Egyptian Archaeology in Need of a Data Turn

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The paper offers a proposal of elementary data formatting for publication, as the various existing approaches may gravely impede any larger syntheses of published data on the level of regions and countries. The key lies in the structuring of the published data, in intentional presentation of data in tabular form whenever possible. These tables ought to parse the data into the smallest possible units, securing a potential for machine-readable processing. The possibilities and limits of suchapproach are herein demonstrated on a particular and specific group of objects, Old Kingdom copper model tools, using the statistical software R.

1 Introduction

The global output of (only) all scientific research articles was estimated to reach 50 million in 2009.[1] Egyptology may be a small discipline in this spectrum of research, yet I hope I am not the only one feeling despair at the number of books and journals in the shelves containing new additions to the library. One cannot read them all, and one never really tries. The computer age offers faster methods of producing texts and forms of instant communication across the globe, but we read at the same pace as before. In our field, the Online Egyptological Bibliography offers now, in June 2020, 149,000 separate records online, adding new ones almost every day, with an estimated 6,000 additions each year.[2] How can we become truly interdisciplinary if the discipline itself has grown vast?[3]

Shall we capitulate? Each one of us is the master of their own specialist fiefdom – that is absolutely all right. Yet somebody sitting next to us might be achieving major breakthroughs e.g. in Egyptian philology, and we can barely notice and hardly appreciate. Is it possible, under such circumstances, to produce a larger synthesis of data?

It is impossible to cover every aspect of the problem; instead of a grand theory, I am offering a proposal of a single fundamental idea. In this paper, I would like to focus solely on the material culture and the form of presentation of data about it. After all, do we even have an idea of how much material, published or unpublished, there is? Taking architecture as an example, we know that there are c. 500 decorated Old Kingdom tombs preserved,[4] but how many undecorated tombs of the same period are there?[5] Porter, Moss, Burney and Málek gathered all inscribed mate-

1 Jinha 2010.

2 oeb.griffith.ox.ac.uk, accessed 29.06.2020.

3 Some of the problems mentioned herein were discussed also by Cruz-Uribe et al. 2013.

4 Linacre College 2007.

5 Old material that is often re-studied and re-dated, e.g. in the case of Meidum, a seemingly one-phase cemetery,

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rial,[6] but what with those thousands of unlucky artefacts bearing no inscription? The current estimate is that there are more than 2 million ancient Egyptian objects in over 850 museums in 69 countries.[7]

I would like to propose an initial step for a "data turn" in Egyptian archaeology. The key lies in the structuring of newly published data, in intentional presentation of data in tabular form whenever possible. Of course, this is often the case, but these tables ought to parse the data into the smallest possible units, securing a potential for machine-readable processing. The possibilities and limits of such an approach are herein demonstrated on a particular and specific group of objects, Old Kingdom copper model tools. Experience obtained on them can be, hopefully, applied also to other types of preserved archaeological evidence.

2 Archaeology and Egyptian archaeology – syntheses and material culture

As regards archaeology, an observation from 2006 is still valid: "... archaeological research remains a mosaic of parochial efforts. ... Research on large geographical areas is particularly difficult at present."[8] If you want to work with a large dataset, the quickest way (measured in years) is to create your own from scratch based on the published literature. While this is the best way, the collection and formatting of the data takes precious time that could be better spent analysing and thinking.

Computers have made it possible to produce longer texts more quickly. However, if we count (Egyptian) archaeology among the humanities, one of the greatest impediments of research is that the researchers often treat computers as typewriters – smarter, less loud and with less effort needed to press the keys, but still essentially as machines destined to produce texts accompanied with textual catalogues of data and illustrated by a "company of images".[9] Even though the digital humanities exist, they tend to be perceived as another "fancy" collocation in our vocabulary rather than as a completely new approach to doing research.[10] In order to achieve this, however, one must perceive the fundamental difference between digitized/digitizable information and mere printed textual information or searchable PDF.

(Egyptian) archaeology is in a phase similar to where classical philology was a hundred years ago. Quoting an early article mentioning computerized texts: "*searching for clusters of words, for metrical patterns and stylistic patterns, and similar philological procedures, can now be done in minutes and hours – where the nineteenth-century scholar spent years of toil*".[11] Texts are, however, easier to be processed by digitization than three-dimensional objects of material culture – and archaeologists are used to the toil, as there is hardly any other option now, especially for intra-site and supra-regional analyses. Forced to remember innumerable entries of the published data, an Egyptian archaeologist spends time that could be devoted to analyses in search for analo-

turned out to be much more complex: Rzeuska 2011; Warden 2015.

6 http://topbib.griffith.ox.ac.uk//index.html, accessed 2.11.2019.

7 http://www.globalegyptianmuseum.org/, accessed 29.11. 2019.

8 Snow et al. 2006.

9 Miniaci et al. 2017.

10 For an overview cf. Wendrich 2018 and for the Egyptology on the Internet, see Claes/Van Keer 2014; Odler 2018.

11 Thomas 1990: 72. For a more recent summary, see e.g. Revellio 2015.

gies. An excellent archaeologist either becomes a specialist in the myriads of monographs, articles and reports and the ways they present the data or a less excellent archaeologist resigns and quotes only parallels from major, most important sites. A synthesis is possible, but only after a lifetime of reading and making excerpts from catalogues.

Numerous monographs on material culture have been published in Egyptian archaeology. Even if we stick to the realm of the copper alloy artefacts (the subject of the following case study), the outputs are manifold.[12] However, any attempt to collect, compare and analyse published or unpublished data means a lot of precious time spent in an effort to accommodate the data to the desired structure, not mentioning the difficulties of accessing the material or travelling to it, if access is allowed at all.

3 A proposal for data analysis

The potential of data structuring and subsequent analysis goes deeper and further. Instead of just looking for parallels in other excavation reports, we could properly analyse statistical data and discover the structures that are "hidden" behind the objects. A solution for material culture studies can lie in a structured and machine-readable presentation of selected data. The data points ought to be parsed into the smallest possible units, thus enabling faster work with them later.

Here I would like to turn away from a detailed presentation of advanced statistical methods.[13] In fact, we can gain fundamental information from data even by using descriptive statistics, which is available in each and every personal computer. Statistical "heavy machinery" of exploratory statistics is often not necessary, although it will be inevitable for the solution of complex problems.

Apart from software present among the applications of any personal computer, often proprietary, the statistical software R can be proposed as another important solution. "*R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS.*"[14] It is a free open-source tool widely used by professionals in the fields of data science, statistics, and many other scientific disciplines. Moreover, you can start using the R software immediately, without any barriers except for the R learning curve. Many textbooks and guides on R exist, freely downloadable on the Internet. Fortunately, archaeology also has its introduction to R, written by Michael Baxter and Hillary Cool, with a PDF version available for free online.[15] In understandable style and clear language, the authors propose many possibilities of data analysis and statistical graphics beyond the ubiquitous and often unnecessary "pie charts". Herein, I would like to apply some of the methods to a selected structured dataset.

