Old Kingdom Copper Tools and Model Tools

Martin Odler

with contributions by

Jiří Kmošek, Ján Dupej, Katarína Arias Kytnarová, Lucie Jirásková, Veronika Dulíková, Tereza Jamborová, Šárka Msallamová, Kateřina Šálková and Martina Kmoníčková

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To my parents
and grandparents

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11.1. Archaeometallurgical study of copper alloy tools and model tools from the Old Kingdom necropolis at Giza

Jiří Kmošek[789] – Martin Odler[790] – Tereza Jamborová[791] – Šárka Msallamová[792] – Kateřina Šálková[793] – Martina Kmoníčková[794]

Introduction

Archaeometallurgical analyses of ancient Egyptian artefacts are needed in order to better understand the context and development of ancient Egyptian metallurgy. This archaeometallurgical study was carried out within the project *Early Copper Metallurgy in Ancient Egypt – a case study of the material from* Ägyptisches *Museum der Universität Leipzig*. The two-year project, funded by the Grant Agency of the Charles University and University of Chemical Technology, started in 2015 and focuses on artefacts in the collection of the Egyptian Museum – Georg Steindorff – of the University of Leipzig (ÄMUL) (Figure 225).

Arsenic copper alloys

Arsenic is a characteristic admixture of many copper ores and, therefore, we can found traces of arsenic in most ancient Egyptian objects made of copper alloys. It is generally assumed that copper objects with arsenic content over the limit of 1 weight % are products of deliberate use of arsenic rich copper ores or of intentional combining of arsenic and copper ores.[795] Arsenical copper had been used from the Naqada culture until the Second Intermediate period; since the Middle Kingdom, arsenical copper alloy was gradually replaced by tin bronzes.[796] The average arsenic concentration in Egyptian artefacts made from arsenical copper was in the range of 2–3 weight % up to the Middle Kingdom; afterwards, the concentration of arsenic slightly decreased.[797] The composition of arsenical copper alloy working tools and their models seems to be very similar.[798] The production of arsenical copper alloys can be accomplished through several metallurgical processes, namely the smelting of secondary copper ores rich in arsenic or co-smelting under reduction condition of copper ores with oxides or sulphides containing arsenic.[799] The alloys copper arsenate olivenite ($Cu_2(AsO_4)(OH)$) or copper sulpharsenide enargite (Cu_3AsS_4) could be used for the production of arsenic copper, while copper ores with sulpharsenide ore of iron – arsenopyrite (FeAsS) were usable for the co-smelting process.[800] Sulphide ores cannot be reduced directly by carbon monoxide and need to be roasted and transformed from a sulphide into an oxide form before the reduction. The roasting of arsenic ore arsenious trioxide (As_2O_3) produces a white fume or smoke which causes serious and long-term health hazards to the human body.[801]

Copper arsenic alloys offer some advantages in casting and mechanical properties in comparison with pure copper. With increasing amount of arsenic in a copper alloy, the melting point of the resulting alloy decreases.[802] The melting and alloying processes of copper-arsenic alloys under oxidizing conditions are accompanied with a loss of arsenic, due to its high volatile properties at higher temperatures.[803] On the contrary, melting and alloying of this alloy under highly reducing conditions is not accompanied by the loss of arsenic and the formation of white vapours of arsenic oxide.[804] The large solidification temperature interval of the copper-arsenic system results in a microsegregation tendency connected with non-equilibrium solidification.[805] The consequence of this phenomenon in alloys containing less than app. 25% is the formation of γ-phase Cu_3As; it could be also visible in non-equilibrium copper alloys containing 3% of arsenic.[806]

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[789] Department of Metals and Corrosion Engineering, University of Chemistry and Technology, Prague.

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[791] Department of Metals and Corrosion Engineering, University of Chemistry and Technology, Prague.

[792] Department of Metals and Corrosion Engineering, University of Chemistry and Technology, Prague.

[793] Department of Metals and Corrosion Engineering, University of Chemistry and Technology, Prague.

[794] Department of Metals and Corrosion Engineering, University of Chemistry and Technology, Prague.

[795] Moorey (1994); Craddock (1976).

[796] McKerrell (1993); Philip (2006, 212).

[797] Cowell (1986, 99).

[798] Cowell (1986, 99).

[799] Tylecote (1992, 10); Lechtmann and Klein (1999, 498).

[800] Lechtmann and Klein (1999, 498).

[801] Lechtmann and Klein (1999, 499).

[802] Subramanian and Laughin (1988).

[803] McKerrel and Tylecote (1972).

[804] Budd (1990).

[805] Subramanian and Laughin (1988).

[806] Northover (1989).

Figure 225: Set of analyzed artefacts. Dashed lines and arrows indicate the sampled locations (Photo J. Kmošek, © Faculty of Arts, Charles University, Czech Institute of Egyptology).

Context	ID of artefact	Artefact	Site	Period	Length (mm)	Width (mm)	Height (mm)	Weight (grams)	Analysis*
G66	ÄMUL 2118	model chisel	Giza	Dynasty 5 [PM]; late Dynasty 5 [Smith], reign of Nyuserra [Ziegler]	78	6	2	5.3	XRD
G91	ÄMUL 2120	model chisel	Giza	late Dynasty 5 – early Dynasty 6 [Giza–Projekt]	64	3	2	2.1	ED-XRF, OM, XRD, SEM/EDS
G90	ÄMUL 2129	spatula/ ingot?	Giza	late Dynasty 5 – early Dynasty 6 [Spiekermann]	92	16	2	6.7	ED-XRF, OM, SEM/EDS, micro HV
G81	ÄMUL 2130	razor	Giza	Dynasty 5 end or Dynasty 6 [PM]	100	45	11	47.4	OM, XRD, SEM/ EDS
G85	ÄMUL 2131	razor	Giza	Dynasty 5-6	122	57	4	34.4	ED-XRF, OM, SEM/EDS, XRD, micro HV
G82	ÄMUL 2170	model chisel	Giza	late Dynasty 5 [Jirásková]	148	7	2	15.9	ED-XRF
–	ÄMUL 2600	chisel	Giza	Dynasty 5-6	71	6	5	9.3	ED-XRF
–	ÄMUL 5513	razor	unknown	Dynasty 6	143	59	3	55.8	ED-XRF, OM, SEM/EDS, micro HV
* OM: Optical Microscopy; XRD: X-Ray Difraction nalysis; ED-XRF: X-Ray Fluorescence Spectrometry; SEM/EDS: Scanning Electron Microscopy with X-Ray Energy Dispersive analyzator; micro HV - Vickers Microhardness testing									

Figure 226: Summary of parameters of the analyzed set of artefacts.

A deliberate addition of arsenic in copper is mostly associated with improved mechanical properties of the resulting alloy. The mechanical hardening processes most often consist of a final cold hammering operation after the forging and annealing cycles. The hardness of metallic objects is determined mainly by the composition of the alloy and by the degree of thermomechanical processing. The ductility level is almost constant until the solid solubility limit of arsenic in copper is reached (about 8 weight % of As in the equilibrium system); with higher concentrations of arsenic, the metal may become brittle. No significant relation between the arsenic content and the measured hardness in non-worked state was found, as the results of recent research have shown.[807] The hardness of the manufactured artefacts was achieved intentionally above all by cold hammering operations in the final step of the artefact fabrication.[808]

[807] Lechtmann (1996, 494); Pereira *et al.* (2013, 2052).
[808] Budd and Ottaway (1995).

Elimination of the hardening effect, which is necessary if the material is to be deformed to a higher degree, was performed by annealing operations. Arsenic copper recrystallizes at temperatures ranging from 300 to 400°C[809], but a temperature up to 600°C is needed for complete recrystallization of the whole microstructure.[810]

Corrosion deterioration of artefacts

The evaluation of the impact of corrosion damage on the examined archaeological artefacts is necessary for the correct interpretation of the results obtained from the chemical and phase composition analysis. Due to long deposition in a sandy environment and their extraction from the sand, archaeological objects made of copper alloys are exposed to external influences, above all of oxygen, moisture, chloride ions, etc. These influences have a negative impact on the material substance of artefacts and lead to their degradation and, in extreme cases, to the complete disappearance of the metallic core of the artefacts and loss of important information. The surface layers of buried copper alloys usually consist of a bottom layer of red cuprous oxide cuprite, which usually indicates the limit of the 'original surface' of the artefact.[811] Copper corrosion products with oxidation state +I are usually covered by outer layers of green or blue copper compounds in oxidation state +II, which consist of one or more copper salts.[812] In an aggressive environment, these corrosion processes continue until the whole metallic core of the artefact is completely corroded. The corrosion products usually contain particles of the sand environment, such as quartz, gypsum, rutile etc. The biggest problem associated with the material survey of archaeological metal artefacts is their significant corrosion damage, which influences the chemical composition and mechanical properties of the artefacts. Valuable information can sometimes be retrieved from corroded metallic fragments, as parts of their structure may remain uncorroded, or a pseudomorphic replacement of the phases by the corrosion products may occur. Corroded metallic artefacts are usually studied in the form of drilled powder samples or cross sections, which allows partial elimination of errors caused by the corrosion damage and the presence of corrosion products on their surface.

Methodology

The eight sampled artefacts can be dated to the Old Kingdom and with one unprovenanced exception, they were found at Giza (Figures 225 and 226). Four of them were chisels, two from each of Tombs D 37, Shaft 1 (ÄMUL 2118) and D 44 (ÄMUL 2120). The first one is datable to the reign of Nyuserra and the latter to late Dynasty 5 or early Dynasty 6. Both of them represent cross-cut chisels of Variant D1 with two bulges, the most frequent Old Kingdom copper alloy model chisel. The chisel from Tomb D 7, Shaft 1 (ÄMUL 2170) is a model blade of Variant G4 imitating full-size picks. The fourth chisel is flat, with a single bevel and flared blade. It was found during the excavations of the mastabas at Giza by Georg Steindorff (ÄMUL 2600). The burr indicates that the chisel was actually used as a chisel, rather than as a model. Its Old Kingdom dating is, however, uncertain. Three razors were analysed as well. Two full-size razor blades were found at Giza in Tombs D 15, Shaft A (ÄMUL 2130) and D 203, Shaft 1 (ÄMUL 2131), both of them are most probably from late Dynasty 5 or early Dynasty 6. They represent Type C of razor blades, with an attached tang. The third razor blade (ÄMUL 5513) is unprovenanced but on the typological basis (wide blade), it can be dated to late Dynasty 6 and assigned to Type B7 of razor blades. It was made of a sheet and therefore most probably served as a model of razor blades. One artefact, fragmentarily preserved ÄMUL 2129 from the tomb D 208, Shaft 9, was named as a cosmetic spatula in the literature, datable to late Dynasty 5 or early Dynasty 6. It has been proposed in this monograph that these objects might have been Old Kingdom metal ingots. It has to be noted that 28 more artefacts from Giza examined for sampling did not have any metal core. These objects include above all Old Kingdom model tools (Figure 226).

In order to analyse the bulk composition of archaeological metal artefacts, it is often necessary to take samples. In the case of the archaeometallurgical survey of the set of copper alloys tools from the collections of the Ägyptisches Museum – Georg Steindorff – der Universität Leipzig, the sampling of the artefacts was performed directly in the university museum in Leipzig and the samples were evaluated in different analytical laboratories in the Czech Republic. Before the sampling, the selected artefacts were visualized by X-Ray radiography in order to characterize the actual state of the metallic core of the artefacts and the possibilities of their sampling. After the evaluation of X-Ray radiography visualizations, samples of metal and corrosion products were taken for material examination. The samples for ED-XRF analysis were taken with a HSS-spiral drill with a surface layer of TiN and a diameter 1 or 1.2mm through a handle Proxxon drilling machine. The drill was cleaned after each operation and replaced after a few cycles of sampling. The samples in the amount of 60–100mg were stored and transferred in small polyethylene containers. The samples for optical microscopy observation, SEM/EDS analysis and micro HV testing were taken using a hand saw with a 0.2mm thick steel blade; the maximum size of the sample was 1x2x2mm. The samples of corrosion products in the amount of 1g for XRD phase analysis were scratched from the surface of the selected objects. During the sampling, great attention was paid to the locations from which the samples were taken in order not to compromise the structure and the aesthetic value of the artefacts. The sampling locations were selected so

809 Northover (1989).
810 Budd (1990).
811 Scott (2002, 42).
812 Selwyn (2004, 65).

Analytical techniques	Shortcut	Number of analyzed artefacts	Information expected
X-Ray diffraction analysis	XRD	4	Determination of phase composition of corrosion products.
Optical microscopy	OM	5	Identification of different phases, inclusions, the thermomechanical processes applied during artefacts production and processes of corrosion deterioration.
Scanning electron microscopy with X-Ray energy dispersive analyzator	SEM/EDS	5	Determination of main chemical phases present in metal alloy and distribution of the chemical elements in the inclusions.
Energy dispersive X-ray fluorescence spectrometry	ED-XRF	6	Identification of alloy elemental composition.
Vickers Microhardness testing	micro-HV	3	Determination of mechanical properties - hardness of the artefacts.

Figure 227: Techniques used to characterize composition and mechanical properties of the examined artefacts.

that they were not under the influence of the corrosion processes occurring on the surface of the artefacts and in order to achieve the best characterization of the chemical and phase composition of all the artefacts (Figure 227).

X-Ray diffraction analysis

Qualitative and semiquantitative phase analyses of powdered corrosion products taken from the artefacts were performed at the Laboratory of X-Ray Difractometry of the University of Chemistry and Technology in Prague. The X-Ray powder diffraction data were collected at room temperature with a Bruker AXS D8 θ-θ powder diffractometer with parafocusing Bragg-Brentano geometry using CoK_{α} radiation (λ = 1.79028Å, U = 34kV, I = 20 or 30mA). The data were scanned with an ultrafast detector LynxEye over the angular range 16–106° (2θ) with a step size of 0.0196° (2θ) and the counting time of 19.2s $step^{-1}$. Data evaluation was performed with the software package HighScore Plus 4.0.

Optical microscopy

Five samples designated for optical microscopy observation were mounted in the Epoxy-resin Specifix-20 kit produced by STRUERS®. The mounted cross sections were grounded with SiC abrasive paper of 800 to 4000 grit size and then polished with diamond paste and detergent at a rotary polishing wheel with 3, 2 and 0.7μm diamond size. Metallic cross-sections were etched by aqueous ferric chloride solution, and the other samples without a metallic core were observed in unetched condition. The observation was performed using the optical metallographic microscope Olympus PME3 in bright field observation mode.

Energy dispersive X-Ray fluorescence spectrometry

ED-XRF analyses were performed at the Nuclear Physics Institute of the Czech Academy of Science on the powdered metallic samples (ÄMUL 2170 and 2600) and the mounted and polished cross sections (ÄMUL 2120, 2129, 2131 and 5513). The dispersive X-Ray fluorescence spectrometer Spectro Midex with automatic motor driven XYZ precision table was used to measure the energy. The spectra from the metallic samples were acquired for 900 seconds from the distance of 2mm with the use of 0.1mm micro focus collimator. The SDD detector with FWHM <160eV was used for detection, measured at the Mn-Kα line. An X-Ray tube with Mo anode with voltage 48kV was utilized for the excitation of the characteristic RTG emission. The calibration was performed using Materials and Standards CRM MBH Analytical, standards 318–322 of ČKD,[813] standard IARM 159A and fine metals standards As 3N, Bi 6N, Fe 4N, Ni 4N, Sb 5N, Sn 5N, Zn 5N.

Scanning electron microscopy with X-Ray energy dispersive analyser

The electron microprobe analysis was performed on the mounted cross sections by the scanning electron microscope TESCAN VEGA 3 equipped with secondary electrons (SE), backscattered electrons (BSE) detectors and the EDS analyser Oxford Instruments INCA 350. The analyses were performed at the Department of Metals and Corrosion Engineering at UCT Prague. The measurement was carried out under 20kV accelerating voltage from the distance of 15mm and with detection of secondary and backscattered electrons. The EDS spectra were acquired for 90s lifetime with dead time adjusted to 30–40%. The samples mounted in epoxy resin were coated with a 5nm layer of gold before measuring, in order to improve the electric conductivity of their surface.

[813] Českomoravská–Kolben–Daněk.

Vickers micro hardness testing

Hardness measurements were carried out with the Future Tech FM 700 microhardness tester. The tests were performed on the mounted and polished cross-sections of the metallic samples with the load of 100g, dwell time of 10s and under the test load of 980.7mN. At least three indentations were made for each sample in order to achieve representative results.

Results and discussion

Corrosion deterioration

An inspection of corrosion products presented on the surface of the metallic artefacts was carried out with the aim to better understand the corrosion processes that take place on archaeological alloys and the description of the environments of long-term storing of the artefacts. Most of the artefacts in the examined set were covered by a compact layer of copper corrosion products, containing in some cases impurities from the sand environment. Samples of corrosion products from selected artefacts were analysed by X-Ray diffraction analysis (XRD) and SEM/EDS analyses and the summarized results are presented in Figures 227 and 228. The razor ÄMUL 2130 with fragments of mineralized textiles was documented by a digital camera with macro lens (Figure 229).

