Non-linear archaeology

By Giorgio Buccellati

Frequent though it is in common parlance, the term "non-linear" generally exhibits a vague frame of reference (it has a precise meaning in some technical contexts such as mathematics or physics). Perhaps by virtue of its novelty and of the inadequate definition generally given of it, the very term "non-linear" is evoked with almost a sense of awe (I retain here the hyphenated spelling to emphasize the contrast with "linear"). An explanation of its import may help to put both term and concept in sharper focus.

The very fact that a positive term is missing to refer to non-linearity suggests that the field is still wide open for a clarification of the issue. Let me begin by proposing such a term, which will help define the concept. The term is "polyhedral." Just as the adjective "linear" refers to the geometric figure of a line, i. e., a point moving along a fixed direction, so the adjective "polyhedral" refers to the geometric figure of a solid bounded by polygons, such as the cube represented in Figure 1. A linear argument that proposes to link conceptually points A and Z has to travel along points b and c (Figure 2). A polyhedral argument, on the other hand, travels directly, across the solid, from A to Z (Figure 3).

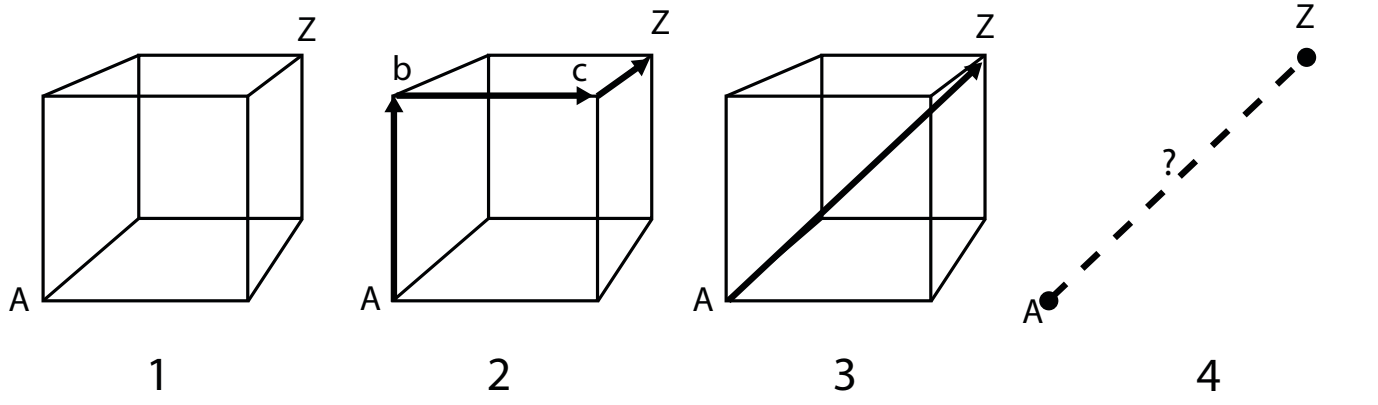
The power and demonstrability of a polyhedral argument rely on a prior knowledge of the whole (the cube) and of its properties. In other words, non-linear" thought, in order to be properly "thought" and not just hit or miss surfing or browsing, must be associated with an underlying knowledge of the structural whole within which the non-linear "jump" occurs. It is only by virtue of this knowledge that A can arguably (i.e., demonstrably) be linked with Z: since the whole structure of the cube is presupposed, the linear possibility of the link (Figure 2) is also virtually known, even if the intermediate steps are not articulated as such. It is also as a result of the prior knowledge of the underlying structure (represented figuratively as a polyhedron) that the linkage takes place along the shortest line. Hence the power: the finer the prior knowledge, the most direct the linkage. And hence the demonstrability: one can refer back to the nature of the solid and show how the link between the two is possible. Such a knowledge is "polyhedral" because it does not rely solely on points b and c, but rather on the whole solid figure (the cube or polyhedron), of which b and c are as much part as A and Z.

Without a supporting structure such as the cube, points A and Z are floating in space, and if so their linkage (Figure 4) results from a hit or miss shot in the dark. This is what happens with intuition. In this case, a connection between A and Z is perceived through a logical short-circuit, one that does not presuppose the argument (i.e., the linear sequence A-b-c-Z) and cannot therefore be demonstrated — at least, not on the basis of the original intuition. But we all know that in most cases it is precisely such an intuition that initiates the process of discovery. A proper polyhedral argument is one that, building on such an intuition, shows how the linkage is possible, and therefore arguable.

It is further worth noting that, strictly speaking, even the linkage represented in Figure 3 remains linear, since the linkage is indeed a line. When referring to the actual flow of an argument, then "linear" means in fact "multilinear" or "poly-segmental" and "non-linear" means "virtually mono-segmental." The argument's process represented in Figure 2 is linear, but it consists of many segments. The argument process represented in Figure 3, on the other hand, is also linear, but, as it cuts across the polyhedron in the most direct way, it consists of a single segment which jumps across intermediate steps because of the known structure of the whole.