4 Case study and proposal of data structuring

An example of the data structuring and simple analysis is provided again in a form of a case study. It is focused on Old Kingdom copper model tools, miniaturized blades of full-size functional tools that were deposited in the bu-

12 Kühnert-Eggebrecht 1969; Lilyquist 1979; Radwan 1983; Davies 1987; Philip 2006; Petschel 2011; Odler 2016, etc.

13 For introduction to them, see e.g. Shennan 1997; Baxter 2003; Baxter 2015.

14 https://www.r-project.org/, accessed on 1.11.2019.

15 Baxter/Cool 2016. See also Carlson 2017.

rial equipment of the Old Kingdom social elite.[16] Several tool kits of the period included copper objects of various uses: artisan, cosmetic, textile and leatherworking, hunting and food processing, weaponry. Standard burial equipment often contained only four classes: chisels, adzes, axes and saws – tools from the artisan tool kit that were used for working wood and stone (Fig. 1). The tomb owner himself or herself – or the person buried in the burial chamber of another tomb owner – did not work with those tools during their lifetime. It was an expression of the owner's social status: this person was capable of ordering and funding craftwork for his or her needs, especially in the creation of the tombs and their functional cultic parts, such as false doors and other decoration.[17]

These model tools were often uninscribed and thus less interesting for publication in detail. In order to document unpublished material and check published objects, the author used a student grant to study them and create a database in the FileMaker software. Four main parameters were recorded for each object or fragment: length, width, thickness and weight, apart from other description entries listed in the monograph. Drawing and photograph documentation was also added, but more complex methods, such as 3D scanning or 3D modelling, were ruled out due to time constraints. Comparative knowledge of the material was gradually acquired, as a direct experience with the artefacts cannot be fully replaced by either the published information or an entry in an online museum database. Archaeology is also a "craft" that must be learned, and such informal knowledge of the material is often difficult to deliver in writing or lecturing; similarly, there are not many texts dealing with crafts written by ancient Egyptians.[18]

This exercise in documentation proceeded from several assumptions. Copper and metals in general are among the items of material culture that were controlled in the Old Kingdom, in the case of metal by weighing.[19] The weight of the objects has been documented, but the original weight of the objects themselves is not accessible due to the corrosion processes in many cases; moreover, smaller model tools may have completely lost their metal cores. Thus, other measurable properties, proxy descriptors, of the objects are observed. The measurements and weights are only proxy data, as we cannot access the objects in their original form, right after the moment of production, in their finished intended shape. Nevertheless, the data cannot be much different from the original size of the objects, if preserved complete.

Besides the measurements, another important descriptor is the completeness. In the stage of analysis, as presented here, only complete artefacts are analysed. In the Old Kingdom, model tools were complemented by small wooden hafts and handles, sometimes bound into bundles or packed in the textile, most probably imitating

16 For a detailed discussion, the reader is referred to the publication of the material in Odler 2016. Only issues relevant to data structuring and data analysis will be highlighted here.

17 For written evidence of contracts between the patrons and the artisans, see Wilson 1947; Müller-Wollermann 1985.

18 For an overview of what we know about ancient Egyptian craft and especially metalworking from ancient Egyptian sources, see e.g. Drenkhahn 1976; Scheel 1985; Scheel 1986; Scheel 1987; Drenkhahn 1995; Davey 2012. As an example of ancient Egyptian text on the craft, cf. Barta 1970; Stauder 2018. On the modern importance of craft and process of its learning, cf. Sennett 2009, although the book lacks substantial information from archaeology, e.g. in a chapter on clay.

19 Scheel 1985; Odler 2016: 29–30, Fig. 11.

Fig. 1: Old Kingdom copper model tools from Abusir South, from Shaft 2 of the tomb AS 29. Following main classes are present: a – chisel blades, b – adze blades, c – axe blades, d – saw blades (photo by Kamil Voděra, © Czech Institute of Egyptology, Faculty of Arts, Charles University, Prague).

real-life storage of the objects.[20] Nevertheless, only the blades were weighed and metal was the material depicted under supervision, not the wooden complements of the models.

5 Complete artisan tool kit blades: a comparison

In this case study, we focus on completely preserved artisan tool kits, meaning that at least a single specimen of each main class – the chisels, adzes, axes and saws – was preserved. Forty such archaeological contexts have survived from the Old Kingdom, defined as Dynasties 4 to 6 (c. 2600–2180 BC), and were documented (Table 1). Even if we limit ourselves to these contexts, the number of preserved specimens is 1,172, which can be considered as an example of ancient Egyptian "big data". The enthusiasm is, however, quickly cooled down by the number of complete specimens (although it is still well over 100 in the case of chisels and adzes) and a subsection of those that could be directly measured (altogether 235 artefacts, or 20 % of the assemblage).

This subset of data was plotted out in several scatter plots, displaying the length of the complete artefacts on the x-axis and the width on the y-axis. When we plot out the measured dimensions, the measurements are apparently different for each of the four classes of model tools. In cases of overlap, the class typology can successfully help in distinguishing between the object shapes (Fig. 2).

20 Odler 2016: 222–223.

Table 1: Tool counts in the Old Kingdom artisan tool kits preserved with all main four classes of tools.