The corrosion products on the surface of the copper alloy model chisel ÄMUL 2118 consist of a mixture of the copper oxide minerals cuprite (Cu_2O) and tenorite (CuO), quartz (SiO_2) and small amounts of the copper chloride mineral clinoatacamite ($Cu_2Cl(OH)_3$) and calcium sulfate dihydrate ($Ca(SO_4).2H_2O$). The corrosion products present on the surface of the copper alloy chisel ÄMUL 2120 consist predominantly of mineral cuprite; about 20% of the occurring mineralogical phases were impossible to identify from the obtained XRD spectra. The secondary electron image of a cross section of the corrosion product sample (see Figure 232a) shows a multiphase structure of different minerals, which were analysed by SEM/EDS (see Figure 231). The matrix of the sample is formed by copper oxides with the presence of areas enriched with arsenic and calcium, and particles of quartz are also present. The surface corrosion products of the copper alloy razor ÄMUL 2130 were identified by XRD as a mixture of the copper chloride minerals atacamite ($Cu_2Cl(OH)_3$), clinoatacamite ($Cu_2Cl(OH)_3$) and paratacamite ($Cu_2Cl(OH)_3$), accompanied by quartz and small amounts of mineral rutile (TiO_2) and calcium sulfate dihydrate. The cross section of corrosion products from this artefact was analysed by SEM/EDS (see Figures 232 and 232d), and a map of chemical element distribution inside the corrosion layers was created. The core of the sample is formed by a mixture of copper chloride minerals, while minerals enriched with chlorides, arsenic and calcium are concentrated near the level of the original surface of the artefact. Visual observation identified fragments of textiles on the outer surface, which presently occurred in a fully mineralized form (see Figure 229) and were not analysed in more detail. They can be interpreted as the remains of the original textile cover in which the artefact was stored at the time of the burial. The last analysed sample of corrosion products with the remaining metallic core comes from the copper alloy razor ÄMUL 2131 and was analysed in the form of cross section. XRD analysis identified copper as the base material, cuprite as the main corrosion product and copper sulfide ($Cu_{1.8}S$). About 10% of the mineralogical phases were not identified, and this group may also include non-equilibrium phases of copper and arsenic. A better view into the corrosion of metallic matrix of this artefact could be obtained from the results of the SEM/EDS analysis (see Figures 231 and 232e). Non-equilibrium phases of copper and arsenic, copper-sulphide inclusions and copper oxide corrosion products are present inside the metallic matrix.

ID of artefact	Copper	Cuprite	Tenorite	Copper Sulfide	Atacamite	Clinoatacamite	Paratacamite	Rutile	Calcium sulfate dihydrate	Quartz	Non-identified
	Cu	Cu_2O	CuO	$Cu_{1.8}S$	$Cu_2Cl(OH)_3$	$Cu_2Cl(OH)_3$	$Cu_2Cl(OH)_3$	TiO_2	$Ca(SO_4).(H_2O)_2$	SiO_2	
ÄMUL 2118	0	29	31	0	0	4	0	0	8	28	0
ÄMUL 2120	0	80	0	0	0	0	0	0	0	0	20
ÄMUL 2130	0	0	0	0	31	19	16	2	5	27	<5
ÄMUL 2131	50	35	0	5	0	0	0	0	0	0	10

Figure 228: Results of X-Ray diffraction analysis of corrosion products presented on surface of the selected artefacts (weight %).

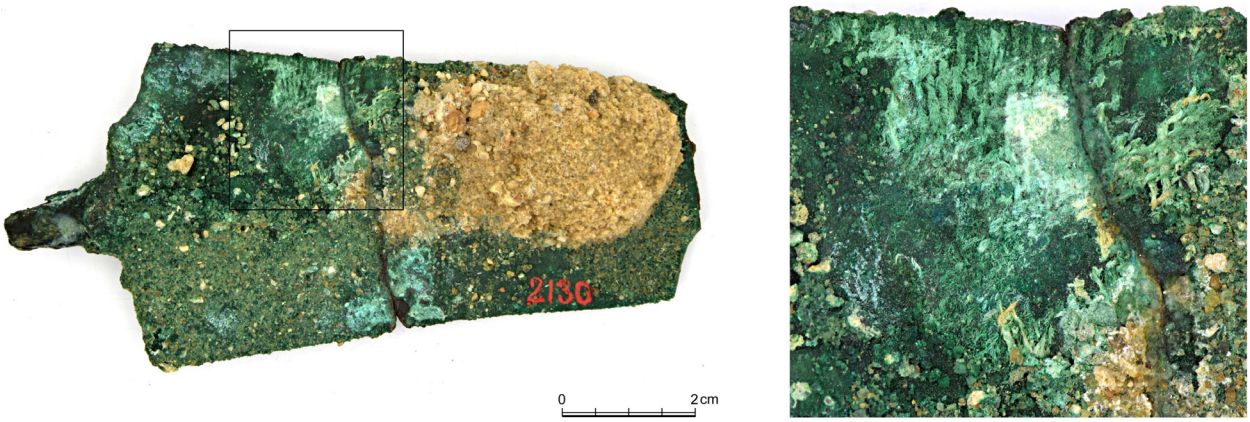

Figure 229: Razor ÄMUL 2130 with detail of preserved fragments of mineralised textile on the surface (Photo J. Kmošek).

Artefact	Cu	As	Sn	Fe	Ag	Sb	Ni	Zn	Bi	Pb
ÄMUL 2120	95.45	3.3	<0.05	0.2	<0.05	n.d.	<0.05	n.d.	n.d.	0.9
ÄMUL 2129	94.7	2.9	<0.05	0.3	1.9	n.d.	<0.05	n.d.	n.d.	<0.10
ÄMUL 2131	92.45	6.7	0.4	<0.20	0.2	n.d.	<0.05	n.d.	n.d.	n.d.
ÄMUL 2170	98.85	0.7	<0.05	<0.20	<0.05	n.d.	<0.05	n.d.	n.d.	<0.10
ÄMUL 2600	98.25	1.2	<0.05	0.3	<0.05	n.d.	<0.05	n.d.	n.d.	<0.10
ÄMUL 5513	95.65	3.6	<0.05	0.5	<0.05	n.d.	<0.05	n.d.	n.d.	<0.10

Figure 230: Results of Energy Dispersive X-Ray Fluorescence analysis of metallic material of the artefacts (weight %).

Artefact	Localization	Spectrum	Cu	As	Fe	Ag	Se	Te	Pb	Si	S	O	Cl	Ca
ÄMUL 2120	Corrosion products	2120/1	96.6	0	0	0	0	0	0	0	0	3.2	0.2	0
	Corrosion products	2120_2	35.4	28	0	0	0	0	0	0.3	0.9	13.5	0	21.9
	Corrosion products	2120_3	2	0	0	0	0	0	0	69.1	0	28.9	0	0
ÄMUL 2129	Matrix	2129_1	98	1.8	0.2	0	0	0	0	0	0	0	0	0
	Inclusions	2129_2	49.3	0	1.5	0	5	5.1	32.2	0	6.9	0	0	0
	Inclusions	2129_3	8.1	0	71.5	0	0	0	0	0	0.9	19.5	0	0
	Corrosion products	2129_4	65.6	1.2	0.4	9.1	0	0	0	0	9.3	0	14.4	0
ÄMUL 2130	Corrosion products	2130/1	75.7	1.6	0.7	0	0	0	0	0	0	13.2	8.4	0.4
	Corrosion products	2130/2	45.3	17.7	0	0	0	0	0	0	0	21	9.1	6.9
ÄMUL 2131	Matrix	2131/1	92.9	6.6	0.2	0	0	0	0	0	0.3	0	0	0
	Intermetallic phase	2131/2	71.8	28.2	0	0	0	0	0	0	0	0	0	0
	Inclusions	2131/3	74.1	0	3.3	0	1.5	0.7	0	0	20.4	0	0	0
	Corrosion products	2131/4	87.3	2.4	0	0	0	0	0	0	0	9.6	0.7	0
ÄMUL 5513	Matrix	5513/1	96.7	3.3	0	0	0	0	0	0	0	0	0	0
	Inclusions	5513/2	79.4	0	6.1	0	1	0	0	0	13.5	0	0	0
	Inclusions	5513/3	53.4	0	31.8	0	0	0	0	0	0.8	14	0	0

Figure 231: Results of the SEM/EDS analysis of the main chemical phases occurring in the analyzed artefacts (weight %).

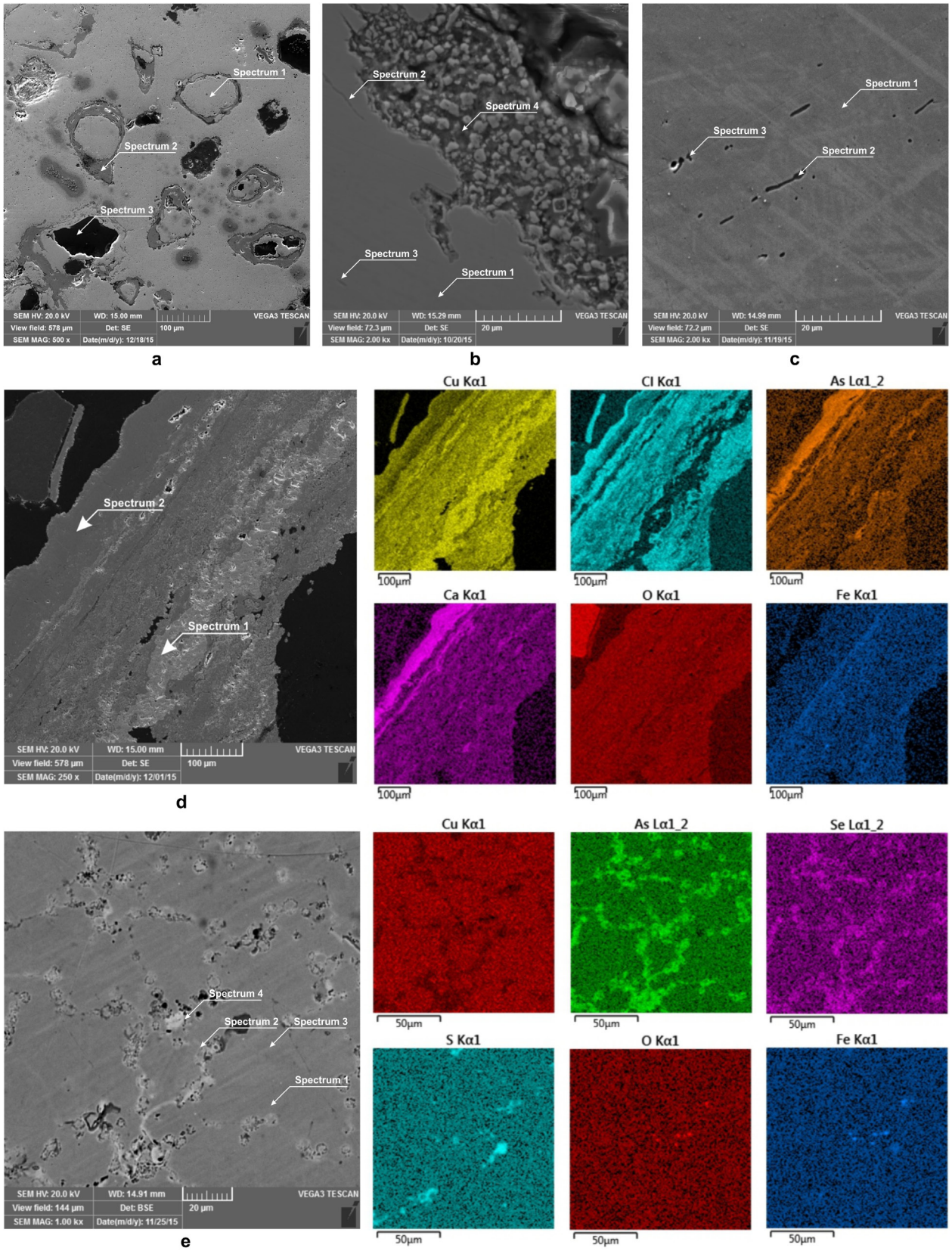

Figure 232: SEM images of cross sections of analyzed samples. A - corroded structure of sample ÄMUL 2120 (SE image, photo T. Jamborová), B - partly corroded structure of sample ÄMUL 2129 (SE image, photo T. Jamborová), C - metallic structure of sample ÄMUL 5513 (SE image, photo T. Jamborová), D - corroded structure of sample ÄMUL 2130 and map of elemental distribution (SE image, photo T. Jamborová), E - metallic structure of sample ÄMUL 2131 and map of elemental distribution (BSE image, photo T. Jamborová).

The copper oxide minerals cuprite of dark red colour and tenorite of grey-black colour are the principal corrosion products of copper; they usually occur directly connected with the metallic surface.[814] The copper trihydroxychlorides atacamite, clinoatacamite and paratacamite, minerals of pale green colour, are often associated with specific corrosion deterioration of archaeological metals called 'bronze disease'.[815] These unstable compounds are formed by a reaction of mineral nantokite (CuCl) with moisture and oxygen. This reaction takes place after the removal of the artefact from the sand environment due to chlorides incorporated in the corrosion layers. This type of corrosion damage can lead to very serious chemical and mechanical deterioration of archaeological artefacts resulting in cracking or fragmentation. Chloride ions necessary for the course of the reaction originate mainly from the degradation process of organic materials that occur in the immediate vicinity of the artefact. This fact is illustrated by the presence of mineralised fragments of textile on the surface of the corroded artefact.[816] The identified minerals such as calcium sulfate dihydrate also called gypsum, quartz and rutile are essential components of the soil in which the objects were originally situated after the burial. There, the minerals were under the influence of ongoing corrosion processes absorbed into the forming corrosion layers. Copper sulfides (digenite) occurring in small amount in metallic structures could be interpreted as an impurity originating from the pyrometallurgical process of the artefact production.[817] Corrosion layers enriched with arsenic and calcium (Figure 232d) are present in the cross sections of the artefacts ÄMUL 2120 and 2130. These enriched zones, which appear on the surface of the artefacts, play an important role in the evaluation of the elemental composition of alloys and can lead to very misleading results. One of the possible reasons for the presence of these layers could be the process of inverse segregation in low arsenic copper alloys during solidification after casting.[818] In this case, however, the presence of these layers is rather the result of the corrosion process in the sand, where migration of calcium and arsenic ions to the metal surface took place, resulting in the formation of corrosion products with a higher concentration of these elements.

Alloy composition

The results of the ED-XRF analysis of the chemical composition of the metallic material make it possible to characterize the material used for the production of the artefacts as an arsenical copper alloy with admixtures of other elements. The ED-XRF analysis results of the chemical composition of the artefacts are summarized in Figure 230 and the results of the SEM/EDS analysis of the individual structural phases in Figure 231. All chemical composition results are listed in weight %. Arsenic, which was used as the main alloying element for copper, was found in concentrations between 0.7 and 6.7 weight percent. Tin is present in all the artefacts in concentrations <0.05%, with the exception of the razor ÄMUL 2131, which contains 0.4% Sn. Iron was detected in all the artefacts in concentrations ranging from <0.2 to 0.5%. The analysis of the examined artefacts revealed silver concentrations <0.05%, only the razor ÄMUL 2131 contains 0.2% Ag and the spatula ÄMUL 2129, surprisingly, as much as of 1.9% Ag. Such a high concentration of silver is most probably cumulated in the layers of corrosion products, as shown by the results of the SEM/EDS analysis (see Figure 231). Lead was analysed in the whole set in concentrations <0.1% except for the artefact ÄMUL 2131, where it was not detected. From the analytical point of view, it is very difficult to determine relatively low concentrations of arsenic and lead, and the whole situation is even more complicated if both elements occur together. This phenomenon is caused by an overlap of the peaks of arsenic and lead in the measured spectra. The whole set of the analysed artefacts contains nickel in concentrations <0.05%, while the content of antimony, zinc and bismuth is below the detection limit of the method used for the analysis.

The method of electron scanning microscopy with energy dispersive analyser enabled a detailed analysis of the individual microstructure phases, which helped better understand the exact description of the elemental distribution in the metallic alloy structures. The survey of the metallic matrix of cross sections revealed two different types of inclusions. The first group consists of oxide inclusions containing copper and iron – they were identified in two out of the three analysed samples. Iron and sulphur occurred above all in these oxide inclusions, with concentrations below 1%. The second group consists of sulphide inclusions containing a variable amount of copper, iron, lead, selenium and tellurium (see Figure 231). These sulphide inclusions are probably formed by the copper sulphide digenite, as was confirmed by the XRD analysis. Selenium and tellurium incorporated into these microstructural phases are found in concentrations lower than 5%. The chemical composition analysis of copper and arsenic non-equilibrium phases carried out for the structure of the razor ÄMUL 2131 provided highly variable concentrations of arsenic, which reached up to 28.2% (see Figure 232e). The other determined elements such as silicon, chlorine and calcium are most likely related with the corrosion processes, rather than with the production technologies of the artefacts or with their provenance.

Arsenic occurring in copper alloys in concentrations under 1% is generally assumed to be an accidental impurity, whereas amounts exceeding 1% are regarded as a deliberate addition.[819] In this case, the whole set with

[814] Scott (2002, 82).
[815] Scott (2002, 125); Selwyn (2004, 66).
[816] Selwyn (2004, 66).
[817] Tylecote (1990); Ottaway (1994).
[818] Meeks (1993, 268).
[819] Craddock (1976); Bray and Pollard (2012).

