Degrees of Digitality

The Case of Excavation Reports

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1. Digitalities

The common sense meaning of the term "digital" refers to the way in which knowledge is transposed onto a form susceptible of being handled by electronic means: it refers, in other words, to the shape in which data are couched and to the processes they can thereby undergo. In a strict sense, this refers to the binary structure of the data and to the way in which they can be processed independently of human intervention, through a computer. We may call this *computational digitality*. It applies essentially to activities that involve programming.

In a broader sense, we may speak of *applied digitality.* This refers to the interface that makes possible in practice the use of the digital dimension: when writing with a word processor or taking a photo with a "digital" camera, we are not operating within a properly digital mindset; we only write as if with a more powerful typewriter, we shoot as if with a more powerful 35 mm. camera. Or think of virtual reality: as a rule, one looks at it as a finished product, which conveys information of a type and in a style that was inconceivable with pre-digital means; however, the mindset of the viewer remains on this side of the interface with the digital, and is not dissimilar to the one that obtains when viewing a film. In each case, the proper digital dimension remains behind the scenes, and the application takes place only through the interface.

There is a third type of digitality, which is not generally recognized as such, and on which I would like to elaborate in this article. It affects the way in which we approach the data, the way in which we conceptualize the world. If we look at this in the light of a wider historical perspective, we may say that we have actually been on a course towards digitality ever since logical thought first began to impose categories on reality as perceived. The ability to break down reality into logical categories is in a sense digital, because it aims at reconstructing that same reality out of the fragments that have been first established through analysis. This reconstruction creates a virtual dimension, which gives us control over the factual dimension. The "dissolving" of the real is implied (also etymologically) in the very meaning of the term "analysis," and this process of dissecting a whole into its component parts and then reconstituting it into a new unity[1] is in effect at the basis of the digital process.

[1] This is the definition that Socrates gives of himself in Plato's Phaedrus: "the lover of split fragments and of re-assembled wholes" (τούτων δὴ ἔγωγε αὐτός τε ἐραστής, ὦ Φαῖδρε, τῶν διαιρέσεων καὶ συναγωγῶν , 266 b). See also his description of the ideal orator or writer as "the one who sets boundaries … in dividing until the limit of the divisible" (ὁρισάμενός τε πάλιν κατ᾽ εἴδη μέχρι τοῦ ἀτμήτου τέμνειν, 277 b).

In this sense, then, digitality as we know it today brings to its full fruition what has always been at the core of any scientific enterprise. In today's computational environment, this means that human interaction with the data is specifically anchored to the digital dimension of their structural make-up. This I call *conceptual digitality*. In what follows, I will focus on three specific instances of this type of digitality as they pertain to archaeological publishing.[2]

Being clear about these different types of digitality helps us to bring out more clearly the real uniqueness of what we have come to call the "digital revolution". In the final analysis, the quantum leap we are witnessing is not such because of the technique used, the computer, but because of the methodology that affects the analysis and the argument. The assessment I give here of this great turn towards digitality, as found in the case of archaeological publishing, is as if a metaphor for the colleague we are celebrating, because Lutz Martin has witnessed what are perhaps even greater changes in his lifetime than the one to the computer age, and our lives have crossed at times and in places where we could fully appreciate how momentous these changes were. I trust that he will see here the echo of such shared events and of our enduring collegiality and friendship.

2. Static dimension: categorization

Excavation reports are aimed at documenting data and showing how they fit together. Even in their most rudimentary form, catalogs of finds are based on categorization systems that imply binary choices, however hidden these may be: they are in fact developed along the lines of a logical tree, where concepts are broken down into progressively narrower subcategories.