Context (Odler 2016)	Site	Structure	Period
G39	Giza	G 8250	Old Kingdom, Dynasty 4, end
Ay1	Abydos	Tomb 918	Old Kingdom, Dynasty 6
G33	Giza	G 8260	Old Kingdom, Dynasty 4 to 5
Ba4	Bubastis	Tomb 161	Old Kingdom, Dynasty 6, the reign of Pepy II
G45	Giza	G 4360	Old Kingdom, Dynasty 4 to 5
EK2	el-Kab	Tomb of Kaimen	Old Kingdom, Dynasty 6, the beginning
G48	Giza	G 7143, Shaft B	Old Kingdom, Dynasty 5, beginning
A15	Abusir	Burial chamber of Kahotep	Old Kingdom, Dynasty 5, the reign of Nyuserra
G46	Giza	G 4631	Old Kingdom, Dynasty 5, the reign of Weserkaf
A28	Abusir	Tomb AC15	Old Kingdom, Dynasty 5, the reign of Djedkara
G53	Giza	Mastaba of the Shaft 559	Old Kingdom, Dynasty 5, middle
A40	Abusir	Tomb of Qar Jr.	Old Kingdom, Dynasty 6, the reign of Pepy II
G63	Giza	G 8656, Shaft 585	Old Kingdom, Dynasty 5, second half
A41	Abusir	Tomb of Qar Jr.	Old Kingdom, Dynasty 6, the reign of Pepy II
A37	Abusir	Tomb Lake of Abusir 5, Shaft 2	Old Kingdom, Dynasty 6, early
A44	Abusir	Tomb of Inti	Old Kingdom, Dynasty 6, the reign of Pepy II, first half
A31	Abusir	AS 68d, Tomb of Nefer	Old Kingdom, Dynasty 5, late
A46	Abusir	Tomb of Inti	Old Kingdom, Dynasty 6, the reign of Pepy II
G71	Giza	G 8853	Old Kingdom, Dynasty 5, late
A49	Abusir	Tomb of Inti, Burial chamber of Inti Pepyankh	Old Kingdom, Dynasty 6, the reign of Pepy II
G68	Giza	G 4520	Old Kingdom, Dynasty 5, late
G97	Giza	G 2381, Shaft A	Old Kingdom, Dynasty 6, the reign of Pepy II
G50	Giza	G 4920	Old Kingdom, Dynasty 5, end
S2	Saqqara	Tomb of Ptahshepses	Old Kingdom, Dynasty 5, end
G92	Giza	G 8640	Old Kingdom, Dynasty 6, first half
S4	Saqqara	Grave 240 in Mastaba of Kaemsenu	Old Kingdom, Dynasty 5
G88	Giza	Mastaba Lepsius 55	Old Kingdom, Dynasty 5 to 6
G105	Giza	Mastaba with Shafts 125/157	Old Kingdom, Dynasty 6
Gb1	Gebelein	"Large Tomb"	Old Kingdom, Dynasty 5 late or 6
	Sedment	Tomb 2106	Old Kingdom, Dynasty 5 late or 6, Stufe IB
G107	Giza	Mastaba S 309-316, Shaft 316	Old Kingdom, Dynasty 6
G109	Giza	Mastaba of Setka and Ptahhetep, Shaft 890A	Old Kingdom, Dynasty 6
S7	Saqqara	Tomb of Ankhmahor	Old Kingdom, Dynasty 6, early
S9	Saqqara	Tomb of Neferseshemra Shesi	Old Kingdom, Dynasty 6, the reign of Teti
S6	Saqqara	Tomb of Kagemni	Old Kingdom, Dynasty 6, the reign of Teti
S14	Saqqara	Tomb of Khentika	Old Kingdom, Dynasty 6, the reign of Pepy I
Ay14	Abydos	Tomb 747, A.09	Old Kingdom, late / First Intermediate period
Mr1	Meir	Tomb of Pepyankh the Middle	Old Kingdom, Dynasty 6, the reign of Pepy II
G124	Giza	Context IV	Old Kingdom general
G125	Giza	Context VIII	Old Kingdom general
Total			
Total			

Table 1 (continued): Tool counts in the Old Kingdom artisan tool kits preserved with all main four classes of tools.

Region	chisels complete	chisels incomplete	chisels fragment	chisels total	adzes complete	adzes incomplete	adzes fragment
Memphite region	7	1		8	6	2	
Abydos	27	11		38	9	10	
Memphite region	1			1	2		
Delta	4	1		5	1		
Memphite region	7			7		1	
between Thebes and el–Kab	6			6	2		
Memphite region			1	1		1	1
Memphite region	12	1		13	6		
Memphite region	4			4	1	1	
Memphite region	10	3		13	1	1	
Memphite region	19			19	14		
Memphite region	28	4	1	33	6	9	
Memphite region	22	5		27	12	4	4
Memphite region	9			9	6	5	
Memphite region	17	6	6	29	17		2
Memphite region	4	8	29	41		3	20
Memphite region	11		14	25	1	12	5
Memphite region	7	1	19	27	1	2	2
Memphite region	9			9	1		2
Memphite region	35	5	3	43	20		
Memphite region	2			2	2		
Memphite region	11	5	5	21	3	3	1
Memphite region		2	3	5	3	1	1
Memphite region	11	4	1	16	2		
Memphite region	28	2		30	7	3	6
Memphite region	3			3	1		
Memphite region	16	4	1	21			1
Memphite region	5	4		9			2
between Thebes and el-Kab	3			3	3		
between Fayum and Beni Hasan	5			5	2		
Memphite region	8		2	10	1	1	
Memphite region	5		1	6	2	1	1
Memphite region		1		1	1		
Memphite region	3			3	3		
Memphite region	4			4	4		
Memphite region	2			2	2		
Abydos	3			3	10		
Between Amarna and Asiut	14			14	8		
Memphite region	8	1	3	12	6	6	
Memphite region	2	5		7		4	
	372	**74**	**89**	**535**	**166**	**70**	**48**
				535			

Table 1 (continued): Tool counts in the Old Kingdom artisan tool kits preserved with all main four classes of tools.

adzes total	axes complete	axes incomplete	axes fragment	axes total	saws complete	saws incomplete	saws fragment	saws total	Total
8	1	1		2	1	3		4	
19	9			9	5	4	1	10	
2	2			2	1			1	
1		2		2		1		1	
1	1			1		1		1	
2	1			1	1			1	
2		1		1			1	1	
6	3			3	7			7	
2	3			3		2		2	
2		1		1		2		2	
14	6	6		12	5	2		7	
15	15	6	1	22	1	2		3	
20	4	7		11		4	8	12	
11	2			2	2	2		4	
19	9			9			5	5	
23	1		2	3			2	2	
18	1	2		3	1	3	1	5	
5	1	1	3	5			1	1	
3	1			1			2	2	
20	2		15	17	15			15	
2	1			1	1			1	
7		10		10	2	6	6	14	
5		1		1		1	1	2	
2	4	2		6			1	1	
16	1	11		12	2	4	4	10	
1	1			1	1	1		2	
1		1		1		3	1	4	
2			1	1		8	1	9	
3	2			2	1			1	
2	3			3	1			1	
2	2			2		2	1	3	
4			1	1		1		1	
1	1			1		1		1	
3	4			4	1			1	
4	1			1		1		1	
2	1			1	2			2	
10	10			10	4			4	
8	5			5	7			7	
12		4	1	5		6	7	13	
4		2		2	1	6	2	9	
284	**98**	**58**	**24**	**180**	**62**	**66**	**45**	**173**	
284				**180**				**173**	**1172**