Artefact	Phases	Inclusions	Structures	Operational sequence	HV0.1	
					Average	Standard deviation
ÄMUL 2129	α	Cu-Fe-Se-Te-Pb -S and Cu-Fe-O	Recrystallized grains of α-Cu phase with elongated non-metallic inclusions and slip bands	Casting + (forging + annealing) + final annealing and fine forging	81	4.6
ÄMUL 2131	α + As-rich γ	Cu-Fe-Se-Te-S	Partly corroded, recrystallized grains of α-Cu phase with As-rich γ phases at the grain boundaries with annealing twins, slip bands at the outer surface and non-metallic inclusions	Casting + anealing and fine forging	91	5.2
ÄMUL 5513	α	Cu-Fe-Se-S and Cu-Fe-O	Extensively worked grains of α-Cu phase with large amount of slip bands and elongated non-metallic inclusions	Casting + (forging + annealing) + final extensive forging	157	8.3

Figure 233: Results of the SEM/EDS analysis of the main chemical phases present in the analyzed artefacts.

the exception of the artefact ÄMUL 2170 is intentionally created from an alloy of copper and arsenic. The obtained results are in a good correlation with the chronology of alloy type compositions created by Cowell, which provides an average content of 3.3% As for the Early Dynastic period and the Old Kingdom.[820] In view of the very low concentrations of bismuth and antimony, arsenic is not expected to be a Fahlore ore product. Arsenic is supposed to have been made from a relatively pure source of its ore by alloying or co-smelting with copper. Iron oxides could be used as slag-forming additives during the smelting of slags with a high melting point, but it is more probable that the integral part of copper ores was used for the production. This hypothesis is confirmed by the research by Craddock and Meeks, who came to the conclusion that low iron content in the analysed set of artefacts implies simple smelting processes without slag formation.[821] The content of iron, arsenic and antimony could be reduced using an adequate refining process or repeated re-melting of copper under certain conditions.[822] The presence of silver, nickel and lead in copper alloys is most likely related to the copper ore from which the artefacts were produced. The absence of the 'Fahlore' element group represented by antimony and bismuth makes these alloys different from European Early Bronze Age copper alloy production. The mutual presence of selenium and tellurium in the sulphide inclusions is associated with the copper sulphide ore deposits. The contents of Se and Te and their abundance ratio seem to be characteristic of the different ore deposits, and it is generally assumed that higher concentrations of both elements occur in igneous rather than sedimentary rocks.[823] A major part of selenium and tellurium remains in the sulphide phase, but under oxidizing roasting conditions of sulphide copper ores, these elements are very unstable and volatile substances.[824]

No correlation between the function and chemical composition of the analysed artefacts is visible from the viewpoint of the chemical analysis. The content of the main alloying element – arsenic – in working tools (ÄMUL 2129, 2131, 2600 and 5513) varies within the range 1.2–6.7%. Working tool models (ÄMUL 2120, 2170) contain 0.7–3.3% arsenic. From this, we can conclude that working tools and their models were made from the same alloy and the concentration of the main alloying elements such as arsenic was not evidently dependent on the function of the artefacts. The analysis of a larger set of artefacts would be necessary to refine these results.

The origin of the individual chemical elements contained in the alloys can be traced back to the original ore material, partly influenced by the pyrometallurgical technologies used in the production of the alloys. According to the classification system by Pernicka, the individual elements in copper alloys can be divided into groups concerning their bearing on provenance and/or smelting technology.[825] The elements related to the production technology group are, in our case, iron, lead and tin. The second transitional group of provenance and production technology is represented in our case by arsenic, lead, selenium and tellurium, and the third provenance group consists of silver and nickel. More detailed evaluation of the trace element composition of the artefacts in the context of the production technology and provenance will require a more accurate analysis such as the neutron activation analysis or the proton induced X-Ray analysis.

Microstructural characterization

The results of a microstructural survey of three tools are summarized in Figure 233, and the photos of the metallic structures are presented in Figure 234. The microstructures of the spatula ÄMUL 2129 and the razor ÄMUL 5513 consist of one-phase α–Cu solid

[820] Cowell (1987, 99).
[821] Craddock and Meeks (1987, 193).
[822] Tylecote *et al.* (1977).
[823] Rehren and Northover (1990, 222).
[824] Tylecote *et al.* (1977).
[825] Pernicka (2015, 253).

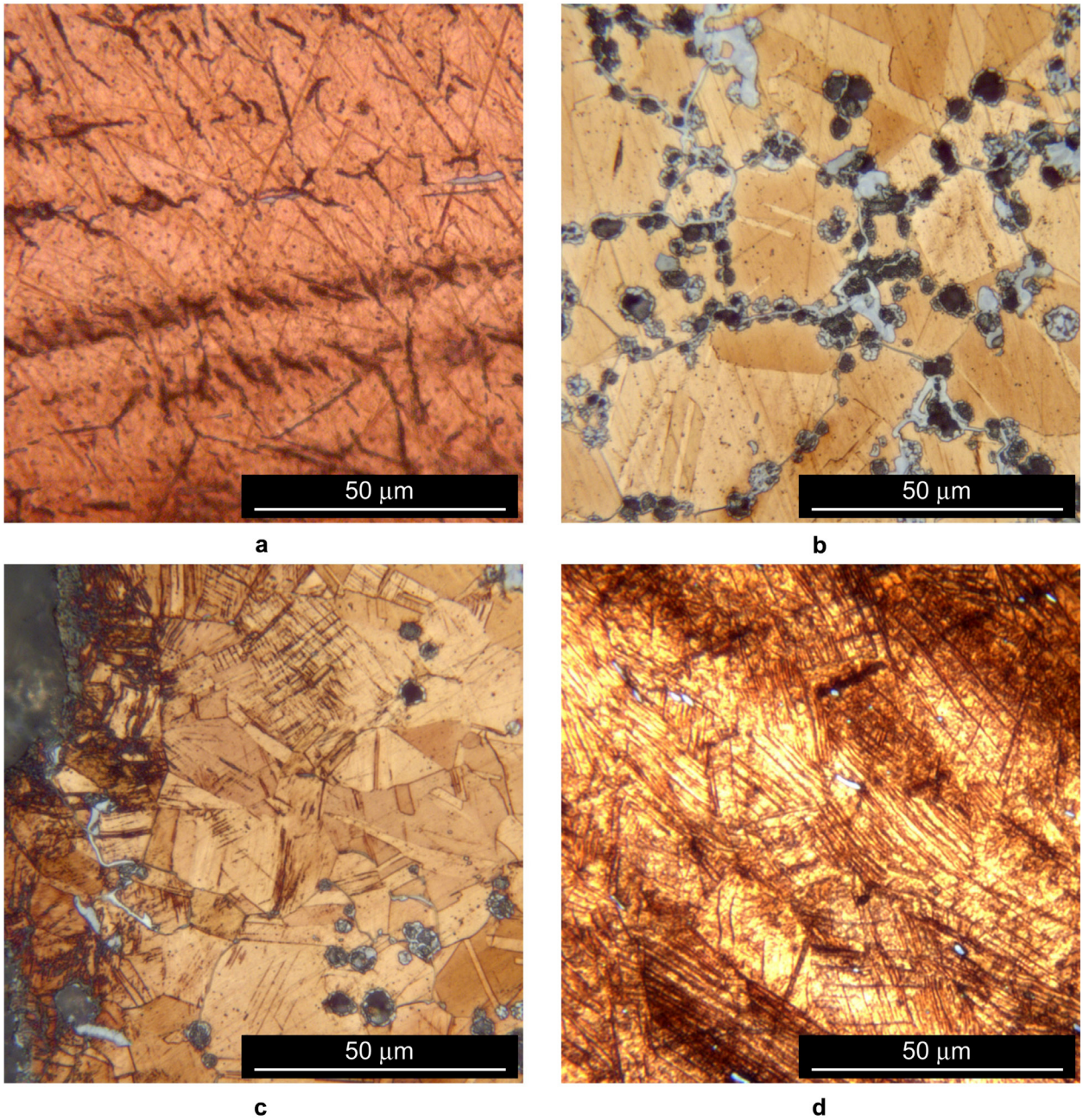

Figure 234: Optical microscopy images of the metallic structures after etching. A - recrystallized grains of α-Cu phase and slip lines (ÄMUL 2129, photo M. Kmoníčková), B - partly corroded, fully recrystallized grains of α-Cu phase with As-rich γ phases at the grain boundaries (ÄMUL 2131, photo K. Šálková), C - partly corroded, recrystallized grains of α-Cu phase with As-rich γ phases at the grain boundaries and slip lines (outer surface of sample ÄMUL 2131, photo K. Šálková), D - extensively worked grains of α-Cu phase with large amount of slip lines (ÄMUL 5513, photo M. Kmoníčková).

solution of copper and arsenic (Figure 234 a, d) , while the razor ÄMUL 2131 consists of two-phase structure of α-Cu and As-rich γ phase, situated unequally on the grain boundaries (Figures 232e and 234b). The spatula 2129 shows recrystallized grains with slip lines and elongated non-metallic inclusions. The structure of the razor ÄMUL 2131 contains fully recrystallized regular grains with annealing twins, slip lines on the outer surface of the sample and non-deformed non-metallic inclusions, accumulated with As-rich γ phases at the grain boundaries. These grain boundaries are partly corroded and filled with oxide corrosion products. The razor ÄMUL 5513 shows extensively worked grains with a large amount of slip lines and elongated non-metallic inclusions (Figure 234d).

The microhardness values measured on the mounted cross-sections are presented in Figure 233. Microhardness of the fine worked structure of the spatula ÄMUL 2129 with the average content of 2.9% As is 81 HV0.1, and in case of the annealed razor ÄMUL 2131 with the average content of 6.7% As, it

is 91 HV0.1. Microhardness of the intensively worked razor ÄMUL 5513 with the average content of 3.6% As has a surprisingly high value of 157 HV0.1. The standard deviation of the measured microhardness values is caused by the inhomogeneous structures of the artefacts, from the point of view of inclusion distribution and non-uniform thermo-mechanical processing. The results clearly indicate that microhardness depends more on the thermomechanical processing of the artefacts than on the content of arsenic, in accordance with the results of other studies.[826] The production technology of the selected artefacts was probably divided into several individual steps consisting of alloy preparation, casting, forging and recrystallization annealing operations. Various combinations of these operations could have resulted in very different mechanical properties of the final products, depending on the different functions of the artefacts. We have not enough data to compare the thermomechanical processing technologies of working tools and their models, because all microstructural analyses involved working tools.

Conclusion

The results of the analysed collection of artefacts from ÄMUL provided insight into the fields of corrosion deterioration, material composition, microstructure features and mechanical properties of Egyptian working tools and their models dated to Dynasty 5 and 6. Out of the set of more than thirty artefacts from the Giza necropolis, only eight artefacts could be sampled for the purposes of the analysis, due to the considerable degree of corrosion deterioration. The metallic cores of the other artefacts were completely transformed into corrosion products. The corrosion products of the analysed artefacts consist on the one hand of a mixture of copper oxide minerals (cuprite and tenorite) with higher amount of arsenic, and on the other hand of a mixture of copper chloride minerals (atacamite, clinoatacamite and paratacamite). The corrosion products contain a certain portion of sand particles, represented by quartz, gypsum and rutile. The chemical composition of the alloys in the analysed set indicates a fairly consistent composition, corresponding to arsenic copper alloys containing arsenic up to 3.6%, iron up to 0.5% and admixtures of tin, silver, nickel and lead. There is only one exception – the razor ÄMUL 2131, which contains higher portion of arsenic, tin and silver and surprisingly does not contain lead. The chemical composition of the working tools and their models seems to be unstable in the proportion of arsenic and there is no visible correlation between the chemical composition and the function of the artefacts. Two out of the three examined microstructures were annealed and contain slip lines on the surface. The third microstructure was fully worked and contains a large amount of slip lines. An As-rich γ phase in the intergranular regions was documented in one case, related to the presence of inverse segregation during solidification after casting. Two types of inclusions were identified in the structure of metallic cross sections. The first type is represented by mixed oxides of copper and iron, and the second type by copper-iron sulphide inclusions with a portion of selenium, tellurium and lead in some cases. The results of Vickers microhardness tests of three artefacts are comparable with the results obtained earlier by other authors and confirm that the hardness of the artefacts was intentionally achieved by mechanical hardening rather than by the alloying effect of alloys with a higher portion of arsenic. The techniques of casting, alloying, hot or cold working, annealing, final cold working and surface finishing were used in the production of the artefacts. From the obtained results it is not possible to distinguish which technology was used for the production of the arsenic copper alloys, but at least the artefacts ÄMUL 2129, 2131 and 5513 were made from rich sulphide ores, which is indicated by the presence of selenium and tellurium.

[826] Pereira *et al.* (2013); Lechtman (1996); Junk (2003).

11.2. Morphometrical and statistical case study of Old Kingdom adze blades

Martin Odler[827] and Ján Dupej[828]

Introduction

The tools of geometric morphometry have been used in anthropology and biology for decades now. On the other hand, their application in other fields, such as archaeology, has been somewhat slower. Geometric morphometry is the quantitative study of shape with the application of multivariate statistical and geometric approaches in the evaluation of the data. The historically earlier traditional morphometry used distances, lengths and angles to describe a particular specimen in the set. In contrast, geometric morphometry (GM) describes shapes using landmarks. The term originates in geography and refers to a well recognizable feature used for navigation. In GM, this term is used for an anatomically significant locus, present and repeatable in all the studied specimens.[829] Each specimen in the set must be described by an equal number of landmarks, placed in these anatomically equivalent loci. This property, referred to as homology, is crucial for a successful application of statistics on the data.

The configurations of landmarks describing a specimen are generally in random locations and orientations

[827] Czech Institute of Egyptology, Faculty of Arts, Charles University. This study was supported by the Grant Agency of Charles University within the project GA CU no. 38715.
[828] Department of Software and Computer Science Education, Faculty of Mathematics and Physics, Charles University; Department of Anthropology and Human Genetics, Faculty of Science, Charles University.
[829] Bookstein (1997b).

Baines, J. and Lacovara, P. 2002. Burial and the dead in ancient Egyptian society: respect, formalism, neglect. *Journal of Social Archaeology* 2/1: 5–36.

Ballet, P. 1987. Essai de Classification des coupes type Maidum-bowl du sondage nord de ‘Ayn-Asil (Oasis de Dakhla). *Cahiers de la Céramique Égyptienne* 1: 1–16.

Bard, K. A. 2015. *An introduction to the archaeology of ancient Egypt*. Second edition. Oxford, Wiley/Blackwell.

Bareš, L., Bárta, M., Smoláriková, K. and Strouhal, E. 2003. Abusir-Spring 2002. *Zeitschrift für ägyptische Sprache und Altertumskunde* 130: 147–159.

Barguet, P. 1952. Le rituel archaïque de fondation des temples de Medinet-Habou et de Louxor. *Revue d‘égyptologie* 9: 1–22.

Barham, L. 2013. *From Hand to Handle. The First Industrial Revolution*. Oxford, Oxford University Press.

Bárta, M. 1996. Class–Type Interpretation of the Pottery. *Památky archeologické* 87: 137–160.

Bárta, M. 1998. Der Tauschhandelszenen aus dem Grab des Fetekty in Abusir. *Studien zur altägyptischen Kultur* 26: 19–34.

Bárta, M. 2000. *Abusir V: the cemeteries at Abusir South I. Excavations of the Czech Institute of Egyptology*. Prague, Set Out.

Bárta, M. 2006. The Sixth Dynasty tombs in Abusir. Tomb complex of the vizier Qar and his family. In M. Bárta (ed.), *The Old Kingdom Art and Archaeology. Proceedings of the conference held in Prague, May 31 – June 4, 2004*: 45–62. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Bárta, M. 2009. Filling the chambers, rising the status: Sixth Dynasty context for the decline of the Old Kingdom. *Cahier de Recherches de l‘Institut de Papyrologie et d‘Égyptologie de Lille* 28: 145–155.

Bárta, M. 2011. *Journey to the West. The world of the Old Kingdom tombs in Ancient Egypt*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Bárta, M. 2013a. A new family cemetery at Abu Sir South. *Egyptian Archaeology* 43: 21–24.

Bárta, M. 2013b. Radiocarbon dates for the Old Kingdom and their correspondences. In A. J. Shortland, C. Bronk Ramsey (eds.), *Radiocarbon and the chronologies of ancient Egypt*: 218–223. Oxford, Oxbow Books.

Bárta M., Bezděk, A., Černý, V., *et al*. 2009. *Abusir XIII. Abusir South 2: Tomb Complex of the Vizier Qar, His Sons Qar Junior and Senedjemib, and Iykai*. Prague, Dryada.

Bárta, M., Coppens, F., Vymazalová, H. *et al.* 2010. *Abusir XIX: tomb of Hetepi (AS 20), tombs AS 33–35, and AS 50–53*. Prague, Czech Institute of Egyptology, Charles University in Prague.

Bárta, M. *et al*. 2014. *Abusir XXIII. The tomb of the Sun Priest Neferinpu*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Bárta, M. and Vachala, B. *et al*. in preparation. *The tomb of Inty*, Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University.

Bárta, M., Vymazalová, H., Dulíková, V., Arias, K., Megahed, M., and Varadzin, L. 2013. Exploration of the necropolis at Abusir South in the season of 2012. Preliminary Report. *Ägypten und Levante* 24: 15–38.

Barta, W. 1963. *Die altägyptischen Opferliste von der Frühzeit bis zur griechisch–römischen Epoche*. Münchner Ägyptologische Studien 3. Berlin, B. Hessing.

Batal, Ali el-,Soleiman, S. and Turkey, R. 2015. Some recent discoveries at Saqqara. *Egyptian Archaeology* 46: 41–44.