The ceramic classification system proposed by Delougaz in 1952[3] is an exemplary model for our purposes, in particular with regard to his classification system. The description he gives of the system is brief: some twenty-five pages, of which the major part is taken up by the definition of the shapes. He outlines a system that is very well thought out and lucidly explained: ten major groups, eight of which can be reduced to a simple or a composite geometrical form, and within each group ten subdivisions, each showing a slight variation of the basic shape, summarized graphically in a chart (Table I, page 11). This results in a "decimal system", as De-

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[2] I have defined this type of digitality in the article "The Question of Digital Thought" in Nikolaeva, Tatiana M. (ed.), *Issledovanija po lingvistike i semiotike (Studies in Linguistics and Semiotics) – A Festschrift for Vyacheslav V. Ivanov*. Moscow: Jazyki slavjanskix kul'tur, 2010, pp. 46–55, and I have further developed it in *A Critique of Archaeological Reason. Structural, Digital and Philosophical Aspects of the Excavated Record*. Cambridge and New York: Cambridge University Press 2017, Part Four. See also the companion website critique-of-AR.net.

[3] Delougaz 1952: 156–161. It was my privilege to have studied briefly under him at the Oriental Institute in the early sixties, and then to serve with him at UCLA where he came in 1967 and with whose support I began to work on the creation of what became the Cotsen Institute of Archaeology. The Institute was established in 1973, two years before his death in the field, at Chogha Mish.

lougaz repeatedly states,[4] and he refers regularly to elements of the system as "ciphers" and "digits". He carries out his system with great rigor, as one sees in the index by period[5] and in the catalog itself; in addition, he also proposed tools for its implementation, in particular a device for measuring[6]. what matters to us here is not so much to explore the details of the system (which, in point of fact, has not been otherwise adopted in the field), but the way in which the concept of data base as is current today has been anticipated by Delougaz: it is an essentially digital system even in a pre-digital era. It was a proper data base, even if not planned for computational use.

The production of data bases is at the start of a digital process. They provide the building blocks for any subsequent analysis, and are specifically construed with a view towards digital analysis. The data can be processed in a variety of different ways, through available programs, commercial and open source, which re-assemble the data at will, including complex sorts, statistical computations, and graphic displays. Several important points need to be stressed here.

The structuring of a data base is profoundly heuristic in its function and intent. When properly construed, a data base is not episodic, i. e., it does not arrange casually the elements, but rather sees them as encased in a comprehensive whole. In this it differs greatly from an inventory: the latter lists, linearly, the elements as found, sorting them according to specific criteria, but without concern for the larger whole within which the pieces fall. A data base, instead, presupposes a matrix, which means that it allows for attributes that may be circumstantially missing in the corpus (the inventory), but are essential for the consistency of the whole. It is in this sense that it is heuristic: it anticipates potentially missing elements, and makes room for them. Thus on the very first page of the Delougaz catalog[7] the first two digits of each vessel shape, which define a type, go from 00 to 05, and then jump to 11; one sees at once that types 06 to 09 (described in the coding system[8]) are missing in this particular corpus (see Fig. 1).

Another central goal of a data base is that it allows for multiple sorts, which would not be possible with a purely linear inventory. This, too, is an aspect that emerges clearly from the Delougaz system: true perhaps to his original training, the system he proposes has a profound architectural sense of structure while being at the same time rooted in a mathematical frame of mind, and it is in this sense that it may be considered conceptually digital, and computational *ante litteram*. See for instance this remarkable statement:

[4] In its abbreviated format, and in particular for the identification of provenience, the system is similar to the Dewey decimal system of library classification, as Delougaz 1952 points out in note 25 on page 21.
[5] Delougaz 1952: 156–161.
[6] Delougaz 1952: 15–16.
[7] Delougaz 1952: Pl. 140.
[8] Delougaz 1952: 7.

> Without changing the order it is still possible to classify vessels in a given group of pottery according to any one of these elements. For instance, by ar-ran- vessels according to the first two digits we obtain a classification based on general form regardless of size. Similarly, if a collection is grouped according to the fourth digit we obtain a classification according to the type of base only. Should it be desirable to group together all spouted vessels, all that is required is to select those whose designations end in 2, 5, or 7.[9]