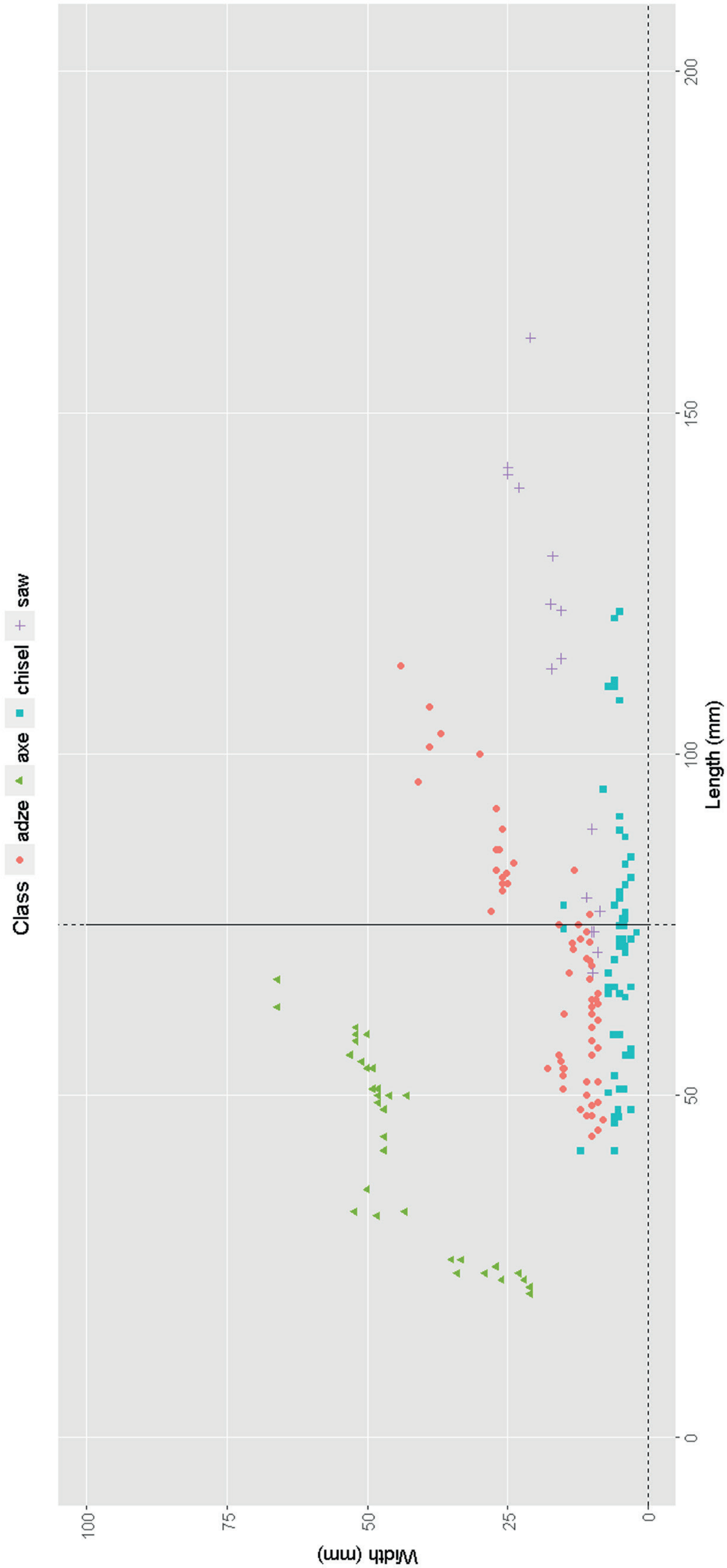

Fig. 2: Scatter plot of the lengths and widths of copper model tools from completely preserved Old Kingdom model tool kits, divided on the basis of the main tool classes. Solid line denotes 75 mm.

The categorization of the data can reveal several important aspects of the subset. Most of the data come from the Memphite necropoleis, especially from Giza and Abusir (Fig. 3). Then, if we compare the dating of the assemblages, most of the complete models of exceptional size are from late Dynasty 6, from the reign of Pepy II (Fig. 4). A closer study leads to an assumption that most of these were under the length of 75 mm, i.e. the ancient unit of one Egyptian palm, one-seventh of an ancient Egyptian cubit (the length of c. 52.5 cm).

Instead of dealing with all classes, let us focus on a measured sample of Old Kingdom adze blades.[21] In absolute numbers, 59 artefacts are longer than 75 mm and 77 specimens are shorter. Statistical graphics offers an advantage, as it demonstrates not only the counts but most importantly the structure of the data. A specific type of boxplots, so-called violin plots, helps to establish that the bulk of the adze blades is concentrated below the level of 75 mm, but not in the case of each variant (Fig. 5).[22] This is also confirmed by a specific type of histogram, the kernel density estimate, which once again demonstrates a concentration of the lengths below the given level (Fig. 6).

6 Discussion of the results

A check of the contexts of longer, exceptional blades, reveals that they most often belonged to high-ranking Old Kingdom officials, their families or members of the royal family (Table 2). On the other hand, many important personages are missing from the table, either having blades shorter than expected or not having measured blades at all. It is important to note that other variables might have also expressed status, including a different alloy (many model tools have not yet been analysed, however) or the gilding of a copper artefact. Such contextual information can also be delivered in tabular form, but it was not examined and published for all contexts. Size could have mattered, but it was most probably not the only variable.

This confirms on the level of funerary material culture an observation Janet Richards made in her study *Society and Death in Ancient Egypt: Mortuary Landscapes of the Middle Kingdom*: "*… (Middle Kingdom) Egyptians may have invested in grave wealth as an alternative to grave size in materializing status*".[23] Such "fuzzy rule" can be applied also to the Old Kingdom and its funerary culture, even within a focus restricted solely to copper artefacts. Bigger does not always mean better; a broader context and socio-cultural setting of the data is important, together with tabular representation of the data.[24]

Old Kingdom written and iconographic sources offer an interpretation of the occurrence of larger model tools, although only by the use of analogy, as they did not inform particularly about the issuance of copper model tools. Larger models could have been issued from the Treasury as a "gift" from the king or the royal administration.[25]

21 On Early Dynastic and Old Kingdom adzes, see Odler 2015. Adze blades have also been analysed using complex methods: Odler/Dupej 2016; therefore, they can be instructive also within descriptive statistics.

22 For the discussion of specific variants and their chronological and chorological meaning, see Odler 2016: 140–142.

23 Richards 2005: 175.

24 I have dealt with these issues in detail in this article: Odler in press.

25 Discussed in Odler 2016: 233–235. Old Kingdom evidence of objects issued from Treasury is listed in Desplancques 2006: 200–206.