Baud, M. 2006. The Relative Chronology of Dynasties 6 and 8. In: E. Hornung – R. Krauss – D. A. Warburton (eds.), *Ancient Egyptian Chronology*. Handbuch der Orientalistik, Section 1. The Near and Middle East 83): 144–158. Leiden – Boston, Brill.

Beaux, N. 2006. Methods in hieroglyphic palaeography. Old Kingdom signs from Saqqara and Giza. In: M. Bárta, F. Coppens, and J. Krejčí (eds.), *Abusir and Saqqara in the year 2005*: 219–228. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Begelsbacher-Fischer, B. L. 1981. *Untersuchungen zur Götterwelt des Alten Reiches: im Spiegel der Privatgräber der IV. und V. Dynastie.* Orbis Biblicus et Orientalis 37. Freiburg (Schweiz); Göttingen, Universitätsverlag; Vandenhoeck & Ruprecht.

Beit-Arieh, I. 2003. *Archaeology of Sinai. The Ophir Expedition*. Monograph Series of the Institute of Archaeology of Tel Aviv University. No. 21. Tel Aviv, Tel Aviv University.

Benešovská, H. 2006. Statues from the Pyramid Complex of the King Raneferef. In M. Verner et al., *Abusir IX. The Pyramid Complex of Raneferef I. The Archaeology*: 360–437. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Bergdoll, S. 2016. Die Dixon-Relikte und die Geheimnisse der kleinen Schächte der Cheopspyramide. *Göttinger Miszellen* 248: 53–90.

Bernbeck, R. 1997. *Theorien in der Archäologie*. Tübingen, Francke-Verlag.

Binford, L. R. 1962. Archaeology as Anthropology. *American Antiquity* 28: 217–225.

Binford, L. R. 1971. Mortuary practices: their study and their potential. *Memoirs of the Society for American Archaeology* 25: 6–29.

Bishop C. M. 2006. *Pattern Recognition and Machine Learning*. New York, Springer.

Bissing, Friedrich Wilhelm von 1905. *Das Re-Heiligtum des Königs Ne-woser-re (Rathures)*. Berlin, Duncker.

Bisson de la Roque, M. F. 1924. *Rapport sur les fouilles d’Abou-Roasch (1922–1923)*. Le Caire, L’Institut Français d’Archéologie Orientale.

Bisson de la Roque, M. F. 1925. *Rapport sur les fouilles d'Abou-Roasch (1924)*. Le Caire, L'Institut Français d'Archéologie Orientale.

Blackman, A. and Apted, M. 1953. *The Rock Tombs of Meir V*. London, Quaritch.

Blackman, A. M. and Fairman, H. W. 1946. The consecretion of an Egyptian temple according to the use of Edfu. *Journal of Egyptian Archaeology* 32: 75–91.

Bonnet, H. 1926. *Die Waffen der Völker des alten Orients*. Leipzig, Hinrichs'sche Buchhandlung.

Bonnet, H. 1928. *Ein frühgeschichtliches Gräberfeld bei Abusir*. Leipzig, Hinrichs'sche Buchhandlung.

Bookstein F. L. 1997a. Landmark methods for forms without landmarks: morphometrics of group differences in outline shape. *Medical Image Analysis* 1: 225–243.

Bookstein F. L. 1997b. *Morphometric Tools for Landmark Data*. Cambridge, Cambridge University Press.

Booth, C. 2001. Possible Tattooing Instruments in the Petrie Museum. *Journal of Egyptian Archaeology* 87: 172–175.

Borchardt, L. 1907. *Das Grabdenkmal des Königs Ne–user–reᶜ*. Ausgrabungen der Deutschen Orient–Gesellschaft in Abusir 1902–1908. Bd. 1. Leipzig, Hinrichs'sche Buchhandlung.

Borchardt, L. 1909. *Das Grabdenkmal des Königs Nefer–ir–kɜ–re'*. Ausgrabungen der Deutschen Orient–Gesellschaft in Abusir 1902–1908. Bd. 5. Leipzig, J. C. Hinrichs.

Borchardt, L. 1910. *Das Grabdenkmal des Königs Śa3–hu–re'. Bd. 1. Der Bau*, Ausgrabungen der Deutschen Orient–Gesellschaft in Abusir 1902–1908. Bd. 6. Leipzig, Hinrichs'sche Buchhandlung.

Borchardt, L. 1913. *Das Grabdenkmal des Königs Śa3–hu–re'. Bd. 2. Die Wandbilder*, Ausgrabungen der Deutschen Orient–Gesellschaft in Abusir 1902–1908. Bd. 7. Leipzig, Hinrichs'sche Buchhandlung.

Bray, P. J. and Pollard, A. M. 2012. A new interpretative approach to the chemistry of copper–alloy objects: source, recycling and technology. *Antiquity* 86: 853–867.

Brewer, D. J. and Friedman, R. F. 1989. *Fish and Fishing in Ancient Egypt.* Cairo, American University in Cairo Press.

Brovarski, E. 2001. *Giza Mastabas, vol. 7. The Senedjemib Complex, Part I*. Boston, The Museum of Fine Arts.

Brumfiel, E. M. and Earle. T. K. 1987. Specialization, exchange, and complex societies: an introduction. In E. M. Brumfiel and T. K. Earle (eds.) *Specialization, Exchange and Complex Societies*: 1–9. Cambridge, Cambridge University Press.

Brunton, G. 1927. *Qau and Badari I.* London, British school of archaeology in Egypt.

Brunton, G. 1937. *Mostagedda and the Tasian Culture. British Museum expedition to Middle Egypt, first and second years, 1928, 1929.* London, Bernard Quaritch.

Brunton, G. 1947. The Burial of Prince Ptah-Shepses at Saqqara. *Annales du Service des Antiquités de l'Égypte* 47: 125–133.

Brunton, G. 1948. *Matmar*. British Museum Expedition to Middle Egypt 1929–1931. London, B. Quaritch.

Bruyère, B., Manteuffel, J. Michałowski, K. and Fare Garnot, J. S. 1937. *Tell Edfou 1937. Fouilles franco–polonaises: rapports 1*. Le Caire, L'Institut français d'archéologie orientale du Caire.

Bryan, B. M. 1996. In women good and bad fortune are on earth: status and roles of women in Egyptian culture. In A. K. Capel and G. E. Markoe (eds.) *Mistress of the House, Mistress of Heaven: women in ancient Egypt*: 25–46. New York, Hudson Hills Press, in association with Cincinnati Art Museum.

Budd, P. 1990. Eneolithic arsenical copper: heat treatment and the metallographic interpretation of manufacturing processes. In: G. A. Wagner and E. Pernicka, *Proceedings of the International Symposium on Archaeometry Heidelberg*: 35–44. Basel, Birkhäuser.

Budd, P. A. 1991. Metallographic investigation of eneolithic arsenical copper artifacts from Mondsee, Austria. *Historical Metallurgy* 25: 99–108.

Budd, P. and Ottaway, B. S. 1995. Eneolithic arsenical copper: chance or choice? In: B. Jovanovic (ed.), *International Symposium Ancient Mining and Metallurgy in Southeast Europe:* 95–102. Archaeological Institute, Donji Milanovac.

Budd, Paul and Taylor, T. 1995. "The Faerie Smith Meets the Bronze Industry: Magic Versus Science in the Interpretation of Prehistoric Metal-Making". *World Archaeology 27*, 133–143.

Bussmann, R. 2010. *Die Provinztempel Ägyptens von der 0. bis zur 11. Dynastie: Archäologie und Geschichte einer gesellschaftlichen Institution zwischen Residenz und Provinz*. Probleme der Ägyptologie 30. Leiden – Boston, Brill.

Butterweck–AbdelRahim, K. 2002. *Untersuchungen zur Ehrung verdienter Beamter*. Aegyptiaca Monasteriensia, 3. Aachen, Shaker Verlag

Callender, V. G. 2008. Finds. In J. Krejčí, M. Verner, V. G. Callender *et al., Abusir XII: minor tombs in the Royal Necropolis I (the mastabas of Nebtyemneferes and Nakhtsare, pyramid complex Lepsius no. 24 and tomb complex Lepsius no. 25)*: 97–134. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Callender, V. G. 2011. *In Hathor's Image I: The Wives and Mothers of Egyptian Kings from Dynasties I–VI*. Prague, Charles University, Faculty of Arts in Prague.

Carrier, C. 2009–2010. *Textes des Pyramides de l'Égypte ancienne*. 6 vols. Paris, Cybele.

Castañeda Reyes, J. C. 2010. Of Women, Mirrors and the ´Social Revolution´ (´Admonitions´: 8, 5). *Göttinger Miszellen* 225: 39–53.

Castel, G. and Pantalacci, L. 2005. *Balat VII. Les cimetières est et ouest du mastaba de Khentika*. Le Caire, L'Institut Français d'Archéologie Orientale.

Castel, G. et al. 1998: Wadi Dara Copper Mines. In F. A. Esmael (ed.), *Proceedings of the First International Conference on Ancient Egyptian Mining and Metallurgy and Conservation of Metallic Artifacts (10-12 April 1995)*: 15–31. Cairo, Ministry of Culture, Supreme Council of Antiquities.

Castel, G., Pantalacci, L. and Cherpion, N. 2001. *Balat V: Le mastaba de Khentika: tombeau d'un gouverneur de l'Oasis a la fin de l'Ancien Empire. Vol. 1., Texte. Vol. 2., Planches*. Le Caire, L'Institut Français d'Archéologie Orientale.

Chassinat, E. and Palanque, Ch. 1911: *Une campagne de fouilles dans la nécropole d'Assiout.* Le Caire, L'Institut Français d'Archéologie Orientale.

Chaaban, M. A. 1998. Metallurgical Industries of Old Kingdom and Prehistoric Egypt. In: F. A. Esmael (ed.), *Proceedings of the First International Conference on Ancient Egyptian Mining and Metallurgy and Conservation of Metallic Artifacts (10–12 April 1995)*: 189–196. Cairo, Ministry of Culture, Supreme Council of Antiquities.

Chauvet, V. 2007. Royal involvement in the construction of private tombs in the late Old Kingdom. In J.-C. Goyon – C. Cardin, Christine (eds.). *Proceedings of the Ninth International Congress of Egyptologists/ Actes du neuvième congrès international des égyptologues,* Grenoble 6–12 September 2004: 313–321. Orientalia Lovanensia Analecta 150. Leuven – Paris – Dudley MA, Peeters.

Chevereau, P.-M. 1987. Contribution à la prosopographie des cadres militaires de l'Ancien Empire et de la Première Période Intermédiaire. *Revue d'égyptologie* 38: 13–48.

Chevereau, P.-M. 1989. Contribution à la prosopographie des cadres militaires de l'Ancien Empire et de la Première Période Intermédiaire. *Revue d'égyptologie* 40: 3–36.

Childe, G. 1966. *Man makes himself*. Collins, The Fontana Library.

Collombert, P. 2010. *Le tombeau de Mérérouka: paléographie*. Paléographie hiéroglyphique 4. Le Caire, L'Institut français d'archéologie orientale du Caire.

Conard, N. J. and Lehner, M. 2001. The 1988/1989 excavation of Petrie's "workmen's barracks" at Giza. *Journal of the American Research Center in Egypt* 38: 21–60.

Coolidge, F. L. and Wynn, T. 2005. Working Memory, its Executive Functions, and the Emergence of Modern Thinking. *Cambridge Archaeological Journal* 15: 5–26.

Cour–Marty, M.–A. 1997. Les poids inscrits de l'Ancien Empire. In C. Berger and B. Mathieu (eds), *Études sur l›Ancien Empire et la nécropole de Saqqâra dédiées à Jean–Philippe Lauer 1*: 129–145. Montpellier, Université Paul Valéry–Montpellier III.

Cowell, M. R. 1987. Scientific Appendix I. Chemical Analysis. In W. V. Davies (ed.), *Catalogue of Egyptian antiquities in the British Museum, Vol. 7 (Axes)*: 96–118. London. The British Museum.

Craddock, P. T. 1976. The composition of the copper alloys used by the Greek, Etruscan and Roman civilizations 1. The Greeks before the Archaic period. *Journal of Archaeological Science 3* (2): 93–113.

Craddock, P. T. and Meeks, N. D. 1987. Iron in ancient copper. *Archaeometry* 29: 187–204.

Ćwiek, A. 2003. *Relief Decoration in the Royal Funerary Complexes of the Old Kingdom: Studies in the Development, Scene Content and Iconography*. Unpublished PhD thesis. Warsaw, Institute of Archaeology, Faculty of History, Warsaw University.

Czarnowicz, M. n.d. *Examples of copper harpoons of Naqada culture in the Eastern Nile Delta area*. Accessible via url: https://www.academia.edu/11296407/Examples_of_copper_harpoons_of_Naqada_culture_in_the_Eastern_Nile_Delta_area

Daressy, G. and Barsanti, A. 1916. La nécropole des grands prêtres d'Héliopolis sous l'Ancien Empire. *Annales du Service des Antiquités de l'Égypte* 16: 193–220.

Davey, C. J. 2009. A metalworking servant statue from the Oriental Institute, University of Chicago. *The Bulletin of the Australian Centre for Egyptology* 20: 37–46.

Davey, C. J. 2012. Old Kingdom metallurgy in Memphite tomb images. In L. Evans (ed.), *Ancient Memphis: ‚Enduring is the Perfection'. Proceedings of the international conference held at Macquarie University, Sydney on August 14–15, 2008*: 85–108. Leuven, Peeters.

Davies, B. G. 1993. O. Berlin P. 11239 and the Coppersmiths at Deir el–Medina. *Göttinger Miszellen* 137: 39–47.

Davies, N. de Garis 1902a. *The Rock Tombs of Deir el Gebrawi I*. Archaeological survey of Egypt 11. London, Egypt Exploration Fund.

Davies, N. de Garis 1902b. *The Rock Tombs of Deir el Gebrawi II*. Archaeological survey of Egypt 12. London, Egypt Exploration Fund.

Davies, N. de Garis 1943. *The tomb of Rekh-mi-rē' at Thebes*, 2 vols. Publications of the Metropolitan Museum of Art Egyptian Expedition 11. New York, The Plantin Press.

Davies, N. de Garis. 1900. *The Mastaba of Ptahhetep and Akhethetep at Saqqareh. Part I. The Chapel of Ptahhetep and the Hieroglyphs*. Archaeological survey of Egypt 8. [n.p.], [n.publ.].

Davies, W. V. 1987. *Tools and Weapons I: Axes. Catalogue of Egyptian Antiquities in the British Museum 7*. London, The British Museum.

Davis, W. 1983. Artists and Patrons in Predynastic and Early Dynastic Egypt. *Studien zur altägyptischen Kultur* 10: 119–139.

De Meyer, M. 2011. Inlaid eyes on Old Kingdom coffins: a history of misidentification. *Journal of Egyptian Archaeology* 97: 201–203.

Decker, W. and Herb, M. 1994. *Bildatlas zum Sport im alten Ägypten: Corpus der bildlichen Quellen zu Leibesübungen*, 2 vols. Leiden, Brill.

Dee, M., Wengrow, D., Shortland, A., Stevenson, A., Brock, F., Flink, L. G. and Ramsey, C. 2013. An absolute chronology for early Egypt using radiocarbon dating and Bayesian statistical modelling. *Proceedings of the Royal Society A 469* (2159, November, article no. 2013.0395): 1–10.

Dee, Michael W. 2013. A radiocarbon–based chronology for the Old Kingdom. In A. J. Shortland C. Bronk Ramsey (eds.) *Radiocarbon and the chronologies of ancient Egypt*: 209–217. Oxford, Oxbow Books.

Deshayes, J. 1960: *Les outils de bronze de l'Indus au Danube (IVe au IIe millénaire)*. 2 vols. Paris, Geuthner.

Desplancques, S. 2006. *L'institution du Trésor en Égypte des origines à la fin du Moyen Empire*. Paris, Presses Paris Sorbonne.

Dever, W. 1994. A review of Eli Miron: Axes and Adzes from Canaan. *Bulletin of the American Schools of Oriental Research* 296: 81.

Dorn, A. 2015. *Elephantine XXXI: Kisten und Schreine im Festzug. Hinweise auf postume Kulte für hohe Beamte aus einem Depot von Kult- und anderen Gegenständen des ausgehenden 3. Jahrtausends v. Chr*. Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 117. Wiesbaden, Harrassowitz.

Drenkhahn, R. 1976. *Die Handwerker und ihre Tätigkeiten im alten Ägypten*. Ägyptologische Abhandelungen 31. Wiesbaden, Harrasowitz.

Drenkhahn, R. 1995. Artisans and artists in Pharaonic Egypt. In J. M. Sasson, J. Baines, G. Beckman, and K. S. Rubinson (eds), *Civilizations of the ancient Near East 1*: 331-343. New York, Simon & Schuster Macmillan.

Dreyer, G. and Swelim, N. 1982. Die kleine Stufenpyramide von Abydos–Süd (Sinki). *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 38: 91–93.

Dreyer, G. 1986. *Der Tempel der Satet: die Funde der Frühzeit und des Alten Reiches*. Elephantine; Bd. 8. Mainz am Rhein, Philipp von Zabern.

Dreyer, G. *et al*. 2006. Umm el–Qaab. Nachuntersuchungen im frühzeitlichen Königsfriedhof 16./17./18. Vorbericht. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 62: 67–129.

Drower, M. S. 1995. *Flinders Petrie. A Life in Archaeology*. Madison, The University of Wisconsin Press.

Duell, P. 1938. *The mastaba of Mereruka*. Chicago, University of Chicago Press.