There is a second important consideration to be made about the conceptual digitality of a data base. By virtue of being part of a matrix, the elements of a data base are of their own nature linked with each other – which is not the case with a linear inventory. This means that any such element is defined not only in itself, but also because of the essential links it automatically implies; not only does an element declare itself, it also invokes essential connections with other specific elements in the matrix. In this respect, too, the system proposed by Delougaz is exemplary. Thus the first two digits in the code of the first vessel in his catalog[10] necessarily "invoke" those that follow: the definition of the first vessel as being of the type 00 is by necessity linked to the next attribute which defines the proportion, in this case identified by the code 0, to be read as "height less than 1/5 of maximum width."[11]

This being said about its digital dimension, the fact remains that any data base is essentially static: it declares a set of conditions, but does not construe an argument. Or, we might say, it is in a potential state to construct an argument.[12] This is so because the attribute matrix that lies behind it anticipates a series of dynamic correlations (such as sorts and links), even though it does not of its own set these correlations in motion. To do this, i. e., to activate the static dimension of a data base, a trigger is needed.

3. Dynamic Dimension – Exo- and Endogenous

The ~~Trigger Comes in Two Forms~~. trigger comes in two forms.

The first operates autonomously, from outside the record: it is an *exogenous* system. This means that the record has first been created, and only subsequently the digital approach is brought to bear on it from the outside. An exogenous system relies on a computer program that, once started, operates from start to finish, for any given operation, on the basis of parameters that have been built into the program and are selectively invoked by the user.

The other is an *endogenous* system. This means that the record in its entirety is born digital, in a conceptual sense. Not operating on fixed parameters, it depends on sequential choices, where both the broader argument and the data are presented in a

9 Delougaz 1952: 10.
10 Delougaz 1952: Pl. 140.
11 Delougaz 1952: 12.
12 For a development of these concepts see Buccellati 2017, especially section 11.4.

format suited for browser access, where recursive procedures (in the linguistic sense of the term) are used to incrementally construct an argument.

3.1 Exogenous systems: data bases and programs

Spreadsheets (such as Microsoft Excel or OpenOffice Calc) and relational data base management systems (such as Microsoft Access or LibreOffice Base) are common types of turnkey programs, both commercial and open source. They trigger the potential aspects of the data base, thus activating its otherwise passive dimension. They are geared to a generic use. If in a primordial way, the process creates an argument: from the collected data, because the output proposes a reconfiguration of the input according to parameters chosen by the user. The term "user" is indicative in this respect: one delegates to the program the faculty to reassemble the *disjecta membra* that have been gathered without knowledge of how they may fit together, and one then proposes multiple different paths towards alternative possible restructured wholes.

Other programs are instead aimed at specific purposes, and serve more specialized aims, all the more so in line with the goal of creating an argument out of multiple discrete data. I will highlight here one such program developed by Federico Buccellati, in connection with our excavations at Tell Mozan, ancient Urkesh,[13] and then broadened to be applicable to any archaeological project. It will serve as a model for what I have in mind when speaking of an exogenous digital system used in the production of the archaeological record.

The program BlockGen produces three-dimensional renderings of architectural volumes (walls), with some significant aspects not found in commercial programs. In the words of the author:

> This website describes BlockGen, a plugin developed for AutoCAD 2012 to produce solid 3D blocks from data collected in archaeological contexts. AutoCAD cannot (at least until 2016) produce a 3D solid object given XYZ coordinates for each corner of the block; this plugin provides that functionality.[14]

There are three aspects in this that should be highlighted (see Fig. 2). (1) The input consists of coordinates for individual points of a wall as regularly taken on the excavation: in other words, the program uses data already collected in the field. (2) The program can be run at will on the excavations, on a normal computer, without any specialized hard- or software (other than AutoCAD 2012). (3) It produces segments of the walls as excavated, not only as reconstructed.

These factors are very significant and relevant for our purposes. In the first place, the results have a high documentary value: the output in fact renders the situation as

[13] Buccellati, F. 2016, the section on BlockGen is given as an Appendix on pp. 279–298. See also Buccellati, F. 2015: 157–169; Buccellati, F. / Kansa 2016: 91–97.