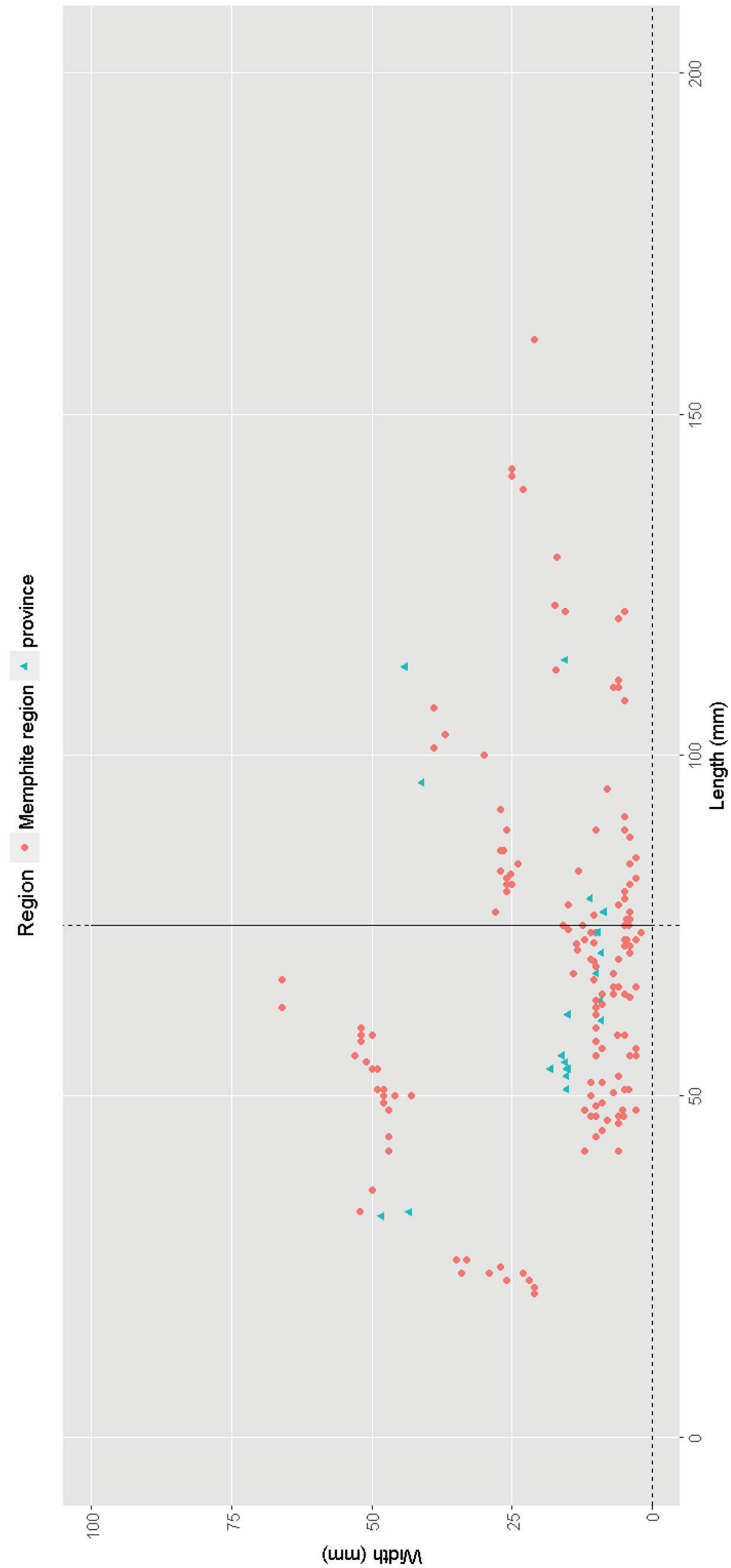

Fig. 3: Scatter plot of the lengths and widths of copper model tools from completely preserved Old Kingdom model tool kits, divided on the basis of the provenance of tool kits. Solid line denotes 75 mm.

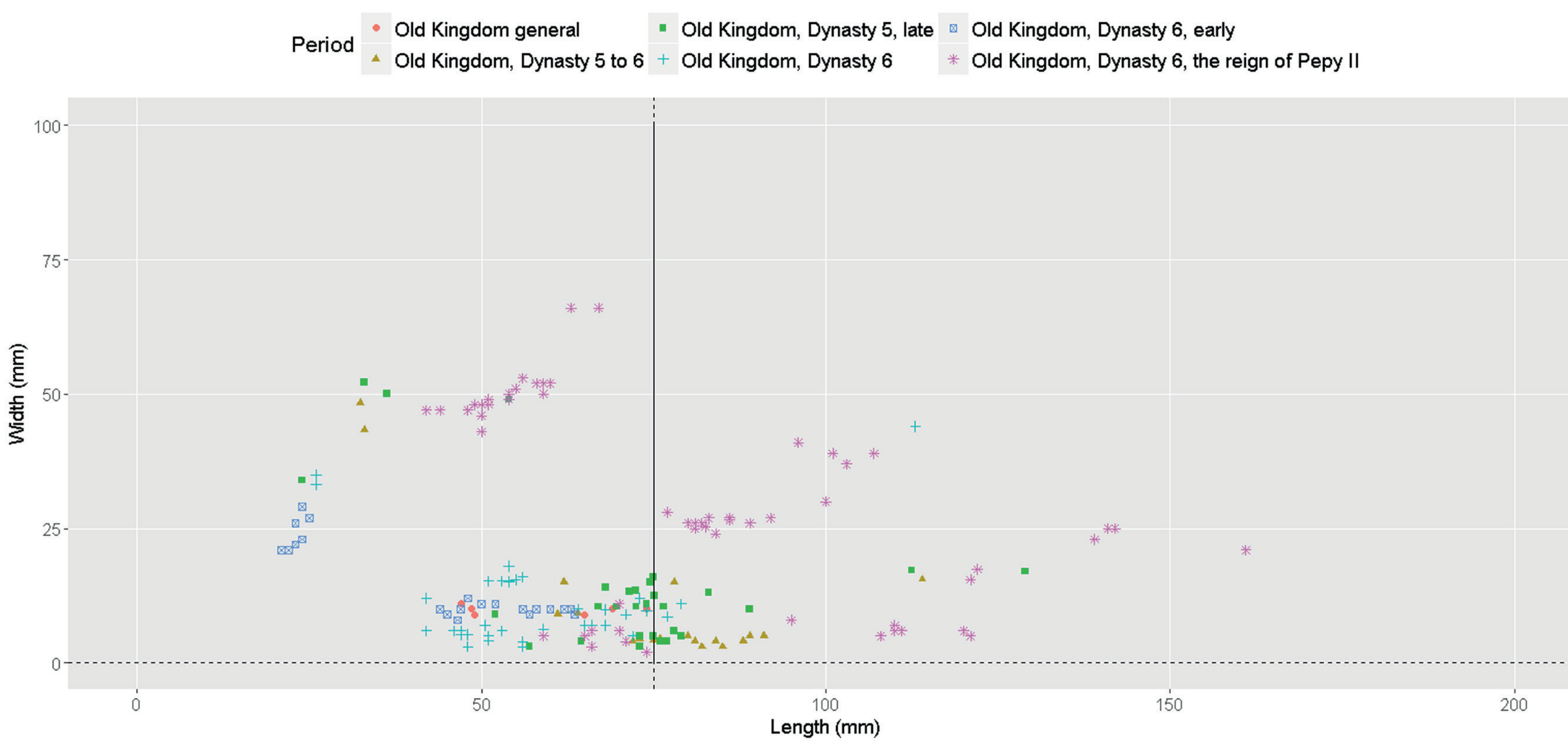

Fig. 4: Scatter plot of the lengths and widths of copper model tools from completely preserved Old Kingdom model tool kits, divided on the basis of the dating of corpora. Solid line denotes 75 mm.

