolutionary and revolutionary.

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[1] It is also worth mentioning that a comparative approach was developed independently by M.B. Schiffer in the United States specifically on the contribution to archaeology of what he termed 'behavioural chain' defined as 'the sequence of all activities in which an element participates during its "life" within a cultural system. A chain segment is then simply a specified portion of a given chain' (Schiffer 1975: 106), which closely mirrors Leroi-Gourhan's understanding of the chaine operatoire.

[2] Simondon's main thesis, *L 'individuation à la lumière des notions de forme et d'information* was published in a single volume in 2005, even though he had originally written it in two parts, *L 'individu et sa genèse physico-biologique*, published in 1964 and *L'individuation psychique et collective*, published in 1989. His main work on technology, *Du mode d'existence des objets techniques*, was originally published in 1958, but was translated in English recently following the renewed interest on Simondon's overall opus since 2005 (Mills 2016: 7, n. 1)