[14] From the introduction to the website available, with the pertinent code, at github.com/fabfab1/BlockGen.

seen in the field rather than an idealized reconstruction; thus it can also render different components of a wall as excavated (this emerges very clearly in the publication of the Urkesh AP palace[15]). And since the program can be run at will, it can easily provide a daily record of the work done, with metrical precision. In this way, it is also extremely useful in terms of the excavation strategy, because in addition to the up-to-date record of the existing remains, one can project what one may expect to find, which conditions the procedure to be used in the subsequent excavation.

It may be said that the program offers a simple and inexpensive equivalent of photogrammetry, obtained not in an applied manner and not through the intervention of specialists,[16] but through the direct and single involvement of the excavator. In this perspective, the archaeologist is neither a programmer nor a simple end user: there is rather a direct involvement precisely qua archaeologist, in the way in which the input data are provided and the way in which the program is run. Here, too, the process generates an argument, however *sui generis*: the discrete elements of the input are reconfigured and produce a given vision of the whole, such as is not otherwise possible.

It is in this close interaction with data and programs that the digital dimension of the archaeological process emerges. It is not only that the result could not be possible without computational means; nor is the running of the program done blindly, as if clicking the shutter of a camera through which an entire scene is caught at once. Rather, the operator must have an intimate (digital) knowledge of the discrete components in function of their being re-assembled graphically in the 3-D rendering. There is a very close interaction between the archaeologist and the data that are summoned to create a finished product, and it is in this that we have the proper digital dimension of the process.

3.2 Endogenous Systems: Browser Editions

Programs operate on a data base according to preset parameters, and thus the “argument” that they create is constrained by these intended limits. But there is another major limitation: the elements of the data base are effectively independent from the broader argument, i. e., from the full reconstruction of the excavation process. They serve the function of a catalog in the traditional sense (save the fact that they are immensely more flexible), and so, they remain subordinate and juxtaposed to the broader “argume[illegible]i. e., to the narrative of the excavation with its results, no matter how extensive the size of the data base and detailed its articulation. Thus it is that, in the final analysis, even an excavation report that extensively uses “digital” means does so in a way that is not fully digital. The broader argument within which the data base is encased is in the form of a linear presentation, and even when this is made available in a “digital” format, and not just in a paper format, the content remains essentially linear. There is, in other words, a real disconnect in standard publications between the broader argument and the data as given in the data base. There

15 See the catalog in Buccellati, F. 2016: 299–350.

16 Thus avoiding what F. Buccellati calls the “UFO problem”, Buccellati, F. 2016: section 5.1.

are two "arguments" that run parallel to each other, without reciprocal interaction: the one that is brought to bear from the outside (exogenously) on the data base, activating its potential, and the narrative which is given in a strictly linear format, even when presented "digitally" (in PDF format). The two exist side by side, they do not speak to each other, there is no reciprocal dialog. The data base remains at the level of a catalog, just as with the Delougaz pottery catalog: this was ahead of its time in proposing a categorization system that was perfectly suitable for digital handling, a conceptually digital catalog in a pre-computational era; but it clearly remained a catalog. It was not, in other words, an integral part of the way in which the broader "argument" was constructed.[17]

To obviate these limitations, I have proposed the concept of a *global record* and of a *browser edition*,[18] which I have applied in the case of the excavations at Mozan, ancient Urkesh. What interests us here are only three points in this regard: the digital underpinnings of the record, the format as a multi-linear browser edition, and the impact on the excavation strategy.

(1) The record is digital not because it is entered in a computer, a process which is obviously the universal rule today. The question regards the physiognomy that the record takes, *the larger framework within which every atomistic observation is encased*. The aim of the Urkesh Global Record is that every single observation ever made during the excavation is recorded in such a way as to be immediately encased in an all encompassing digital matrix, i. e., a matrix that is designed digitally to serve at once the highest nodes of the argument and the lowermost individual components. These components are atomistic in nature because they emerge from the ground without any claim to correlation with each other, save the manner in which they are in contact in the ground (the emplacement). From the stratigraphic moment in the field to the typological moment in the lab, every single observation, even the most minute, flows immediately into this single overall matrix, and so does every photo, drawing, or input from external sources (e. g., the surveyor's measurements), see Fig. 3. The record is thus digital because every single observation or note of fact is *born digital*, with a vocation to being instantly integrated in the all encompassing whole of the system.