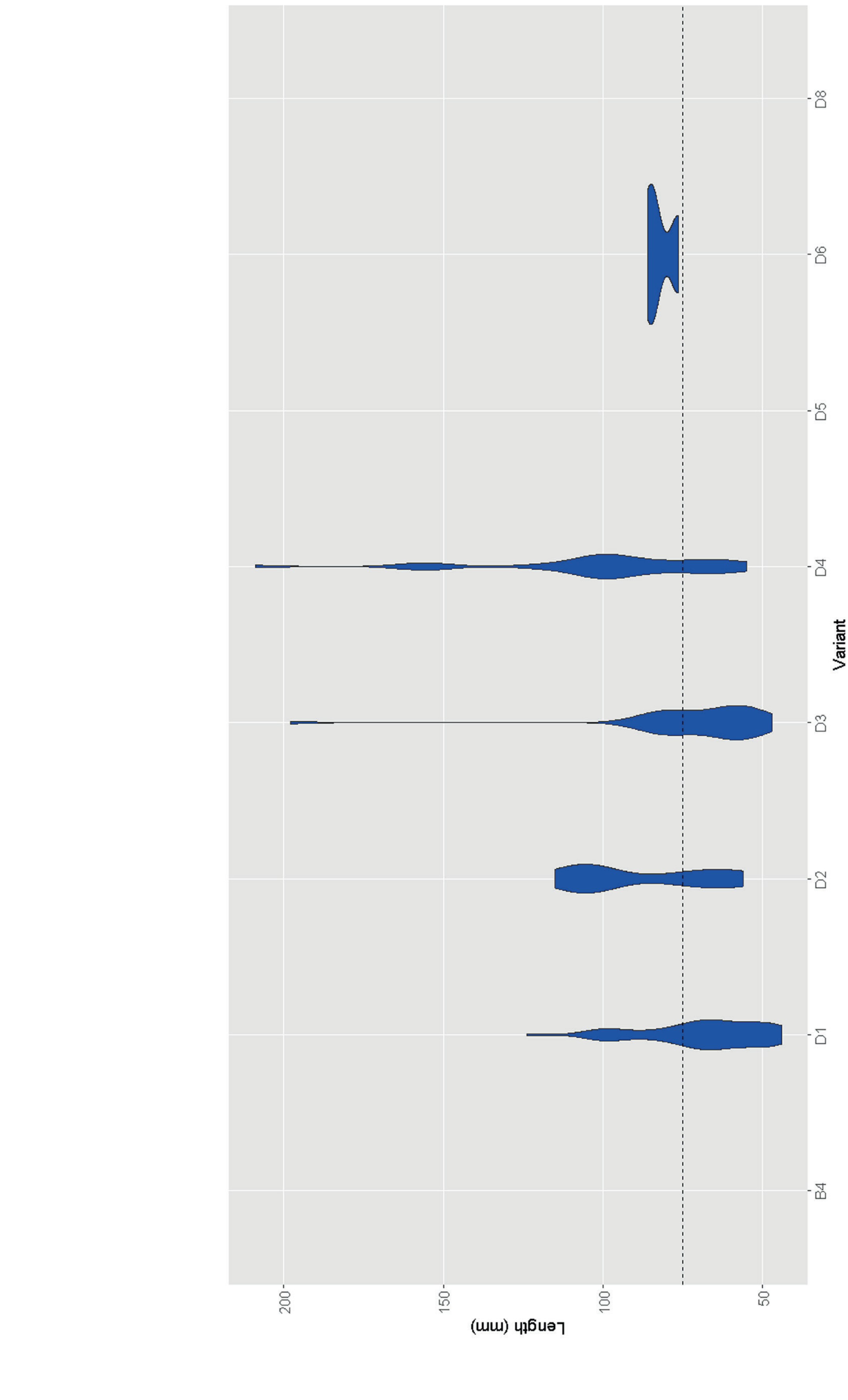

Fig. 5: Violin plots of the lengths of complete Old Kingdom adze blades, divided on the basis of adze variants. Dashed line denotes 75 mm.