It is important to note that the concept hiding behind the mystique is by no means novel. To look at cases of pre-digital non-linearity is instructive, especially in an archaeological perspective. Think of the introduction of writing: its broader significance is generally linked to the power of specificity it conveys (e.g., proper names) or its socio-economic import (e.g., the recording of transactions). But an even greater significance can be seen in the impact it had on conceptual modeling. Thus the tabular structure of a Mesopotamian written ledger is exquisitely non-linear, the conceptual "polyhedron" being defined by the coherence with which cells and their values are located in the overall matrix.

Or think of such disparate examples as long term observations of recurrent celestial phenomena, and the consequent establishment of calendars (which crystallize the perception of the recurrence of time); the organizational control



of long distance trade (with the inherent mental connection of the intermediate steps from obtaining raw materials to exploiting the final markets); the technical ability to establish an industrial mode of production (coordinating multiple resources and individuals none of whom is aware of the overall chain of events); the metrical organization of discourse in poetry (the expectation of overarching patterns channels the flow in given directions and invokes attention to non-sequential moments in that flow). All of these and countless more cases presuppose the coherence of a whole within which the argument flows from one point to the next, or jumps across them in virtue precisely of the structural cohesion of the whole.

Let us consider in more detail another instance of non-linear thinking — a map. To go from point A to point Z you follow a line, hence the directions formulated as a string of words are indeed linear. Their representation on a map is linear or poly-segmental, because the line goes through intermediate points. Alternate sequences are also possible: you may get from A to Z through c and d, or through e and f. The evaluation of these alternatives is akin to an argument: how best can you reach the target point, or what are the respective merits of the different paths?

On the other hand, the realization that points A and Z as shown on the map can be linked is non-linear or mono-segmental: the connection is virtual because of the properties of the map. Mark well: non-linearity pertains primarily to the way in which the map is constructed. As in the case of a polyhedron, a map is built as a coherent whole, based on specific rules that spell out the organization of space and the systemic correlation of points on a plane. The confidence with which we ultimately get proper directions (alternatively: the confidence with which we con construe the linear argument that links points A and Z) derives from the expectation that the presupposed whole is coherent (scale, proportionality along axes, etc.). The whole is properly non-linear (polyhedral) in two ways — (1) how it is constructed, and (2) how this construct is presupposed when being used. So the linear use (the directions) depends intimately on the non-linear structure of the whole (the map as a given organization of space).

The fact that very early plans and maps exist (from Mesopotamia in the third millennium BC to Soleto in Puglia in the fifth century BC) is indicative of how intuitive the basic process is, no matter how precise the underlying polyhedral structure may or may not be. By no means self-evident, the graphic organization of space shown by these early maps represents a major conceptual leap. It was not grounded in theoretical explicitness, but it shows full awareness of the coherence of the presupposed non-linear, polyhedral system.

The map as a graphic organization of space points to another important distinction, that between non-linear thought and non-linear representation of thought. Writing had a profound impact on human self-perception precisely because it objectified thought. Even when it does not translate to complex graphic representations (e.g., a cuneiform ledger does not yet result in the creation of bar histograms), writing gives thoughts and thought processes an extra-somatic embodiment which can be manipulated independently of their original locus, the human mind. A Mesopotamian dictionary, for instance, is a compilation that does not exist in reality (meaning that in normal speech we never recite lists of words), but is a powerful tool for organizing the lexical whole (the polyhedron) within which speech unfolds.

The intuitive steps that led to the eventual understanding of the agricultural cycle may be seen as a vernacular tradition: thought came to be articulated along precise "lines" which had to be followed for farming to be successful. When at the turn of the third millennium the Mesopotamian scribes codified in writing the whole process, farming became a "theory" (theoria as the visible embodiment of a sequential argument). The written representation was linear. But — and this is the fundamental point about writing — it allowed non-linear comparisons among segments within the extrasomatic representation of the flow of argument (the written text), comparisons that were not possible within mere speech.

Electronic data processing is comparable only to writing in terms of its impact on the human mind. The graphic representation of thought through writing had impacted the very nature of thought by giving it an extrasomatic embodiment which could be observed and manipulated: non-linear jumps could be visually verified, e.g., by comparing cells in a tabular ledger. Computer programming adds a whole new dimension, because it manipulates thought automatically. The myriad logical links effected by a program result instantly, in the output, as single logical jumps. Thus it is that the computer emerges as the perfect tool for non-linear thinking — where "non-linear" means precisely the conflation of multiple strands of linearity, brought together by virtue of the known coherence of the universe within which the segments are organized.

The conclusion, then, is that we can make a case for the validity and distinctiveness of the concept of digital non-linearity. It is valid — even though it properly refers to virtual multi-linearity inscribed within a known coherent whole, which I suggest is properly rendered by the term "polyhedral." And it is novel — even though the conceptual dimension as such is intrinsic to pre-digital human thought and to its earlier representations. What digitality makes possible is an extraordinary expansion of the potential for mono-segmental "jumps" across vast conceptual landscapes where normal thought processes would require laboriously established poly-segmental, overlong paths. Let me review briefly three salient points that help define digital non-linear thought: (1) non-contiguous sequentiality, (2) demonstrability of logical jumps, (3) structured hyperlinking.