(2) The form this takes is that of *a browser edition, which in practice means a website*. What makes this a dynamic process is the close interaction of the arguments in building up the record, whether discursive in nature or in the form of a data base. The hyperlink mechanism makes it possible to pursue a multi-linear argument, enabling the reader to follow multiple themes in an organized manner. Pertinent numbers are significant: for example, the record of an excavation unit like A16, which

[17] It is a situation that mirrors the excavation strategy and process in the way they are generally understood. The depositional and functional understanding of the material excavated takes pride of place, and the data in their atomistic dimension (as given in the catalog) are subordinated to this understanding. By contrast, I see as essential the centrality and absolute priority of emplacement in the excavated record and of the way in which this should be reflected in the conceptual record, see Buccellati 2017, especially chapter 4.

[18] See Buccellati 2006: 49–55.

covers an area of eight 5x5 m loci, with a total volume of approximately 700 cubic meters, contains a total of more than five and half million records and more than one million hyperlinks (urkesh.org/ A16-dataset). But quantity is not an end in itself. It rather means that there are few if any limits to the interaction one can have with both the discursive narrative and the various data-bases that are included in the website.

(3) Finally, the digital dimension has a major impact on excavation strategy: since the totality of the observations made any given day by any member of the staff is processed immediately, and since no record thus entered is ever altered, we have what amounts to *a final publication on a daily basis*, available to all on the excavation. This means that all decisions about the progress of the excavation are based on a full knowledge of the results obtained until that moment, all accessible immediately – both in the form of the data bases and of the overarching argument that is being developed. I view this as the best validation of the digital dimension of the whole system, because it is possible only as a result of the overall approach as described.

4. Data gathering

Data are at the starting point of all analysis, and here, too, the question arises as to the role of digitality in the data gathering process. The first and obvious distinction is between data collection (done manually) and data capture (done automatically). Only the second is viewed as digital. Take, for example, the record of temperature and humidity at a site, which is important when planning for conservation of the exposed portions of the excavations, such as mud brick walls. In the case of our excavations at Mozan, we considered introducing an automated system of data capture, and consulted with our colleagues Neville Agnew and Martha Demas of the Getty Conservation Institute. Together, we decided against it, and opted for a manual type of data collection, with a manual thermometer and a manual hygrometer placed within the walls of the AP palace. How fortunate it was to have done so became clear during the long war period in Syria: having been away from the site for eight years, we have nevertheless been able to maintain the record, replacing easily both instruments when they broke down.

But the reason for mentioning it here is because of how it relates to the question of digitality. We eschewed the (applied) "digital" dimension of data capture, but produced a record which was wholly digital conceptually. This is because the results were entered in the data base of the project, where some preliminary simple tabulations can also be found (urkesh.org/temp, under Full Record): this is perhaps the most complete record for temperature and humidity taken within any archaeological site in Syria. Thus, what makes this truly digital is that it has become part of the broader Urkesh Global Record as described in the preceding section, and as such it can be called upon at will when dealing with other issues not only of conservation, but also, for instance, of excavation strategy (when is the best time to excavate; how to correlate this digital record with the images and videos relating to weather at the site, also available in the website; etc.).

The question of data gathering is of much greater relevance in the case of archaeology than perhaps for any other science. The initial observation of the emplacement is in fact the only evidence that remains, once the excavation proceeds and the evidence so far excavated for the physical record is thereby removed and obliterated. In other words, for most of the excavated material there are no more physical data in the measure in which the excavation has progressed: one simply cannot check the data as they were in the ground, one cannot ever repeat the experiment.[19] Thus it is that the question of digitality becomes imperative for data gathering more than in perhaps any other case, given the necessity of having a system that maintains every single observation ever made during the excavation process. True digitality becomes then an issue that goes well beyond theory and abstraction, and becomes instead a most concrete imperative for keeping the archaeological process within the framework of an arguable analytical process.