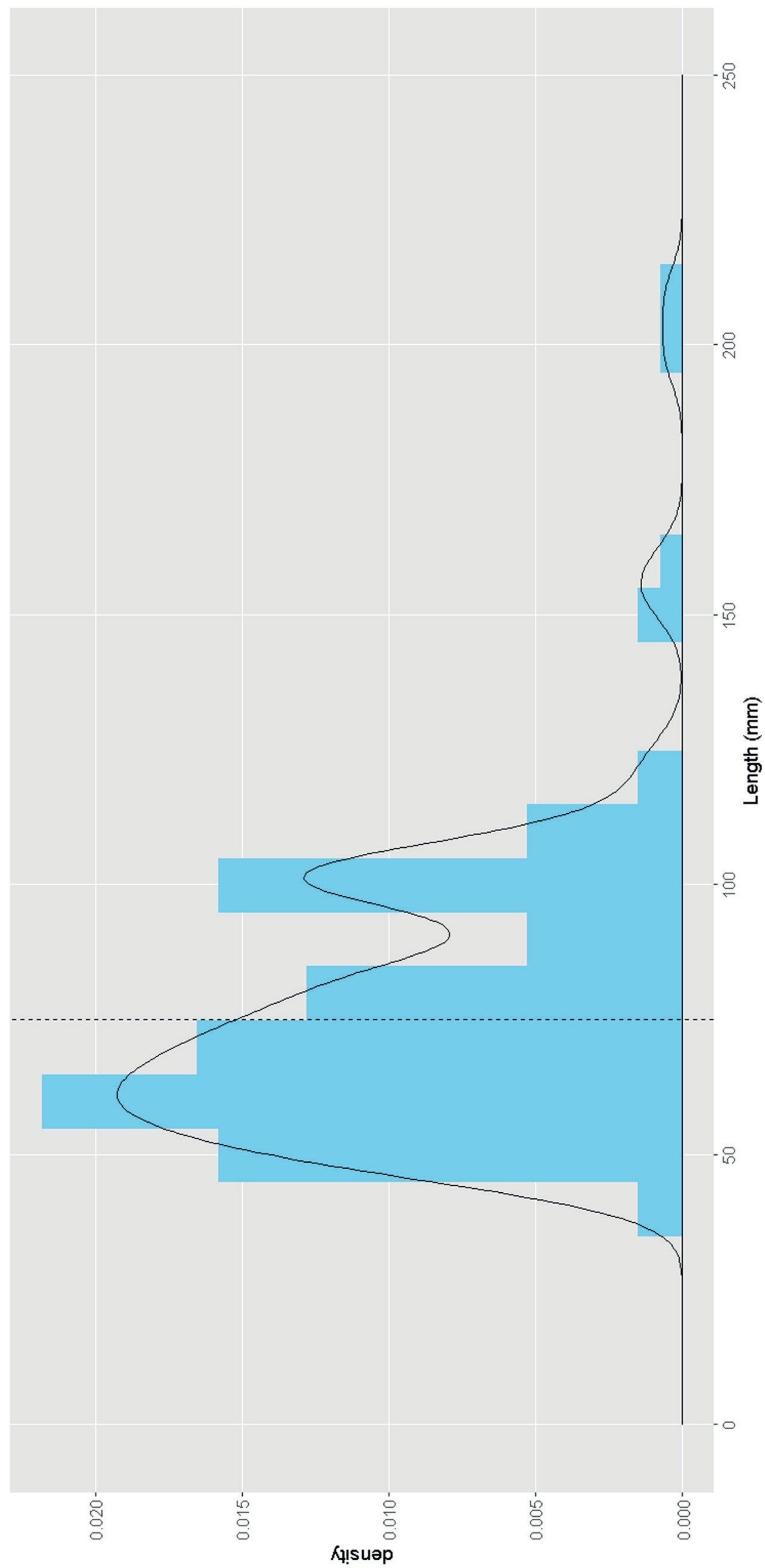

Fig. 6: Kernel density estimate of the lengths of complete Old Kingdom adze blades. Dashed line denotes 75 mm.

Table 2: Old Kingdom model tool assemblages with blades longer than 75 mm.

Site	Structure	Owner	Tools	Period	Social status
Abusir	Tomb of Princesses Khaemerernebty and Meretites, and Kahotep	*Kꜣ(=j)-ḥtp*	adzes, saws	Old Kingdom, Dynasty 5, the reign of Nyuserra	sole companion
Abusir	Tomb AC15	*Ḫkr.t-Nb.ty*	chisel	Old Kingdom, Dynasty 5, the reign of Djedkara	princess
Giza	Context IV	unknown	saw	Old Kingdom, Dynasty 5 to 6	unknown
Giza	Mastaba Lepsius 55	*Ny-ꜥnḫ-Rꜥ(.w)*	chisels	Old Kingdom, Dynasty 5 to 6	inspector of physicians of the Great House
Abusir	AS 68d, Tomb of Nefer	*Nfr-Ḥwt-Ḥr.w*	saw	Old Kingdom, Dynasty 5, late	spouse of a middle-ranking official
Giza	G 4520	*Ḫw(j)=f-wj-ꜥnḫ*	chisel	Old Kingdom, Dynasty 5, late	singer and khentyesh
Giza	G 4920	*Ṯn.tj*	adzes, chisels	Old Kingdom, Dynasty 5, end	sole companion, controller of the palace
Abydos	Tomb 918	unknown	adzes, saws	Old Kingdom, Dynasty 6	unknown
Abusir	Tomb of Inti	*Jn-tj*	adzes, chisels	Old Kingdom, Dynasty 6, the reign of Pepy II, first half	judge
Abusir	Tomb of Inti, Burial chamber of Inti Pepyankh	*Jn-tj ꜥnḫ-Pp.y*	adzes, chisels	Old Kingdom, Dynasty 6, the reign of Pepy II	scribe of the royal documents in the king's presence
Abusir	Tomb of Qar Jr.	*Kꜥr*	adzes, chisels, saws	Old Kingdom, Dynasty 6, the reign of Pepy II	judge
Bubastis	Tomb 161	*Mr(j)-Mr-n-Rꜥ.w*	adzes, chisels	Old Kingdom, Dynasty 6, the reign of Pepy II	sole companion
Giza	G 2381, Shaft A	*Mr(.y)–Ptḥ–ꜥnḫ Mr(.y)–Rꜥ.w Špss-Ptḥ Jmp.y*	adzes, chisels, saws	Old Kingdom, Dynasty 6, the reign of Pepy II	vizier
Meir	Tomb of Pepyankh the Middle	*Ḥw.t–jꜥḥ*	chisels	Old Kingdom, Dynasty 6, the reign of Pepy II	spouse of a nomarch

Table 3: Examples of the data presentation.

A	Category	Class	Type	Variant	Completeness	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
	model blade	adze	D	D1	incomplete	97	18	2	8.9

B	Category	Class	Type	Variant	Completeness	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
	model blade	adze	D	D1	incomplete	97	18 + x	2	8.9

C	Category and class	Variant	Completeness	Dimensions	Weight
	model adze blade	D1	incomplete	97 × 18 + x × 2 mm	8.9 g

An inscription is not needed if the "high-status" connotation is understood by the society or if the inscriptions were present on other objects coming from the king. Singer Khufuankh's false door was a gift from the king, as an inscription on it states clearly.[26] Did this royal favour extend to the burial equipment, as among the model tools was also a single specimen longer than 75 mm?

7 Structured data

If you open any publication of "material" from ancient Egypt, many pages are devoted to its catalogue presentation. However, analytical work is only possible after investing considerable effort in transcribing the data into a structure, nowadays preferably machine-readable. A data structuring proposal is offered in Table 3. Sample A divides all information and is the preferred template used in this study. Sample B adds more complex information about the completeness of the data, but it may complicate machine processing. Sample C is the least user-friendly, merging many data points into one field. Sample A can be processed using an OCR software, although after the publication of a corpus, there is no reason not to offer the data in an openly accessible form, as a structured computer file.

What I have tried to argue in this article is that at least part of the data should be parsed into the simplest possible units. Such units are machine readable and can be easily imported and worked upon. On the other hand, detailed descriptive catalogue presentations can impede its processing.