Dulíková, V. 2016. *The Reign of King Nyuserre and Its Impact on the Development of the Egyptian State*. Unpublished PhD thesis, Prague, Charles University in Prague, Faculty of Arts, Czech Institute of Egyptology.

Dulíková, V., Odler, M. and Havelková, P. 2011. Archeologický výzkum hrobky lékaře Neferherptaha [Excavation of the physician Neferherptah's tomb], *Pražské egyptologické studie [Prague Egyptological Studies]* VIII: 9–16.

Dunham, D. and Simpson W. K. 1974. *Giza Mastabas 1: The Mastaba of Queen Mersyankh III. G7530–7540*. Boston, Department of Egyptian and Ancient Near Eastern Art, Museum of Fine Arts.

Dürring, N. 1995. *Materialien zum Schiffbau im Alten Ägypten*. Abhandlungen des Deutschen Archäologischen Instituts Kairo, Ägyptologische Reihe 11. Berlin, Achet.

Dvořák, M. 2002. Konzervace a přírodovědný průzkum nálezů v severním a jižním Abúsíru. *Pražské egyptologické studie* 1, 51–60.

Eaton, E. R. and McKerrell, H. 1976. Near Eastern Alloying and Some Textual Evidence for the Early Use of Arsenical Copper. *World Archaeology* 8, 169–191.

Eaton-Krauss, M. 1984: *Representations of Statuary in Private Tombs of the Old Kingdom*. Ägyptologische Abhandlungen 39. Wiesbaden, Harrasowitz.

Eckmann, C. and Shafik, S. (eds) 2005. *»Leben dem Horus Pepi«: Restaurierung und technologische Untersuchung der Metallskulpturen des Pharao Pepi I. aus Hierakonpolis.* Mainz; Bonn, Verlag des Römisch–Germanischen Zentralmuseums.

Eco, U. 1979. *The Theory of Semiotics*. Bloomington, Indiana University Press.

Edel, E., Seyfried, K.–J. and Vieler, G. 2008. *Die Felsgräbernekropole der Qubbet el–Hawa bei Assuan: I. Abteilung. Band 1. Architektur, Darstellungen, Texte, archäologischer Befund und Funde der Gräber QH24–QH34p*. Paderborn, F. Schöningh.

Eerkens, J. and Bettinger R. L. 2001. Techniques for Assessing Standardization in Artifact Assemblages: Can We Scale Material Variability? *American Antiquity* 66: 493–504.

Eichler, E. 1993 *Untersuchungen zum Expeditionswesen des ägyptischen Alten Reiches*. Göttinger Orientforschungen, 4. Reihe: Ägypten 26. Wiesbaden, Harrasowitz.

Ellis, S. 1984. A bronze mirror with the titles *rḫt-nsw ḥm(t)-nṯr Ḥwt-Ḥr*. *Journal of Egyptian Archaeology* 70: 139–140.

el-Sawi, A. 1979. *Excavations at Tell Basta: report of seasons 1967 – 1971 and catalogue of finds*. Prague, Charles University.

Emery, W. B. 1949. *Great tombs of the First Dynasty*. Cairo, Government Press.

Emery, W. B. 1958. *Great tombs of the First Dynasty III*. Cairo, Government Press.

Emery, W. B. 1963. Egypt Exploration Society: Preliminary Report on the Excavations at Buhen, 1962. *Kush* 11: 116–120.

Emery, W. B. and Kirwan, L. P. 1935. *Mission archéologique de Nubie 1929–1934. The Excavations and Survey Between Wadi es–Sebua and Adindan, 1929–1931*. Cairo, Government Press.

Engel, E.-M. 2006. Die Entwicklung des Systems der ägyptischen Nomoi in der Frühzeit. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 62: 151–160.

Engelbach, R. (ed.) 1946. *Introduction to Egyptian Archaeology with Special Reference to the Egyptian Museum, Cairo*. Le Caire, L'Institut français d'archéologie orientale.

Enmarch, R. 2008. *A world upturned: commentary on and analysis of The dialogue of Ipuwer and the Lord of All*. British Academy Postdoctoral Fellowship monograph. Oxford, Oxford University Press.

Erkanal, H. 1977. *Die Äxte und Beile des 2. Jahrtausends in Zentralanatolien*. Prähistorische Bronzefunde, Abteilung IX–8. München, C. H. Beck.

Evely, D. R. G. 1993. *Minoan crafts: tools and techniques: an introduction*. Vol. 1. Studies in Mediterranean archaeology 92. Göteborg, Paul Åström Voerlag.

Eyre, C. 2002. *The Cannibal Hymn. A Cultural and Literary Study*. Liverpool, Liverpool University Press.

Eyre, C. J. 1987. Work and the Organisation of Work in the Old Kingdom. In M. A. Powell (ed.) *Labor in the Ancient Near East.* American Oriental Series 68: 5–47. New Haven, American Oriental Society.

Eyre, C. J. 1994. Weni's Career and Old Kingdom Historiography. In C. Eyre, A. Leahy, and L. Montagno Leahy (eds.), *The unbroken reed: studies in the culture and heritage of ancient Egypt in honour of A. F. Shore*: 107–124. London, Egypt Exploration Society.

Fakhry, A. 1935. *Sept Tombeaux à l´est de la grande pyramide de Guizeh*. Le Caire, L'Institut français d'archéologie orientale.

Fakhry, A. 1961. *The Valley Temple. Part I. The Temple Reliefs*. Cairo, General Organisation for Government Printing Office.

Falck, M. von and Schmitz, B. 2009. *Das alte Reich. Ägypten von den Anfängen zur Hochkultur*. Mainz am Rhein, Philipp von Zabern.

Feucht, E. 1992. Fishing and fowling with the spear and the throw-stick reconsidered. In U. Luft (ed.), *The intellectual heritage of Egypt: studies presented to László Kákosy by friends and colleagues on the occasion of his 60th birthday. Studia Aegyptiaca XIV*: 157–169. Budapest, La chaire d'Égyptologie.

Feucht, E. 1998. Fisch- und Vogelfang im *wꜣḏ-wr* des Jenseits. In I. Shirun-Grumach, (ed.), *Jerusalem studies in Egyptology.Ägypten und Altes Testament 40*: 37–44. Wiesbaden, Harrassowitz.

Firth, C. M. 1927. *The Archaeological Survey of Nubia. Report for 1910–1911*. Survey of Egypt. Cairo, Government Press.

Firth, C. M. and Gunn, B. 1926. *Excavations at Saqqara. Teti Pyramid Cemeteries. Vol. I*. Le Caire, L'Institut français d'archéologie orientale.

Firth, C. M. and Quibell, J. E. 1935. *Excavations at Saqqara. The Step Pyramid*. Vols. I–II. Le Caire: L'Institut français d'archéologie orientale.

Fischer, H. G. 2000. *Egyptian Women of the Old Kingdom and of the Heracleopolitan Period*. Second Edition. New York, The Metropolitan Museum of Art.

Fischer, H. G. 1968. *Dendera in the Third Millennium B.C. down to the Theban Domination of Upper Egypt*. Metropolitan Museum of Art and the Institute of Fine Arts, New York University, Locust Valley NY, J. J. Augustin Publisher.

Fitzenreiter, M. 2001. Grabdekoration und die Interpretation funerärer Rituale im Alten Reich. In H. Willems (ed.), *Social aspects of funerary culture in the Egyptian Old and Middle Kingdoms: proceedings of the international symposium held at Leiden University 6–7 June, 1996*: 67–140. Leuven, Peeters.

Foxhall, L. and Barfoed, S. (eds.) 2015. *World Archaeology 47 (1), Miniaturization*. Abingdon, Taylor and Francis.

Frankfort, H. 1924. *Studies in Early Pottery of the Near East I. Mesopotamia, Syria and Egypt and their Earliest Interrelations*. Royal Anthropological Institute, occasional papers 6. London, Royal Anthropological Institute of Great Britain and Ireland.

Frankfort, H. 1930. The Cemeteries of Abydos: Work of the Season 1925–26. *Journal of Egyptian Archaeology* 16: 213–219.

Galvin, M. 1981. *The Priestesses of Hathor in the Old Kingdom and the 1st Intermediate Period*. Waltham MA, Brandeis University Ph.D. thesis.

Gardiner, A. H. 1969. *Egyptian Grammar. Being an Introduction to the Study of Hieroglyphs.* Third Edition, revised. London, Oxford University Press.

Garland, H. and Bannister, C. O. 1927. *Ancient Egyptian Metallurgy*. London, Griffin.

Garstang, J. 1903: *Mahasna and Bet Khallaf*. British School of Archaeology in Egypt and Egyptian Research Account 7, 7th year. London, Bernard Quaritch.

Garstang, J. 1909. Excavations at Abydos, 1909: preliminary description of the principal finds. *Annals of Archeology and Anthropology* 2: 125–129.

Gauthier-Laurent, M. 1954. Les scènes de coiffure féminine dans l´Ancienne Égypte. In Anonymous (ed.), *Mélanges Maspero I.3.* Orient Ancien: 673–696. Le Caire, L'Institut français d'archéologie orientale.

Gayar, el-S. el and Rothenberg, B. B. 1998. Predynastic and Old Kingdom copper metallurgy in South

Sinai. In: F. A. Esmael (ed.), *Proceedings of the First International Conference on Ancient Egyptian Mining and Metallurgy and Conservation of Metallic Artifacts (10–12 April 1995)*: 147–158. Cairo, Ministry of Culture, Supreme Council of Antiquities.

Gilbert, G. P. 2004. *Weapons, warriors and warfare in early Egypt*. British Archaeological Reports, International Series 1208. Oxford, Archaeopress.

Glück, B. 2010. Post-A-Group and „Proto"-C-Group in Lower Nubia. In: K. Godlewski – A. Łajtar (eds.), *Between the Cataracts, Part two, fasc. 1, Session papers, The Polish Centre of Mediterranean Archaeology Warsaw University*, Polish Archaeology in Mediterranean, Supplement Series 2.2/1–2: 371–385. Warsaw, Warsaw University Press.

Goedicke, H. 1970. *Die privaten Rechtsinschriften aus dem Alten Reich*. Beihefte zur Wiener Zeitschrift für die Kunde des Morgenlandes, Band 5. Wien, Verlag Notring.

Goedicke, H. 1971. *Re-Used Blocks from the Pyramid of Amenemhet I at Lisht*. New York, The Metropolitan Museum of Art.

Goedicke, H. 2002. The perimeter of geographical awareness in the Fourth Dynasty and the significance of *ḥꜣw-nbwt* in the Pyramid Texts. *Studien zur altägyptischen Kultur* 30: 121–136.

Golden, J. M. 2002. The Origins of the Metals Trade in the Eastern Mediterranean: Social Organization of Production in the Early Copper Industries. In E. C. M. van den Brink – T. E. Levy (eds.), *Egypt and the Levant. Interrelations from the 4th through the Early 3rd Millenium BCE*: 225–238. London – New York, Leicester University Press.

Gordon, A. H. and Schwabe, C. W. 1998. 'Live Flesh' and 'Opening-of-the-Mouth': biomedical, ethnological, and Egyptological aspects. In C. J. Eyre (ed.), *Proceedings of the Seventh International Congress of Egyptologists, Cambridge, 3–9 September 1995*: 461–469. Leuven, Peeters.

Gosden, C. and Marshall, Y. 1999. The Cultural Biography of Objects. *World Archaeology 31*: 169–178.

Gower J. C. 1975. Generalized procrustes analysis. *Psychometrika* 1: 33–51. doi: 10.1007/BF02291478

Grajetzki, W. 2003. *Burial Customs in Ancient Egypt. Life in Death for Rich and Poor*. London, Duckworth.

Grajetzki, W. 2014. *Tomb treasures of the late Middle Kingdom: the archaeology of female burials*. Philadelphia, University of Pennsylvania Press.

Grébaut, E. 1890–1900. *Le Musée égyptien. Recueil de monuments et de notices sur les fouilles d'Égypte*, Tome premier. Le Caire, L'Institut français d'archéologie orientale.

Gwinnett, A. J. and Gorelick, L. 1978. Ancient seals, modern science. Using the scanning electron microscope as an aid in the study of ancient seals. *Expedition* 20: 38–47.

Gwinnett, A. J. and Gorelick, L. 1979. Ancient lapidary. A study using scanning electron microscopy and functional analysis. *Expedition* 22: 17–32.

Haag, S., Hölzl, R., and Jánosi, P. (eds.) 2013. *Im Schatten der Pyramiden: die österreichischen Grabungen in Giza (1912 – 1929). Eine Ausstellung des Kunsthistorischen Museums Wien, 22. Jänner bis 20. Mai 2013*. Wien, Kunsthistorisches Museum.

Hafsaas–Tsakos, H. 2010. Between Kush and Egypt: the C-Group people of Lower Nubia during the Middle Kingdom and Second Intermediate Period. In W. Godlewski, W. and A. Łajtar (eds), *Between the cataracts: proceedings of the 11th Conference for Nubian studies, Warsaw University, 27 August–2 September 2006*. Part two: session papers 2: 389–396. Warsaw, Warsaw University Press.

Haiman, M. 1996. Early Bronze Age IV Settlement Pattern of the Negev and Sinai Deserts: View from Small Marginal Temporary Sites. *Bulletin of the American Schools of Oriental Research* 303: 1–32.

Hampson, M. 2010. 'Experimenting with the new': innovative figure types and minor features in Old Kingdom workshop scenes. In A, Woods, A. McFarlane, and S. Binder (eds), *Egyptian culture and society: studies in honour of Naguib Kanawati* 1: 165–179. Le Caire, Conseil Suprême des Antiquités.

Hampson, M. 2012. 'A Princely Find': The Lost Scenes of Craftsmen in the Tomb of Khuenre. In: L. Evans (ed.), *Ancient Memphis "Enduring is the Perfection"*, Orientalia Lovanensia Analecta 214: 193–203. Leuven – Paris – Walpole, Peeters,

Hampson, M. 2014. A work in progress: methods of communicating a sense of process in workshop scenes of the Old Kingdom. *The Bulletin of the Australian Centre for Egyptology* 25: 51–71.

Hannig, R. 2003. *Ägyptisches Wörterbuch I. Altes Reich und erste Zwischenzeit.* Mainz, Philipp von Zabern.

Hannig, R. 2006. *Ägyptisches Wörterbuch II: Mittleres Reich und Zweite Zwischenzeit*, 2 vols. Hannig-Lexica 5. Kulturgeschichte der Antiken Welt 112. Mainz, Philipp von Zabern.

Hansen, D. P. 1967. I. Excavations at Tell el–Rub'a. *Journal of the American Research Center in Egypt* 6: 5–16.

Harmand, S. et al. 2015. 3.3-million-year-old stone tools from Lomekwi 3, West Turkana, Kenya. *Nature* 521: 310–315. doi:10.1038/nature14464.

Harpur, Y. 1987. *Decoration in Egyptian Tombs of the Old Kingdom. Studies in Orientation and Scene Content*. London and New York, Kegan Paul International.

Harpur, Y. 2001. *The tombs of Nefermaat and Rahotep at Maidum: discovery, destruction and reconstruction*. Egyptian Tombs of the Old Kingdom 1. Prestbury, Cheltenham, Oxford Expedition to Egypt.

Harpur, Y. 1996. Old Kingdom blocks from the tomb of Ḥoremḥeb. In H. D. Schneider, *The Memphite tomb of Ḥoremḥeb, commander-in-chief of Tut'ankhamūn*

I: a catalogue of the Finds: 81–90. London, Egypt Exploration Society.

Harpur, Y. and Scremin, P. 2006. *The chapel of Kagemni: scene details. Egypt in Miniature 1*. Reading, Oxford Expedition to Egypt.

Harpur, Y. and Scremin, P. 2015. *The Chapel of Nefer and Kahay. Scene Details*. Egypt in Miniature: Volume Five. Reading, Harpur Scremin Publishing Ltd.

Haslauer, E. 1992. Werkverfahren bei Statuen aus Stein, Holz, Bronze, Fayence und Ton. In: W. Seipel (Hrsg.), *Gott – Mensch – Pharao. Viertausend Jahre Menschenbild in der Skulptur des alten Ägypten*: 49–55. Wien, Kunsthistorisches Museum.

Hassan, S. 1936. *The excavations at Gîza. Vol. 2., 1930–1931*. Cairo, Government Press.

Hassan, S. 1938. Excavations at Saqqara 1937–1938. *Annales du Service des Antiquités de l'Égypte* 38: 503–521.

Hassan, S. 1941. *The excavations at Gîza: Vol. 3., 1931–1932*. Cairo, Government Press.

Hassan, S. 1943. *The excavations at Gîza. Vol. 4., 1932–1933*. Cairo, Government Press.

Hassan, S. 1948. *Excavations at Gîza. The Offering–List in the Old Kingdom. Vol. VI– Part II. 1934–1935*. Cairo, Government Press.

Hassan, S. 1953. *The Mastabas of the Seventh Season and Their Description*. Cairo, Government Press.

Hassan, S. and Iskander, Z. 1975. *Mastabas of Ny-´ankh-Pepy and Others*. Cairo, General Organisation for Government Printing Offices.

Hauptmann, H. and Pernicka, E. (Hrsg.) 2004. *Die Metallindustrie Mesopotamiens von den Anfängen bis zum 2. Jahrtausend v. Chr.: Katalog, Tabellen, Tafeln; Katalog der untersuchten Metallobjekte aus dem Iraq und Syrien und Ergebnisse der Röntgenfluoreszenz– und Neutronenaktivierungsanalysen*. Leidorf, Verlag Marie Leidorf.