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[19] This, too, is a central theme of the thesis I present in Buccellati, G. 2017, especially chapter 15.

Figures

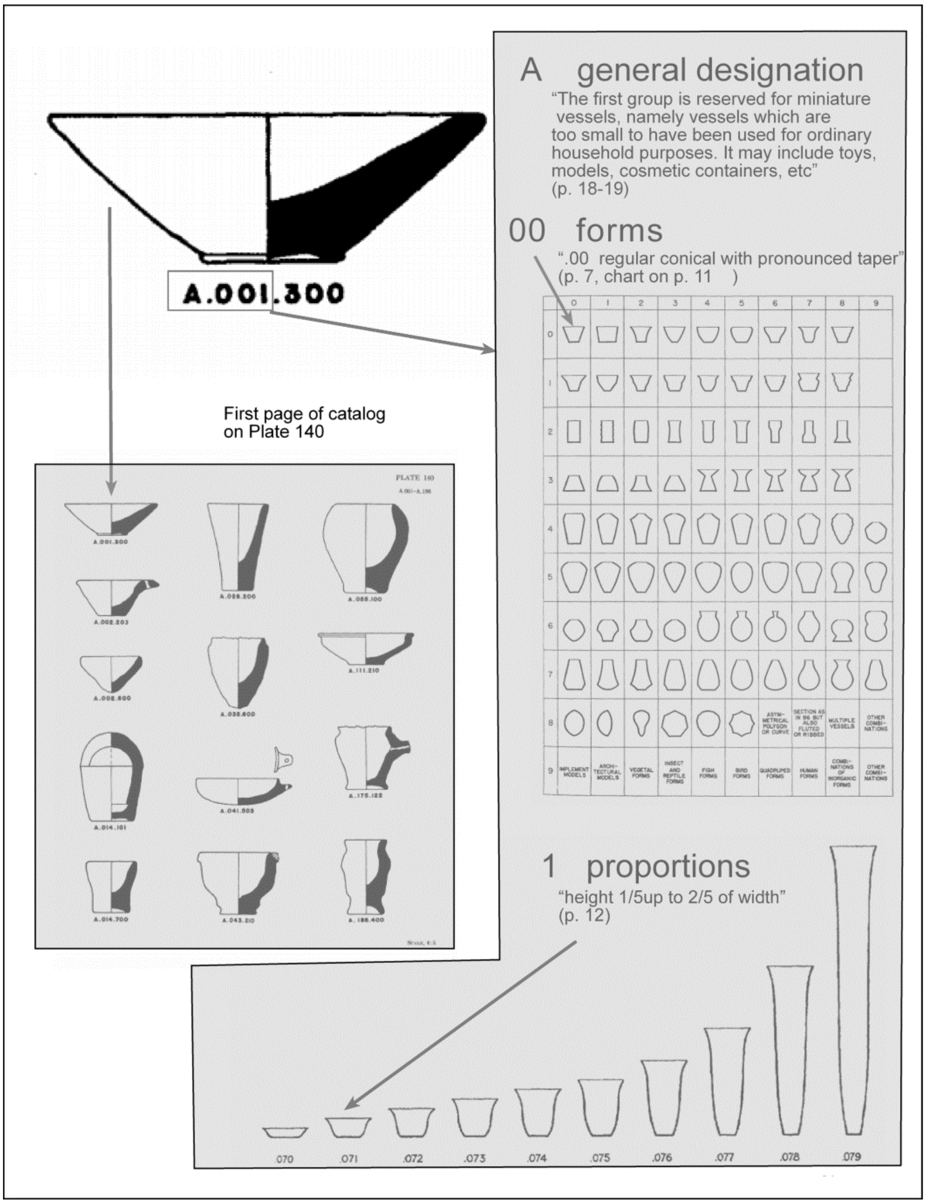

Fig. 1 Categorization. A pre-computational "digital" approach (P. Delougaz, Pottery from the Diyala Region, 1952).