(1) The nature of sequentiality is essentially different in the two modes of thought. In linear thought, the argument is built on the adjacency of contiguous segments. In non-linear thought, on the other hand, the argument is still sequential, but it jumps across contiguous segments, and it does so because of

the previous knowledge of the whole within which the segments are inscribed (hence the suggested term "polyhedral"). The adjacency of the segments makes it easier to see their reciprocal relationship, but the farther apart the segments are the more significant becomes the realization of their connection. The computer cuts across unlimited adjacencies and proposes unsuspected and innumerable connections, thereby increasing immensely the power of seeing sequentiality where it is not linearly given.

(2) Digital non-linearity is not only powerful; it is also demonstrable, on two counts: the universe within which the links take place must be articulated as a coherent whole, and the links themselves are traceable even though one may see only the final output. Take the example of a ceramic assemblage: through a well-developed "grammar" of attributes (typological and stratigraphic), very large quantities of sherds can be brought rapidly within a coherent conceptual construct that matches the material data excavated, and each quantity can be traced back to every single component that goes into making up the total.

(3) Concretely, on way in which this can happen, in the specific case of a digital archaeological publication, is through the extensive use of hyperlinks. If a comprehensive "grammar" is in place, one that spells out the properties of the stratigraphic and typological whole (the polyhedron), then automatic tagging can be implemented that will generate unsuspected quantities of hyperlinks (up to a million for an excavation unit of 10 by 20 meters and approximately 3 meters deep). The linkages allow the user to follow inquiry paths that propose themselves as one follows one clue after the next — each remaining in memory so that each segment of the argument can be traced, making the argument properly arguable. So it is that, in the final analysis, a non-linear mode of thought does in fact emerge as valid and distinctive, and that the main use to which it can be put is indeed primarily and exquisitely digital. ▲

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The archaeology of the Levant in North America

By Aaron A. Burke

The eminent Syro-Palestinian archaeologist, William G. Dever, was by and large correct when he proclaimed the demise of "Biblical Archaeology" more than a decade ago (1995). However, the changes that have occurred over the last three decades within what has been most often identified as Syro-Palestinian archaeology cannot be regarded as the "death of a discipline" as Dever suggested. Rather these changes must be recognized as the transformation, if at times painful, of Syro-Palestinian archaeology into a truly anthropological discipline that is grounded in available historical sources, thanks predominantly to the influence of "Biblical Archaeology." This new discipline, like its siblings Mesopotamian, Anatolian, and Egyptian archaeology, has thus come to be known by the most appropriate geographical designation, the archaeology of the Levant. By definition this region includes not only Israel, Palestine, and Jordan in the south — the region traditionally identified with Syria-Palestine, but also the Egyptian Sinai, and Lebanon, western Syria, and a small part of southern Turkey known as the 'Amuq Valley and its tributaries in the north — thus, essentially the eastern Mediterranean between Egypt and southern Turkey.

Why, though, should the term Levant now be adopted for the archaeology of this region when terms like Syria-Palestine and Canaan have been used so frequently? Although these other terms have been applied to the region, neither is historically or geographically appropriate. Syria-Palestine, on the one hand, is correctly speaking the title of a province under Roman administration of the Levant established by Hadrian in the second century AD (Millar 1993). This term also carries political overtones in the present day that, unfortunately, are overshadowed by efforts to establish a Palestinian state and thus the term has always been misleading to students. On the other hand, the most ancient term, Canaan, is equally inadequate for somewhat different reasons. Despite the fact that Canaan is attested in the Mari texts, from the middle Euphrates, as early as the eighteenth century BC, since it only seems to have referred to a geographic region roughly equivalent to the southern half of the Levant, it does not adequately represent the full geographic extent of the region's cultures. Neither term, therefore, satisfactorily identifies the region without suggesting a specific historical context. Added to this is the fact that no other ancient geographical terms that are thus far attested, such as Egyptian Djahy or Retenu, are sufficiently geographically identified in order to be adopted. Thus, we are left with the term Levant.

The term Levant came into wide currency in English during the sixteenth century to refer to all eastern Mediterranean countries from Turkey to Egypt (see Braudel 1972), though it remains an unknown entity to most people today. Perhaps for this very reason, unfettered by common preconceptions, the term has been used almost exclusively in Near Eastern archaeology to identify the region bounded by the mountains of southern Turkey to the north, the upper Euphrates and the Arabian Desert to the east, the Red Sea to the south, and the Mediterranean Sea and Pelusiac branch of the Nile to the west. While it might be thought of as the leftover strip of land between Egypt, and Mesopotamia and Anatolia, the Levant shares a number of geographic features that facilitated its cultural continuity and thus warrant its identification today by means of a single geographical term. The greatest of these features is the seismically active Great Rift Valley, which bisects the region from north to south, and has always served as an "access corridor" for the movement of man and beast alike, including trade, communication, and invasions. In a