Havelková P. 2013. Staří Egypťané pohřbení v hrobovém komplexu princezny Šeretnebtej (AS 68) [Ancient Egyptians buried in the tomb complex of Princess Sheretnebty (AS 68)]. *Pražské egyptologické studie [Prague Egyptological Studies]* X, 47–54.

Hays, H. 2002. The Worshipper and the Worshipped in the Pyramid Texts. *Studien zur altägyptischen Kultur* 30: 153–167.

Helck, W. 1954. *Untersuchungen zu den Beamtentiteln des ägyptischen Alten Reiches*. Ägyptologische Forschungen 18. Glückstein, Augustin.

Helck, W. 1974: *Die altägyptischen Gaue*. Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe B (Geisteswissenschaften) 5. Wiesbaden, Reichert.

Hendrickx, S. and Eyckerman, M. 2009. The 1955 excavation of an early Old Kingdom storage site at Elkab. In W. Claes, H. de Meulenaere and S. Hendrickx (eds), *Elkab and beyond: studies in honour of Luc Limme*: 1–30. Leuven, Peeters.

Hestrin, R. and Tadmor, M. 1963. A Hoard of Tools and Weapons from Kfar Monash. *Israel Exploration Journal* 13: 265–288.

Hikade, T. 2013. *Elephantine XXXV: The lithic industries on Elephantine Island during the 3rd millennium BC*. Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 121. Wiesbaden, Harrassowitz.

Hodder, I. 1989. This is not an article about material culture as text. *Journal of Anthropological Archaeology* 8: 250–269.

Hodjash, S. and Berlev, O. 1982. *The Egyptian Reliefs and Stelae in the Pushkin Museum of Fine Arts*. Moscow, Leningrad, Aurora Art Publications

Höflmayer, F. and Eichmann, R. (eds.) 2014. *Egypt and the Southern Levant in the Early Bronze Age*. Orient-Archäologie 31. Rahden, Verlag Marie Leidorf.

Hölscher, U. 1912. *Das Grabdenkmal des Königs Chephren*. Veröffentlichungen der Ernst von Sieglin Expedition in Ägypten 1. Leipzig, Hinrichs.

Hornung, E., Krauss, R. and Warburton, D. A. (eds.) 2006. *Ancient Egyptian Chronology*. Handbuch der Orientalistik. Section 1. The Near and Middle East 83. Leiden – Boston, Brill.

Hornung, E. 1982. *Conceptions of god in ancient Egypt: the one and the many*. London; Ithaca NY, Routledge & Kegan Paul; Cornell University Press.

Huzayyin, S. A. 1937. The Flint Industry. In R. Mond and O. H. Myers, *Cemeteries of Armant, I–II.* Memoir of the Egypt Exploration Society 42: 191–253. London, Egypt Exploration Society.

Ikram, S. 1995. *Choice Cuts: Meat Production in Ancient Egypt*. Orientalia Lovanensia Analecta 69. Leuven, Peeters.

James, T. G. H. 1953. *The Mastaba of Khentika called Ikhekhi*. London, Egyptian Exploration Society.

James, T. G. H. 1961. A Group of Inscribed Egyptian Tools. *British Museum Quarterly* XXIV: 36–43.

Jánosi, P. 2005. *Giza in der 4. Dynastie*. Wien, Verlag der Österreichischen Akademie der Wissenschaften.

Jánosi, P. 2006. *Die Gräberwelt der Pyramidenzeit*. Mainz am Rhein, Philipp von Zabern.

Janssen, J. J. 1994. An exceptional event at Deir El–Medina (P Turin 1879, verso II). *Journal of the American Research Center in Egypt* 31: 91–97.

Jéquier, G. 1921. *Les frises d'objets des sarcophages du Moyen Empire*. Le Caire, L'Institut français d'Archéologie orientale.

Jéquier, G. 1929. *Tombeaux de particuliers contemporains de Pepi II*. Le Caire, Institut français d'archéologie orientale.

Jéquier, G. 1935. Rapport préliminaire sur les fouilles exécutées en 1934–1935 dans la partie méridionale de la nécropole memphite. *Annales du Service des Antiquités de l'Égypte* 35: 31–34.

Jéquier, G. 1938. *Le monument funéraire de Pepi II. T. 2. Le temple*. Le Caire, L'Institut français d'archéologie orientale.

Jéquier, G. 1940. *Le monument funéraire de Pepi II. T. 3. Les approches du temple*. Le Caire, L'Institut français d'archéologie orientale.

Jeuthe, C. 2012. *Balat X: Ein Werkstattkomplex im Palast der 1. Zwischenzeit in Ayn Asil*. Fouilles de l'Institut Français d'Archéologie Orientale 71. Le Caire, Institut français d'archéologie orientale.

Jirásková, L. forthcoming. Model stone vessels of the Old Kingdom – their typology and chronology. In M. Bárta, F. Coppens and J. Krejčí, *Abusir and Saqqara in the year 2015*, Prague.

Jirásková, L. in preparation. *Stone model and miniature vessels of the Old Kingdom*. Unpublished PhD thesis, Charles University.

Jirásková, L. in press. Abusir miniature and model stone vessels of the Old Kingdom. In T. Gillen (ed.), *(Re) productive Traditions in Ancient Egypt*, Liège.

Jirásková, L., Arias Kytnarová, K., and Odler, M. forthcoming. Model and miniature vessels in the Old Kingdom burial chambers of the Giza cemeteries. In *Proceedings of the Fifth International Congress for Young Egyptologists, Vienna 2015*.

Johnson, D. et al. 2013. Analysis of a prehistoric Egyptian iron bead with implications for the use and perception of meteorite iron in ancient Egypt. *Meteoritics & Planetary Science* 48: 997–1006.

Jones, D. 1986. The Phrase šd dšr, šd m dšr in Boat–Building Scenes. *Journal of Egyptian Archaeology* 72: 185–187.

Jones, D. 2000. *An index of ancient Egyptian titles, epithets and phrases of the Old Kingdom*. Vols. 1–2. Oxford, Archaeopress.

Jørgensen, M. 1996. *Catalogue Egypt I (3000–1550 B. C.). Ny Carlsberg Glyptotek*. Copenhagen, Ny Carlsberg Glyptotek.

Junk, M. 2003. *Material properties of copper alloys containing arsenic, antimony and bismuth*. Unpublished PhD thesis, Technische Universität Bergakademie Freiberg.

Junker, H. 1927. *Vorläufiger Bericht über die vierte Grabung bei den Pyramiden von Gizeh*. Vienna, Akademie der Wissenschaft.

Junker, H. 1929. *Gîza I. Die Mastabas der IV. Dynastie auf dem Westfriedhof*. Wien und Leipzig, Hölder–Pichler–Tempsky.

Junker, H. 1938. *Gîza III. Die Mastabas der vorgeschrittenen V. Dynastie auf dem Westfriedhof*. Wien und Leipzig, Hölder–Pichler–Tempsky.

Junker, H. 1940. *Gîza IV: Die Mastaba des Kꜣjmʿnḫ (Kai–em–anch)*. Wien: Hölder–Pichler–Tempsky.

Junker, H. 1944. *Gîza VII: Der Ostabschnitt des Westfriedhofs. Erster Teil.* Wien, Hölder–Pichler–Tempsky.

Junker, H. 1947. *Gîza VIII. Der Ostabschnitt des Westfriedhofs. Zweiter Teil.* Wien, Rudolf M. Rohrer.

Junker, H. 1950. *Gîza IX. Das Mittelfeld des Westfriedhofs*. Wien, Rudolf M. Rohrer.

Junker, H. 1951. Gîza X. Das Friedhof südlich der Cheopspyramide. Westteil. Wien, Rudolf M. Rohrer.

Junker, H. 1953. *Gîza XI: Der Friedhof südlich der Cheopspyramide. Ostteil*. Wien, Rudolf M. Rohrer.

Junker, H. 1956. Die Hieroglyphen für "Erz" und "Erzarbeiter". *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 14: 89–103.

Kaiser, W. 1969. Die Tongefässe. In Ricke, H. *Das Sonnenheiligtum des Königs Userkaf, Vol. II: Die Funde. Beiträge zur ägyptischen Bauforschung und Altertumskunde* 11: 49–82. Wiesbaden, Schweizerisches Institut für ägyptische Bauforschung und Altertumskunde.

Kaiser, W. et al. 1980. Stadt und Tempel von Elephantine, Achter Grabungsbericht. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 40: 245–291.

Kaiser, W. et al. 1997. Stadt und Tempel von Elephantine. 23./24. Grabungsbericht. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 53: 117–193.

Kaiser, W., Dreyer, G., Jaritz, H., et al. 1987. Stadt und Tempel von Elephantine. 13./14. Grabungsbericht. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 43: 75–114.

Kaiser, W., Avila, R., Dreyer, G. et al. 1984. Stadt und Tempel von Elephantine: Elfter/Zwölfter Grabungsbericht. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 40: 169–205.

Kamal, A. 1912. Fouilles à Dara et à Qoçéîr el-Amarna. *Annales du Service des Antiquités de l'Égypte* 12: 128–142.

Kamal, A. 1915. Le tombeau nouveau de Méîr. *Annales du Service des Antiquités de l'Égypte* 15: 209–258.

Kanawati N. 1983. *The Rock Tombs of el-Hawawish. The Cemetery of Akhmim. Volume IV.* Sydney, The Macquarie Ancient History Association.

Kanawati, N. 1977. *The Egyptian Administration in the Old Kingdom. Evidence on its Economic Decline.* Warminster, Aris and Phillips Ltd.

Kanawati, N. 1980. *The rock tombs of el–Hawawish : the cemetery of Akhmim. Vol. 1*. Sydney, Macquaire Ancient History Association.

Kanawati, N. 1981. *The rock tombs of el–Hawawish : the cemetery of Akhmim. Vol. 2*. Sydney, Macquaire Ancient History Association.

Kanawati, N. 1992. *Akhmim in the Old Kingdom, part I: chronology and administration*. Australian Centre for Egyptology Studies 2. Sydney, The Australian Centre for Egyptology.

Kanawati, N. 2001. *Tombs at Giza: Volume I: (G4561) and Seshemnefer I (G4940)*. Australian Centre for Egyptology Reports 16. Warminster, Aris and Phillips.

Kanawati, N. 2005. *Deir el-Gebrawi. Volume 1: the northern cliff*. Australian Centre for Egyptology Reports 23. Oxford, Aris and Phillips.

Kanawati, N. 2006. *The Teti Cemetery at Saqqara VIII. The Tomb of Inumin*, Oxford, Aris and Phillips, Ltd.

Kanawati, N. 2013. *Deir el-Gebrawi, volume III: The southern cliff. The tomb of Djau/Shemai and Djau*.

Australian Centre for Egyptology Reports 32. Oxford, Aris and Phillips.

Kanawati, N. and Abder–Raziq, M. 1998. *The Teti Cemetery at Saqqara. Volume III: The Tombs of Neferseshemre and Seankhuiptah*. Warminster, Aris and Phillips.

Kanawati, N. and Abder–Raziq, M. 1999. *The Teti Cemetery at Saqqara. Volume V: The tomb of Hesi*. Australian Centre for Egyptology Reports 13. Warminster, Aris and Phillips.

Kanawati, N. and Abder–Raziq, M. 2003. *The Unis Cemetery at Saqqara, vol. 2: The Tombs of Iynefert and Ihy (reused by Idut)*. Oxford, Aris and Phillips.

Kanawati, N. and Evans, L. 2014. *The cemetery of Meir. Volume II: The tomb of Pepyankh the Black*. Australian Centre for Egyptology Reports 34. Oxford, Aris and Phillips.

Kanawati, N. and Hassan, A. 1997. *The Teti Cemetery at Saqqara. Volume II: The Tomb of Ankhmahor*. The Australian Centre for Egyptology Reports, 9. Warminster, Aris and Phillips.

Kanawati, N. and McFarlane, A. 1993. *Deshasha. The Tombs of Inti, Shedu and Others*. The Australian Centre for Egyptology Reports, 5. Sydney, The Australian Centre for Egyptology.

Kanawati, N. et al. 2010 – 2011. *Mereruka and his family, part III.1-2: the tomb of Mereruka*. Australian Centre for Egyptology Reports 29–30. Oxford, Aris and Phillips.

Kaplony, P. 1965. Bemerkungen zu einigen Steingefäßen mit archaischen Königsnamen. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 20: 1–50.

Kaplony, P. 1966. *Kleine Beiträge zu den Inschriften der ägyptischen Frühzeit*. Wiesbaden, Harrasowitz.

Kees, H. 1956. *Totenglauben und Jenseitsvorstellungen der alten Ägypter*. Berlin, Akademie–Verlag.

Kees, H. and Morrow, I. F. D. 1961. *Ancient Egypt. A Cultural Topography*. Chicago, The University of Chicago Press.

Khouli, A. el- and Kanawati, N. 1990. *The Old Kingdom tombs of el-Hammamiya.* Australian Centre for Egyptology Reports 2. Sydney, The Australian Centre for Egyptology.

Killen, G. 1980. *Ancient Egyptian Furniture I. 4000–1300 BC*. Warminster, Aris and Phillips.

Killen, G. 1994. *Egyptian Woodworking and Furniture*. Shire Egyptology 21. Princes Risborough, Shire Publications.

Killick, D. 2009. Cairo to Cape: The Spread of Metallurgy Through Eastern and Southern Africa. *Journal of World Prehistory* 22/4: 399–414.

Kinney, L. 2008. *Dance, dancers and the performance cohort in the Old Kingdom*. BAR International Series 1809. Oxford, Archaeopress.

Klebs, L. 1915. *Die Reliefs des alten Reiches (2980 – 2475 v. Chr.)*. Material zur ägyptischen Kulturgeschichte. Heidelberg, Winter,

Kobusiewicz, M. 2011. Lithic Implements. In M. Chłodnicki et al. (eds.), *Kadero, The Lech Krzyżaniak Excavations in the Sudan*, Studies in African Archaeology, vol. 10. 267–297. Poznań, Muzeum Archeologiczne w Poznaniu.

Kobusiewicz, M. 2015. *The Production, Use and Importance of Flint Tools in the Archaic Period and the Old Kingdom in Egypt.* Archaeopress Egyptology 12. Oxford, Archaeopress.

Köhler, E. C. 2014. *Helwan III. Excavations in Operation 4, Tombs 1–50*, Rahden/Westf, Verlag Marie Leidorf.

Köhler, E. C. and Jones, J. 2009. *Helwan II: The Early Dynastic and Old Kingdom Funerary Relief Slabs*. Studien zur Archäologie und Geschichte Altägyptens 25. Kairo – Heidelberg, Marie Leidorf.

Kopp, P. 2006. *Elephantine XXXII. Die Siedlung der Naqadazeit*. Archäologische Veröffentlichungen 118. Mainz am Rhein, Philipp von Zabern.

Kowalska, A. 2013. Finds: small finds. In K. Myśliwiec (ed.), *Saqqara V: Old Kingdom structures between the Step Pyramid complex and the Dry Moat 2*: 436–476. Varsovie, Neriton.

Krejčí, J. 2000. Some notes on the "overseers of works" during the Old Kingdom. *Ägypten und Levante* 10: 67–75.

Krejčí, J. 2008a: Finds from Lepsius no. 25/1. In J. Krejčí, M. Verner, V. G. Callender *et al., Abusir XII: minor tombs in the Royal Necropolis I (the mastabas of Nebtyemneferes and Nakhtsare, pyramid complex Lepsius no. 24 and tomb complex Lepsius no. 25)*: 185–200. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Krejčí, J. 2008b: Finds from Lepsius no. 25/2. In J. Krejčí, M. Verner, V. G. Callender *et al., Abusir XII: minor tombs in the Royal Necropolis I (the mastabas of Nebtyemneferes and Nakhtsare, pyramid complex Lepsius no. 24 and tomb complex Lepsius no. 25)*: 200–209. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Krejčí, J. 2008c: The Mastaba of Nakhtsare. In J. Krejčí, M. Verner, V. G. Callender *et al., Abusir XII: minor tombs in the Royal Necropolis I (the mastabas of Nebtyemneferes and Nakhtsare, pyramid complex Lepsius no. 24 and tomb complex Lepsius no. 25)*: 37–68. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Krejčí, J. 2013. Das Grab des Kakaibaef in Abusir. *Sokar* 27: 26–37.

Krejčí, J., Arias Kytnarová, K. and Odler, M. 2015. Archaeological excavation of the mastaba of Queen Khentkaus III (tomb AC 30) in Abusir. *Prague Egyptological Studies* XV: 28–42.

Krejčí, J., Arias Kytnarová, K., Vymazalová, H., Pokorná, A. and Beneš, J. 2014. *Abusir XXIV. Mastaba of Werkaure, Volume I: Tombs AC 26 and AC 32 – Old Kingdom strata*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Krejčí, J., Verner, M., Callender, V. G. *et al.* 2008. *Abusir XII: minor tombs in the Royal Necropolis I (the mastabas of Nebtyemneferes and Nakhtsare, pyramid complex Lepsius no. 24 and tomb complex Lepsius no. 25)*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Krieger, A. 1944. The Typological Concept. *American Antiquity* 9: 271–288.

Kroeper, K. 1992. Tombs of the Elite in Minshat Abu Omar. In E. C. M. van den Brink (ed.), *The Nile Delta in transition: 4th – 3rd millennium BC. Proceedings of the seminar held in Cairo, 21 – 24 October 1990, at the Netherlands Institute of Archaeology and Arabic Studies*: 127–150. Tel Aviv, E. C. M. van den Brink.