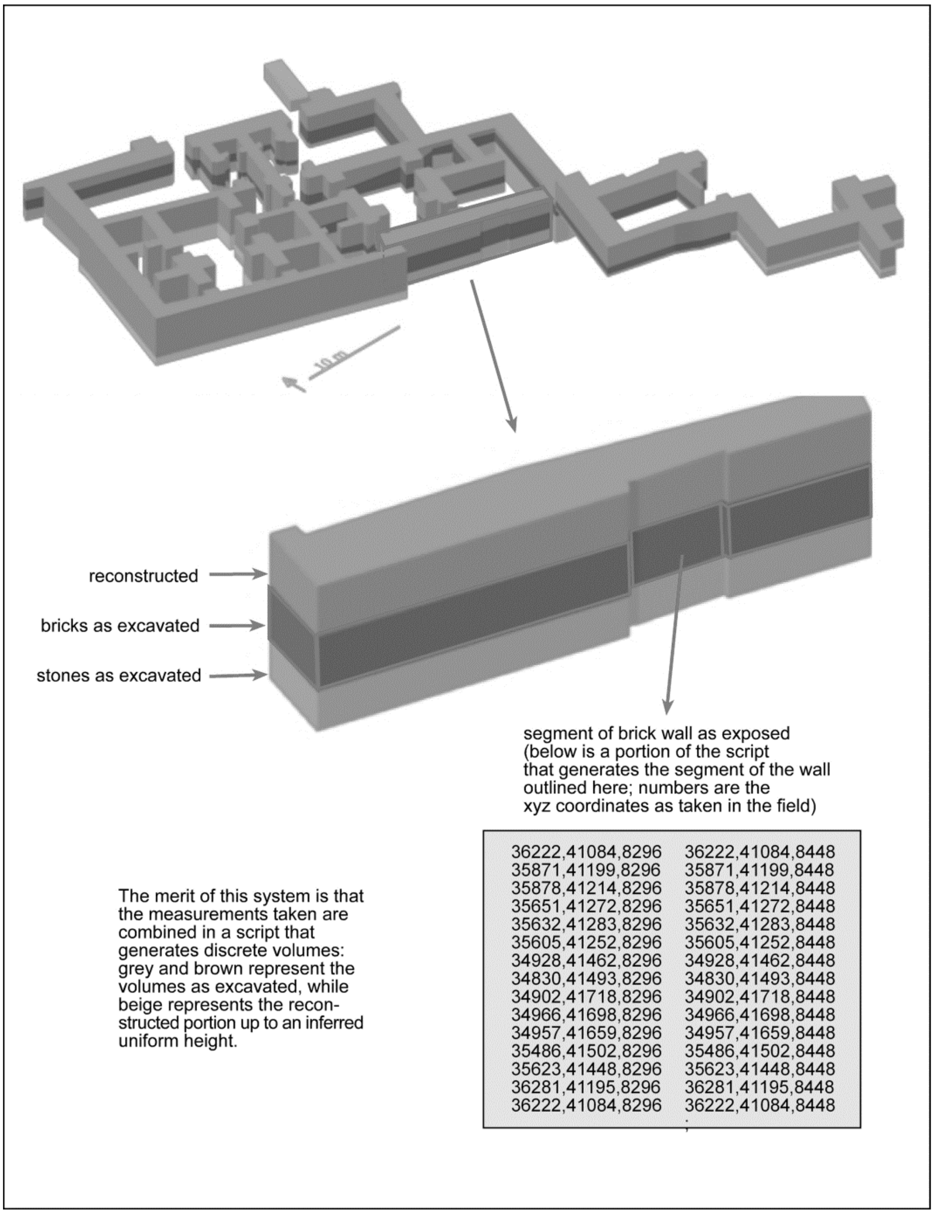

Fig. 2 Exogenous systems. The BlockGen program applied to a specific field situation: the AP Palace at Urkesh (after Buccellati 2016).