This contribution presents a fundamental approach to data structuring applicable virtually on any computer, even on simpler ones. I have tried a similar approach in the presentation of data on Old Kingdom copper vessels found in the burial equipment of Inti Pepyankh from Abusir South (Table 4).[27] Another practical example of a formatting of archaeological data is represented by our recent archaeological report on the excavations of the tomb AS 104 at Abusir South, where this approach was used for presentation of the metric data on offering basins and shafts.[28] A similar approach was applied also in author's PhD thesis, completed and submitted in March 2020.[29] As a commendable example on wider scale outside of our field, we can mention a recent monograph on a category of Bronze Age Scandinavian objects with fundamental measurements of the objects presented in a table rather than in a catalogue.[30]

8 Complex approaches to analyses

Naturally, more complex analytic methods are also available. In the monograph mentioned above, case study was devoted to a morphometric analysis of the Old Kingdom adze blades, based on geometrical morphometry and principal component analysis and providing results similar to our basic approach. We have applied geometrical morphometry to represent the shapes of 199 complete Old Kingdom adze blade outlines; a peculiarity of information processing by the software Morphome 3CS enabled also the analysis of adzes not included in the plots presented above.[31]

26 Museum of Fine Arts, Boston, accession number 21.3081, https://collections.mfa.org/objects/144615/false-door-of-khufuankh, last accessed 29.11.2019.

27 Published as Table 1 in Odler 2017.

28 Odler/Peterková Hlouchová et al. 2019, Tables 1, 2.

29 Odler 2020.

30 The monograph is available in open access, the referred table is Table 1 in Nørgard 2018.

31 Odler/Dupej 2016.

Table 4: An example of the data publication, parsed into separate data units (published in Odler 2017: Table 1).

Find no.	Owner	Category	Type	Completeness	Diameter (mm)	Height (mm)	Base diameter (mm)
101/AS22/2000_rr	Inti	miniature vessel	bowl with flat base and concave sides	complete	70	13	22
108/AS22/2000_y	Inti	miniature vessel	convex bowl	fragment			
127/AS22/2002_a	Inti Pepyankh	miniature vessel	nemset vessel	complete	48	171	83
127/AS22/2002_a	Inti Pepyankh	full-size vessel	lid of nemset vessel	complete	80	67	40
127/AS22/2002_b	Inti Pepyankh	full-size vessel	spouted jar	incomplete	68		
127/AS22/2002_b	Inti Pepyankh	full-size vessel	wash basin	incomplete	280	146	138
127/AS22/2002_c	Inti Pepyankh	full-size vessel	spouted jar	complete	66	225	112
127/AS22/2002_c	Inti Pepyankh	full-size vessel	wash basin	complete	330	165	177
127/AS22/2002_d	Inti Pepyankh	full-size vessel	hes vase	complete	72	278	53
128/AS22/2002_d	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	59	25	32
128/AS22/2002_e	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	52	22	29
128/AS22/2002_f	Inti Pepyankh	miniature vessel	hes vase	incomplete	28	92	24
128/AS22/2002_g	Inti Pepyankh	miniature vessel	hes vase	complete	30	94	26
128/AS22/2002_h	Inti Pepyankh	miniature vessel	cup with pointed base and flaring rim, S-shaped section	complete	36	65	
128/AS22/2002_i	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	58	27	33
128/AS22/2002_j	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	59	25	32
128/AS22/2002_k	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	51	20	30
128/AS22/2002_l	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	50	22	29
128/AS22/2002_m	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	52	22	32
128/AS22/2002_n	Inti Pepyankh	miniature vessel	bowl with flat base and inclining sides	complete	51	24	29
130/AS22/2002_a	Inti Pepyankh	miniature vessel	censer on foot: lower part	complete	83	111	38
130/AS22/2002_a	Inti Pepyankh	miniature vessel	censer on foot: lid	complete	82	47	82
130/AS22/2002_b	Inti Pepyankh	miniature vessel	spouted carinated bowl on stand: bowl	incomplete	107	39	
130/AS22/2002_b	Inti Pepyankh	miniature vessel	spouted carinated bowl on stand: stand	complete	26	35	44
130/AS22/2002_c	Inti Pepyankh	miniature vessel	kebeh vessel	incomplete	33	113	31
130/AS22/2002_d	Inti Pepyankh	miniature vessel	bowl with convex base and vertical side	complete	118	19	
130/AS22/2002_e	Inti Pepyankh	miniature vessel	stand	incomplete	41	111	67
130/AS22/2002_f	Inti Pepyankh	miniature vessel	spouted jar	complete	16		25
130/AS22/2002_f	Inti Pepyankh	miniature vessel	wash basin	complete	101	56	49
130/AS22/2002_g	Inti Pepyankh	miniature vessel	nemset vessel	complete	27	56	25
130h/AS22/2002	Inti Pepyankh	miniature vessel	spouted jar	complete	20	59	29
134/AS22/2002	Inti Pepyankh	miniature vessel	spouted convex bowl	incomplete	115	22	
135/AS22/2002	Inti Pepyankh	miniature vessel	spouted convex bowl	fragment			

More complex structure of the data was uncovered, with some persons of higher status having rather small objects and vice versa. Continuing in this line of research, a paper is being written on the results of the application of artificial neural networks to a selection of data on Old Kingdom model tools, namely chisel blades.[32]

The case study is demonstrably material-dependent – we need first to have an idea of what can be done with a particular material and then accommodate the structure of the data to the formulated questions and working hypotheses. However, preserved material culture is usually represented by a stable set of data representing measurements and a description of other features and traits. By combining statistics with contextual information, we might be able to address the issues of the differences in the production and their meaning. Thus, it could be possible to reach beyond the simple search for analogies in other excavation reports.

A reader who expected a sophisticated treatise with showing off of the latest and most complex statistical methodology will probably be disappointed. What I wanted to demonstrate is that the fundaments of our approach to data and its structure need to be clear and simple to explain. Only detailed analytical parsing of data enables a later synthesis with datasets from other disciplines, such as archaeometallurgy in the case of copper artefacts, or with GIS data on sites and tombs, making spatial analysis possible. In selecting of the vocabulary, existing thesauri might be of help, e.g. Thot.[33] Fundamental explanations of database systems are also available.[34]

9 Conclusion

The aim of this article is to demonstrate that a simple description of the finds can lead to complex thoughts about their interpretation. Ancient Egyptian culture, with its rich material culture that is often mentioned or explained in ancient Egyptian texts and iconography, offers intriguing possibilities of intra-site, regional and supra-regional studies. This is especially the case for objects that were produced in regularized forms and shapes. In order to save time in data formatting, we have to think about their most useful initial structure first. Herein, I tried to propose a tabular representation parsing the information into the smallest possible units. Hopefully, this paper opens the discussion on the most useful possible ways of data presentation in the Egyptian archaeology, in the so-called "computer age".

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32 Daniel Gaude Fugarolas – Martin Odler, Whose tools are these? Artificial neural network applied to the classification of Old Kingdom Egyptian chisels, in preparation.

33 http://thot.philo.ulg.ac.be/index.html, last accessed 20.11.2019.

34 Adams/Strudwick 2008; Bergman 2008.

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