Kroeper, K. and Wildung, D. 2000. *Minshat Abu Omar. Ein vor– und frühgeschichtlicher Friedhof im Nildelta II*. Mainz am Rhein, Philipp von Zabern.

Kromer, K. 1978. *Siedlungsfunde aus dem frühen Alten Reich in Giseh. Österreichische Ausgrabungen 1971–1975*. Wien, Verlag der Österreichischen Akademie der Wissenschaften.

Krumrine, C. 1995. An Investigation of Ancient Pigment and Early Repairs Discovered During Conservation Treatment of the Brooklyn Museum's Statuette of Pepy I In: C. E. Brown, F. Macalister, M. M. Wright (eds.), *Conservation in Ancient Egyptian Collections, Papers given at the conference organised by the United Kingdom Institute for Conservation, Archaeology Section, and International Academic Projects, held at London, 20–21 July 1995*: 57–68. London, Archetype.

Kuhn, R. 2011. Überlegungen zu Modellwerkzeugen im Grabinventar frühzeitlicher Bestattungen anhand einiger Beispiele aus dem Ägyptischen Museum der Universität Leipzig – Georg Steindorff. *Mitteilungen des Deutschen archäologischen Instituts Abteilung Kairo* 67: 111–124.

Kühnert–Eggebrecht, E. 1969. *Die Axt als Waffe und Werkzeug im alten Ägypten*. Münchner Ägyptologische Studien 15. Berlin, B. Hessling.

Kuraszkiewicz, K. O. 2013. Architecture and development of the necropolis. In K. Myśliwiec (ed.), *Saqqara V: Old Kingdom structures between the Step Pyramid complex and the Dry Moat 1*: 21–321. Varsovie, Neriton.

Kurth, D. 2006. Zur Konstruktion altägyptischer Harpunen. *Nikephoros; Zeitschrift für Sport und Kultur im Altertum, Festschrift für Wolfgang Decker zum 65. Geburtstag, 18*: 53–69.

Labrousse, A. and Lauer, J.-P. 2000. *Les complexes funéraires d´Ouserkaf et de Néferhétepès*. Bibliothèque d'étude 130/1–2. Le Caire, L'Institut français d'archéologie orientale.

Labrousse, A. and Albouy M. 1999. *Les pyramides des reines. Une nouvelle nécropole à Saqqâra*. Paris, Hazan.

Lacovara, P. 1988. No. 7. Set of eighty model vessels. In: S. D'Auria – P. Lacovara – C. Roehrig (eds.), *Mummies and Magic: The Funerary Arts of Ancient Egypt*, 77–78. Boston, The Museum of Fine Arts.

Lallemand, H. 1923. Les assemblages dans la technique égyptienne et le sens originel du mot menkh. *Bulletin de l'Institut Français d'Archéologie Orientale* 22: 77–98.

Laroze, E. and Garric, A. 2013. La technique du sciage des joints dans la maçonnerie ptolémaïque en grès. *Bulletin de l'Institut Français d'Archéologie Orientale* 113: 239–282.

Lashien, M. 2013. *The chapel of Kahai and his family*. Australian Centre for Egyptology Reports 33. Oxford, Aris and Phillips.

Lauer, J.–P. 1936. *La pyramide à degrés. L´architecture. Tomes I–II.* Le Caire, L'Institut français d'archéologie orientale.

Leclant, J. and Clerc, G. 1990. Fouilles et travaux en Égypte et au Soudan, 1988–1989. *Orientalia* 59–3: 335–439.

Lehner, M. 2002. The Pyramid Age Settlement of the Southern Mount at Giza. *Journal of the American Research Center in Egypt* 39: 27–74.

Lehner, M. 2007. Introduction to the Gallery III.4 excavations. In M. Lehner and W. Wetterstrom, *Giza reports, volume 1: project history, survey, ceramics, and main street and gallery III.4 operations*: 183–192. Boston, Ancient Egypt Research Associates.

Lechtmann, H. 1996. Arsenic bronze: dirty copper or chosen alloy? A view from the Americas. *Journal of Field Archaeology* 23: 477–514.

Lechtmann, H. and Klein, S. 1999. The production of copper–arsenic alloys (Arsenic bronze) by cosmelting: modern experiment, ancient practice. *Journal of Archaeological Science* 26: 497–526.

Lembke, K. and Schmitz, B. (Hrsg.) 2011. *Giza. Am Fuß der großen Pyramiden. Katalog zur Sonderausstelung*. München, Hirmer.

Lemonnier, P. 1986. The study of material culture today: Toward an anthropology of technical systems. *Journal of Anthropological Archaeology* 5: 147–186.

Lepsius, R. 1849–1859. *Denkmäler aus Ägypten und Äthiopien*. Berlin, Nicolaische Buchhandlung. Accessed via: http://edoc3.bibliothek.uni-halle.de/lepsius/start.html.

Leroi–Gourhan, A. 1943. *L'Homme et la matière*. Paris, Albin Michel.

Leroi–Gourhan, A. 1993. *Gesture and Speech*. Cambridge, Massachusetts & London, MIT Press.

Levy, T. E. 2007. *Journey to the Copper Age. Archaeology in the Holy Land*. San Diego, San Diego Museum of Man.

Levy, T. E. et al. 2002. Early Bronze Age metallurgy: a newly discovered copper manufactory in southern Jordan. *Antiquity* 292: 425–437.

Lightbody, D. I. 2008. *Egyptian Tomb Architecture. The archaeological facts of pharaonic circular symbolism*. BAR International Series 1852. Oxford, Archaeopress.

Lilyquist, C. 1979. *Ancient Egyptian Mirrors: From the Earliest Times through the Middle Kingdom*. Münchner Ägyptologische Studien 27. Berlin, Deutscher Kunstverlag.

Limme, L. 2008. Elkab, 1937–2007: seventy years of Belgian archaeological research. *British Museum studies in ancient Egypt and Sudan* 9: 15–50.

Limme, L., Hendrickx, S., and Huyge, D. 1997. Elkab: excavations in the Old Kingdom rock necropolis. *Egyptian Archaeology* 11: 3–6.

Linacre College, Oxford (2006) *Oxford Expedition to Egypt: Scene–details Database [data–set]*. York, Archaeology Data Service. doi: 10.5284/1000009

Lloyd, A. B., Spencer, A. J. and el–Khouli, A. 1990. *Saqqâra Tombs II: The Mastabas of Meru, Semdenti, Khui and others*. London, Egypt Exploration Society.

Loeben, C. 2014. III. Stiftung Niedersachsen, Hannover: Schenkung Pelling/Zarnitz. In M. Fitzenreiter, C. E. Loeben, D. Raue, and U. Wallenstein (eds), *Gegossene Götter: Metallhandwerk und Massenproduktion im alten Ägypten*: 321–334. Rahden/Westf, Verlag Marie Leidorf.

Lucas, A. and Harris, J. 1962. *Ancient Egyptian Materials and Industries*. 4th revised edition. London, Edward Arnold.

Lucas, G. 2012. *Understanding the Archaeological Record*. Cambridge, Cambridge University Press.

Lythgoe, A. M. and Ransom, C. L. 1916. *The tomb of Perneb*. New York, Metropolitan Museum of Art.

Mace, A. H. 1909. *Naga ed–Dêr: The early Dynastic Cemeteries of Naga ed–Dêr*. Leipzig, Hinrichs.

Maddin, R. *et al.* 1984. Old Kingdom models from the tomb of Impy: metallurgical studies. *Journal of Egyptian Archaeology* 70: 33–41.

Málek, J. 1999. *Egyptian Art*. London, Phaidon Press Ltd.

Maragoudaki, E. and Kavvouras, P. K. 2012. Mycenaean shipwright tool kit: its reconstruction and evaluation. *Archaeological and Anthropological Sciences* 4: 199–208.

Marangou, C. 1991. Social differentiation in the Early Bronze Age: miniature metal tools and child burials. *Journal of Mediterranean Studies*, 1: 211–225.

Maravelia, A.-A. 2006. *Les Astres dans les Textes Religieux en Égypte Antique et dans les Hymnes Orphiques*. British Archaeological Reports, International Series 1527. Oxford, Archaeopress.

Marchand, S. 2009. Abou Rawash à la IVe dynastie: les vases en céramique de la pyramide satellite de Rêdjédef. In T. I. Rzeuska and A. Wodzińska (eds), *Studies on Old Kingdom pottery*: 71–94. Warsaw: Neriton.

Mariette, A. 1889. *Les Mastabas de L'Ancien Empire. Fragment Du Dernier Ouvrage*, Paris, F. Vieweg.

Martin-Pardey, E. 1989. Die Verwaltung im Alten Reich, Grenzen und Möglichkeiten von Untersuchungen zu diesem Thema. *Bibliotheca Orientalis 46*: cols. 533–552.

Mathieu, B. 2006. Techniques, culture et idéologie. Deux exemples égyptiens: les navires de Kaïemânkh et la toise du foulon, in: B. Mathieu et al. (eds.), *L'apport de l' Égypte à l'historie des techniques. Méthodes, chronologie et comparaisons*, Bibliothèque d'étude 142: 155–167. Le Caire, L'Institut français d'archéologie orientale.

Mauss, M. 1973. The Techniques of the Body. *Economy and Society* 2(1): 70–88.

McDermott, B. 2004. *Warfare in ancient Egypt*. Stroud, Sutton Publishing.

McFarlane, A. and Mourad, A.-L. (eds.) 2012. *Behind the scenes: daily life in Old Kingdom Egypt*. Australian Centre for Egyptology Studies 10. Oxford, Aris and Phillips.

McGuire, R. H. 2002. *A Marxist Archaeology*. New York, Percheron Press.

McKerrell, H. 1971. *Metal analyses by radio-isotope non-dispersive X-ray fluorescence in Egyptian Department, Ashmolean Museum.* Oxford, The Ashmolean Museum, unpublished document.

McKerrell, H. 1993. Results of radio–isotope non–dispersive X–ray fluorescence analysis of predynastic Egyptian copper. In: J. Crowfoot Payne, *Catalogue of the predynastic collection in the Ashmolean Museum*: 256. Oxford, Clarendon Press.

McKerrell, H. and Tylecote, R. F. 1972. The working of copper–arsenic alloys in the Early Bronze Age and the effect of the determination of provenance. *Proceedings of the Prehistoric Society* 38: 209–218.

Meeks, N. 1993. Surface characterization of tinned bronze, high–tin bronze, tinned iron and arsenical bronze. In S. La Niece and P. T. Craddock (ed.), *Metal plating and patination:* 247–275. Oxford, Butterworth-Heinemann.

Mesoudi, A. 2011. *Cultural Evolution: How Darwinian Theory Can Explain Human Culture and Synthesize the Social Sciences*. Chicago, University of Chicago Press.

Messiha, K., and Messiha, H.. 1964. A new concept about the implements found in the Excavations at Gîza. *Annales du Service des Antiquités de l'Égypte* 58: 209–225.

Michałowski, K. et al. 1950. *Tell Edfou III*. Le Caire, L'Institut français d'archéologie orientale.

Michel, F. 1972. Analyse de quarante miroirs appartenant au Département des Antiquités égyptiennes du Musée du Louvre. *Annales 23 (Laboratoire de recherche des musées de France)*: 34–46.

Minault–Gout, A. and Deleuze, P. 1992. *Le mastaba d'Ima–Pépi. Tombeau d'un gouverneur de l'oasis à la fin de l'Ancien Empire*. Le Caire, L'Institut français d'archéologie orientale.

Miron, E. 1992. *Axes and adzes from Canaan*. Prähistorische Bronzefunde. Abteilung 9, Band 19. Stuttgart, Franz Steiner Verlag.

Mogensen, M. 1921. *Le mastaba égyptien de la Glyptothèque Ny Carlsberg*. Copenhague, Nordisk Forlag.

Mogensen, M. 1930. *La Glyptothèque Ny Carlsberg: La collection égyptienne*. Copenhague, Levin & Munksgaard.

Montanari, D. 2015: Metal Weapons in the Southern Levant During the Early Bronze Age: an Overview. In K. Rosińska-Balik; A. Ochał-Czarnowicz; M. Czarnowicz; J. Dębowska-Ludwin (eds.), *Copper and Trade in the South-Eastern Mediterranean. Trade routes of the Near East in Antiquity*: 67–76. Oxford, BAR International Series 2573.

Montet, P. 1925. *Les scènes de la vie privée dans les tombeaux égyptiens de l´Ancien Empire*. Strasbourg, Imprimerie Alsacienne.

Montet, P. 1928. *Byblos et l´Égypte. Quatre campagnes de fouilles 1921–1924*. Paris.

Montet, P. 1933. Contribution a l´étude des mastabas de l´Ancien empire. *Kêmi* IV: 161–189.

Montet, P. 1938. *Tombeaux de la Ire et de la IVe dynasties à Abou Roach*. Kêmi VII: 11–69.

Moores, R. G. 1991. Evidence for Use of a Stone–Cutting Drag Saw by the Fourth Dynasty Egyptians. *Journal of the American Research Center in Egypt* XXVIII: 139–148.

Moorey, P. R. S. 1994. *Ancient Mesopotamian Materials and Industries*. Oxford, Oxford University Press.

Moussa, A. M. and Altenmüller, H. 1971. *The Tomb of Nefer and Ka–hay: Old Kingdom tombs at the causeway of king Unas at Saqqara*. Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 5. Mainz am Rhein, Philipp von Zabern.

Moussa, A. M. and Altenmüller, H. 1977. *Das Grab des Nianchchnum und Chnumhotep. Old Kingdom Tombs at the Causeway of King Unas at Saqqara excavated by the Department of Antiquities*. Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 21. Mainz am Rhein, Philipp von Zabern.

Müller-Wollermann, R. 1985. Warenaustausch im Ägypten des Alten Reiches. *Journal of the Economic and Social History of the Orient* 28: 121–168.

Münch, H.–H. 2000. Categorizing archaeological finds: the funerary material of Queen Hetepheres I at Giza. *Antiquity* 74: 898–908.

Murray, M. A. 2011. Archaeological Science 2009. In M. Lehner (ed.), *Giza Plateau Mapping Project. Season 2009, Preliminary Report, Giza Occasional Papers 5*: 153–171. Boston, Ancient Egypt Research Associates.

Myśliwiec, K. 2001. West Saqqara Excavations 2000. *Polish Archaeology in Mediterranean* XII: 107–119.

Op de Beeck, L. 2004. Possibilities and Restrictions for the Use of the Maidum-Bowls as Chronological Indicators. *Cahiers de la Céramique Égyptienne* 7: 239–280.

Naville, E. 1914. *The Cemeteries of Abydos. Part. I–1909–1910. The Mixed Cemetery and Umm el–Ga'ab*. London, Egypt Exploration Fund.

Neustupný, E. 2010: *Teorie archeologie*. Plzeň, Aleš Čeněk.

Nigro, L. 2010. *In the Palace of the Copper Axes. Khirbet al–Batrawy: the discovery of a forgotten city of the III millennium BC in Jordan*. Roma Studies on the Archaeology of Palestine & Transjordan. Colour Monographs I. Roma, Università di Roma „La Sapienza".

Nigro, L. 2015. The Copper Axes Hoard in the Early Bronze IIIb Palace of Batrawy, Jordan. In K. Rosińska-Balik; A. Ochał-Czarnowicz; M. Czarnowicz; J. Dębowska-Ludwin (eds.), *Copper and Trade in the South-Eastern Mediterranean. Trade routes of the Near East in Antiquity*: 77–83. Oxford, BAR International Series 2573.

Nordström, H.–Å. 1972. *The Scandinavian Joint Expedition to Sudanese Nubia. Vols. 3: 1–2: Neolithic and A–Group Sites*. Stockholm, Läromedelsförlagen.

Northover, J. P. 1989. Properties and use of arsenic–copper alloys. In A. Hauptmann, E. Pernicka, G. A. Wagner (eds.), *Old World Archaeometallurgy*. Der Anschnitt: Beiheft 7: 111–118. Bochum, Deutsches Bergbaumuseum.

Nunn, J. and Rowling, J. 2001. The Eye of the Needle in Predynastic Egypt. *Journal of Egyptian Archaeology* 87: 171–172.

O'Brien, M. J. and Lyman, R. L. 2000. *Applying Evolutionary Archaeology: A Systematic Approach*. New York, Kluwer Academic/Plenum.

O'Connor, D. 2009. *Abydos: Egypt's first pharaohs and the cult of Osiris. New aspects of antiquity*. London, Thames & Hudson.

O'Connor, D. 2014. *The Old Kingdom town at Buhen*. Edited by Patricia Spencer. Egypt Exploration Society, Excavation Memoir 106. London, Egypt Exploration Society.

O'Neill, B. 2015. *Setting the Scene: The deceased and regenerative cult within offering table imagery of the Egyptian Old to Middle Kingdoms (c.2686 – c.1650 BC)*. Archaeopress Egyptology. Oxford, Archaeopress.

Odler, M. 2013. Medené nálezy z hrobového komplexu rodiny princeznej Šeretnebtej [Copper finds from the burial complex of the relatives of Princess Sheretnebty]. *Pražské egyptologické studie [Prague Egyptological Studies]* X: 62–64.

Odler, M. 2015a. Adzes in the Early Dynastic Period and the Old Kingdom. In K. Rosińska-Balik; A. Ochał-Czarnowicz; M. Czarnowicz; J. Dębowska-Ludwin (eds.), *Copper and Trade in the South-Eastern Mediterranean. Trade routes of the Near East in Antiquity*: 85–109. Oxford, BAR International Series 2573.