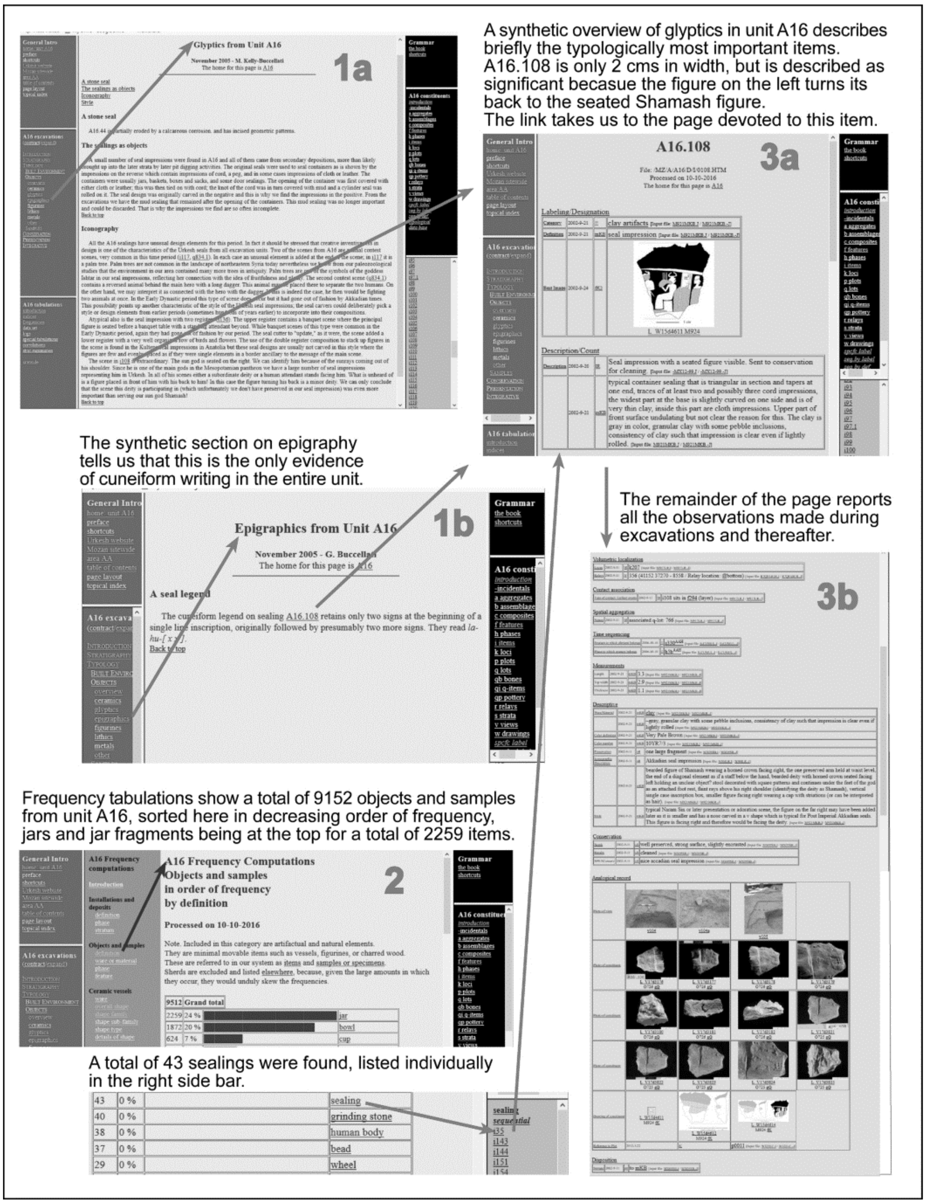

Fig. 3 Endogenous systems. Three parallel inquiry paths from the *Urkesh Global Record*. The first consists of two discursive narratives that deal respectively with glyptics and epigraphy (1a and 1b). The second is in the form of tabulations (2). The third (3a–b) is the full segmented narrative of a single item, an impressed sealing. The narratives interact with each other as indicated by the arrows. They are accessible online at urkesh.org/A16-glypt, /A16-epigr, /A16-freq-od and /A16.108.