Odler, M. 2015b. Copper Model Tools in Old Kingdom Female Burials. In M. S. Pinarello; J. Yoo; J. Lundock; C. Walsh (eds), *Current Research in Egyptology 2014: Proceedings of the Fifteenth Annual Symposium*: 39–58. Oxford, Oxbow Books.

Odler, M. *in preparation*. Copper Finds from the Tomb Complex of Inti. In M. Bárta, M., B. Vachala, B. et al. in preparation. *The tomb of Inti*, Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University.

Odler, M. and Dulíková, V. 2015. Social Context of the Old Kingdom copper model tools. *World Archaeology* 47 (1): 94–116. DOI: 10.1080/00438243.2014.991805.

Ogden, C. K. and Richards, I. A. 1923. *The Meaning of Meaning: A Study of the Influence of Language upon Thought and of the Science of Symbolism*. London, Kegan Paul.

Orthmann, W., Matthiae, P, and al-Maqdissi, M. (eds.) 2013. *Archéologie et Histoire de la Syrie I La Syrie de l'époque néolithique à l'âge du fer*. Wiesbaden, Harrasowitz.

Ottaway, B. S. 1994. *Prähistorische Archäometallurgie*. Leidorf, Espelkamp.

Pantalacci, L. 2013. Balat, a frontier town and its archive. In: J. C. Moreno Garcia (ed.), *Ancient Egyptian Administration*: 197–214. Leiden, Brill.

Parker Pearson, M. 1999. *The Archaeology of Death and Burial*. Phoenix Mill, Sutton Publishing Ltd.

Parkinson, R. B. 2009. *The Tale of Sinuhe and Other Ancient Egyptian Poems 1940–1640 B.C*. Oxford, Oxford University Press.

Payne, J. C. 1993. *Catalogue of the Predynastic Egyptian Collection in the Ashmolean Museum*. Oxford, Clarendon Press.

Peet, T. E. 1914. *The Cemeteries of Abydos. Part II. – 1911–1912*. Memoir of the Egypt Exploration Fund 34. London, Egypt Exploration Fund.

Pereira, F., Silva, Rui J. C., Soares, A. M. M., and Araújo, M. F. 2013. The role of arsenic in Chalcolithic copper artifacts – insights from Vila Nova de São Pedro (Portugal). *Journal of Archaeological Science* 40: 2045–2056.

Peres–Neto P. R., Jackson D. A., and Somers K. M. 2005. How many principal components? Stopping rules for determining the number of non–trivial axes revisited. *Computational Statistics & Data Analysis 49*: 974–997. doi: 10.1016/j.csda.2004.06.015.

Perez S. I., Bernal V., and Gonzalez P. N. 2006. Differences between sliding semi–landmark methods in geometric morphometrics, with an application to human craniofacial and dental variation. *Journal of Anatomy* 208: 769–784. doi: 10.1111/j.1469–7580.2006.00576.x

Pernicka, E. 2015. Provenance Determination of Archaeological Metal Objects. In B. W. Roberts and C. Thornton (eds.), *Archaeometallurgy in Global Perspective 2014: Methods and Syntheses:* 239–268. New York, Springer–Verlag New York Inc.

Petrie, H. and Murray, M. A. 1952. *Seven Memphite Tomb Chapels*. London, Quaritch.

Petrie, W. M. F., Brunton, G. and Murray, M. A. 1923. *Lahun II*. British School of Archaeology in Egypt and Egyptian Research Account 33. 26th year. London, British School of Archaeology in Egypt; Bernard Quaritch.

Petrie, W. M. F. and Quibell, J. E. 1896. *Naqada and Ballas. 1895*. British School of Archaeology in Egypt and Egyptian Research Account 1. 1st year. London, Bernard Quaritch.

Petrie, W. M. F., Wainwright, G. A. and Gardiner, A. H. 1913. *Tarkhan I and Memphis V*. British School of Archaeology in Egypt and Egyptian Research Account 23. 19th year. London, Aylesbury, Hazell, Watson and Viney, Ltd.

Petrie, W. M. F. 1892: *Medum*. London, Nutt.

Petrie, W. M. F. 1898. *Deshasheh 1897*. Memoir of the Egypt Exploration Fund 15. London, Kegan Paul, Trench, Truebner & Co.

Petrie, W. M. F. 1900. *Dendereh 1898*. Memoir of the Egypt Exploration Fund 17. London, Egypt Exploration Fund.

Petrie, W. M. F. 1901. *Diospolis Parva. The cemeteries of Abadiyeh and Hu 1898–9.* London, The Egypt Exploration Fund.

Petrie, W. M. F. 1903. *Abydos. Part II*. Memoir of the Egypt Exploration Fund 24. London, Egypt Exploration Fund; Kegan Paul, Trench, Trübner & Co.

Petrie, W. M. F. 1907. *Gizeh and Rifeh*. British School of Archaeology in Egypt and Egyptian Research Account 13. 13th year. London, British School of Archaeology in Egypt, Bernard Quaritch.

Petrie, W. M. F. 1917. *Tools and Weapons*. London, British School of Archaeology in Egypt.

Petrie, W. M. F. 1925. *Tombs of the courtiers and Oxyrhynkhos*. British School of Archaeology in Egypt and Egyptian Research Account 37 (28th year). London, British School of Archaeology in Egypt – Bernard Quaritch.

Petrie, W. M. F. 1939. *The Making of Egypt*. British School of Archaeology in Egypt and Egyptian Research Account 61. London, Sheldon Press.

Petrie, W. M. F. and Mackay, E. 1915. *Heliopolis, Kafr Ammar and Shurafa*. British School of Archaeology in Egypt and Egyptian Research Account 24. London, School of Archaeology in Egypt; Bernard Quaritch

Petrie, W. M. F., and Brunton, G. 1924. *Sedment I–II*. London, British School of Archaeology in Egypt.

Petrie, W. M. F., Mackay, E. and Wainwright, G. A. 1910. *Meydum and Memphis III*. London, B. Quaritch.

Petrie, W. M. Flinders 1900–1901. *The royal tombs of the First Dynasty*, 3 vols. Memoir of the Egypt Exploration Fund 18; 21. London, Egypt Exploration Fund, Kegan Paul, Trench, Trübner & Co.

Petschel, S. 2011. *Den Dolch betreffend. Typologie der Stichwaffen in Ägypten von der prädynastischen Zeit bis zur 3. Zwischenzeit*. Wiesbaden, Harrasowitz.

Philip, G. 1989. *Metal Weapons of the Early and Middle Bronze Ages in Syria–Palestine I–II*. British Archaeological Reports 526. Oxford, Archaeopress.

Philip, G. 2006. *Tell el–Dab'a XV: metalwork and metalworking evidence of the late Middle Kingdom and the Second Intermediate Period.* Untersuchungen der Zweigstelle Kairo des

Österreichischen Archäologischen Institutes 26; Österreichische Akademie der Wissenschaften, Denkschriften der Gesamtakademie 36. Wien, Verlag der Österreichischen Akademie der Wissenschaften.

Piacentini, P. 1993. *Zawiet el–Mayetin nel III Millenio A. C.* Pisa, Giardini.

Pike, K. L. 1967. *Language in Relation to a Unified Theory of the Structure of Human Behaviour*. The Hague, Mouton.

Porter, B. and Moss, R. B., assisted by E. W. Burney. 1974. *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings. III. Memphis. Part I. Abû Rawâsh to Abûṣîr*. Second Edition Revised and Augmented by J. Málek, Oxford, Clarendon Press.

Porter, B. and Moss, R. B. 1981. *Topographical bibliography of ancient Egyptian hieroglyphic texts, reliefs and paintings III-2: Memphis. Part 2: Ṣaqqâra to Dahshûr*. 2nd, revised and augmented ed. Oxford, Oxford University Press – Griffith Institute.

Preucel, R. W. 2006. *Archaeological semiotics*. Oxford, Blackwell Press.

Preucel, R. W. and Bauer, A. 2001. Archaeological pragmatics. *Norwegian Archaeological Review* 34: 85–96.

Quibell, J. E. 1898. *El Kab*. London, Quaritch.

Quibell, J. E. 1913. *Excavations at Saqqara (1911–12). The Tomb of Hesy*. Le Caire, L'Institut français d'archéologie orientale.

Quibell, J. E. 1923. *Archaic Mastabas. Excavations at Saqqara 1912–14*. Cairo, L'Institut français d'archéologie orientale.

Quibell, J.E. and Firth, G. 1935. *Excavations at Saqqara: The Step Pyramid*, Cairo: L'Institut Francais d'archéologie Orientale.

Quirke, S. 2003. 'Art' and the 'artist' in late Middle Kingdom administration. In S. Quirke (ed.) *Discovering Egypt from the Neva: the Egyptological legacy of Oleg D. Berlev*: 85–106. Berlin, Achet–Verlag.

R Development Core Team. 2011. R: A Language and Environment for Statistical Computing. Vienna, the R Foundation for Statistical Computing. Available online at http://www.R-project.org/.

Rademakers, F., Verly, G., Delvaux L. and Degryse, P. 2016. *Egyptian bronzes at the RMAH. A first look into the ancient Egyptian bronze collection at the RMAH, Brussels*. Poster presented at 41st International Symposium on Archaeometry, Kalamata (Greece). Accessible via link: http://www.academia.edu/25778414/Egyptian_bronzes_at_the_RMAH.

Radwan, A. 1983. *Die Kupfer– und Bronzegefäße Ägyptens*. Prähistorische Bronzefunde, Abteilung II, 2. Band. München, C. H. Beck Verlag.

Randall–MacIver, D. and Mace, A. C. 1902. *El Amrah and Abydos 1899–1901*. London, Egypt Exploration Fund.

Redford, D. B. 2010. *City of the Ram–Man: The Story of Ancient Mendes*. Princeton, Princeton University Press.

Rehren, T. et al. 2013. 5,000 years old Egyptian iron beads made from hammered meteoritic iron. *Journal of Archaeological Science* 40 (12): 4785–4792.

Rehren, T. and Northover, J. P. 1990. Selenium and tellurium in ancient copper ingots. G. A. Wagner and E. Pernicka, *Proceedings of the International Symposium on Archaeometry Heidelberg*: 221–228. Basel, Birkhäuser.

Reisner, G. A. 1910. *The Archaeological Survey of Nubia. Report for 1907–1908. Vol. I: Archaeological Report*. Cairo, National Printing Department.

Reisner, G. A. 1931. *Mycerinus. The Temples of the Third Pyramid at Giza*. Cambridge MA, Harvard Univeristy Press.

Reisner, G. A. 1932. *A provincial cemetery of the pyramid age. Naga-ed-Dêr. Part III*, Berkeley – Los Angeles, University of California Press.

Reisner, G. A. 1942. *A History of the Giza Necropolis 1*. Cambridge, Harvard University Press.

Reisner, G. A. and Smith, W. S. 1955. *A History of the Giza Necropolis 2: The Tomb of Hetep–heres, the Mother of Cheops*. Cambridge, Harvard University Press.

Reisner, G. A., and Fisher, C. S. 1914. Preliminary Report on the Work of the Harvard – Boston Expedition in 1911–13. *Annales du Service des Antiquités de l'Égypte 13*: 227–252.

Riggs, C. 2014. *Unwrapping Ancient Egypt*. London – Oxford, Bloombsbury Publishing.

Richards, J. 2002. Text and context in late Old Kingdom Egypt: the archaeology and historiography of Weni the Elder. *Journal of the American Research Center in Egypt* 39: 75–102.

Richards, J. 2005. *Society and Death in Ancient Egypt: Mortuary Landscapes of the Middle Kingdom*. Cambridge, Cambridge University Press.

Robins, G. 1993. *Women in Ancient Egypt*. London, The British Museum Press.

Roeder, G. 1937. *Ägyptische Bronzewerke.* Glückstadt – Hamburg – New York, Augustin.

Rossi, C. 2004. *Architecture and Mathematics in Ancient Egypt*. Cambridge, Cambridge University Press.

Roth, A. M. 1991. *Egyptian Phyles in the Old Kingdom. The Evolution of a System of Social Organization*. Studies in Ancient Oriental Civilization, 48. Chicago, The Oriental Institute of the University of Chicago.

Roth, A. M. 1993a. Fingers, stars, and the 'opening of the mouth': the nature and function of the *nṯrwj*–blades. *Journal of Egyptian Archaeology* 79: 57–79.

Roth, A. M. 1993b. Social change in the Fourth Dynasty: the spatial organization of pyramids. *Journal of the American Research Center in Egypt* 30: 33–55.

Roth, A. M. 1995. *Giza Mastabas 6: A cemetery of palace attendants*. Boston, Department of Ancient Egyptian, Nubian, and Near Eastern Art, Museum of Fine Arts.

Roth, A. M. 2002. The meaning of menial labor: "servant statues" in Old Kingdom serdabs. *Journal of the American Research Center in Egypt* 39, 103–121.

Rots, V., Van Peer, P. and Vermeersch, P. M. 2011. Aspects of tool production, use, and hafting in Palaeolithic assemblages from Northeast Africa. *Journal of Human Evolution* 60 (5): 637–664.

Rouault, O. 1977. *Mukannisum: l'administration et l'économie palatiales à Mari*. Archives royales de Mari 18. Paris, Geuthner.

Rowe, A. 1936. *A catalogue of Egyptian scarabs, scaraboids, seals and amulets in the Palestine Archaeological Museum*. Le Caire, L'Institut français d'archéologie orientale.

Rowe, A. 1938. Provisional notes on the Old Kingdom inscriptions from the diorite quarries. *Annales du Service des Antiquités de l'Égypte* 38: 391–396, 678–688.

Rowland, J. M. 2014. Interregional exchange: the evidence from Kafr Hassan Dawood, East Delta. In A. Mączyńska (ed.), *The Nile Delta as a centre of cultural interactions between Upper Egypt and the Southern Levant in the 4th millennium BC*: 269–297. Poznań, Poznan Archaeological Museum.

Rzeuska, T. 2006. *Saqqara: Polish–Egyptian Archaeological Mission. T. 2., Pottery of the Late Old Kingdom: funerary pottery and burial customs*. Warszawa, Neriton.

Rzeuska, T. I. 2011. Meidum revisited. Remarks on the late Old Kingdom topography of the site. Bárta, M., Coppens, F. and Krejčí, J. (eds), *Abusir and Saqqara in the Year 2010*: 709–722. Prague, Charles University in Prague.

s. a. 2003. Life Stories of the Pyramid City Unfold. *Aeragram. Newsletter of the Ancient Egypt Research Associates* 6 (2): 1, 4–5.

Saad, Z. Y. 1951. *Excavations at Saqqara and Helwan (1945–1947)*. Le Caire, L'Institut français d'archéologie orientale.

Saad, Z. Y. 1969. *The Excavations at Helwan. Art and Civilization in the First and Second Egyptian Dynasties.* Norman, University of Oklahoma Press.

Sahrhage, D. 1998. *Fischfang und Fischkult im alten Ägypten*. Kulturgeschichte der antiken Welt 70. Mainz am Rhein, Philipp von Zabern.

Saleh, A.-A. 1974. Excavations around Mycerinus pyramid complex. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 30: 131–154.

Saleh, M. 1977. *Three Old Kingdom Tombs at Thebes*. Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 14. Mainz, Philipp von Zabern.

Saleh, S. A. 1983. Treatment and Restoration of a Corroded Copper Mirror. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 39: 177–181.

Sallaberger, W. and Schrakamp, I. (eds.) 2015. A*ssociated Regional Chronologies for the Ancient Near East and the Eastern Mediterranean*. History & Philology. Tournhout, Brepols.

Sayce, A. H. and Somers Clarke, E. 1906. Report on certain excavations made at El–Kab During the Years 1901, 1902, 1903, 1904. *Annales du Service des Antiquités de l'Égypte* 6: 239–272.

Scott, D. A. 2002. *Copper and Bronze in Art: Corrosion, Colorants, Conservation*. Los Angeles, J. P. Getty Museum.

Seidlmayer, S. J. 1990. *Gräberfelder aus dem Übergang vom Alten zum Mittleren Reich: Studien zur Archäologie der Ersten Zwischenzeit*. Studien zur Archäologie und Geschichte Altägyptens 1. Heidelberg, Heidelberger Orientverlag.

Seidlmayer, S. 2000. The First Intermediate Period (c. 2160-2055 BC). In I. Shaw (ed.), *The Oxford history of ancient Egypt*: 118–147. Oxford, Oxford University Press.

Selbitschka, A. 2015. Miniature Tomb Figurines and Models in Pre-imperial and Early Imperial China: Origins, Development, and Significance. *World Archaeology* 47 (1): 20–44.

Selwyn, L. 2004. *Metals and Corrosion: A Handbook for the Conservation Professional*. Canada, Canadian Conservation Institute.

Sethe, K. 1908. *Die altägyptischen Pyramidentexte. Bd. 1. Text, erste Hälfte : Spruch 1–468 (Pyr. 1–905)*. Leipzig, Hinrichs.

Sethe, K. 1914. Hitherto Unnoticed Evidence Regarding Copper Works of Art of the Oldest Period of Egyptian History. *Journal of Egyptian Archaeology* 1: 233–235.

Shalev, S. and Braun, E. 1997. The metal objects from Yiftaḥ'el II. In E. Braun (ed.), *Yiftaḥ'el, Israel Antiquities Authority Reports 2*: 92–96. Jerusalem, Israel Antiquities Authority.

Shanks, M. and Tilley, C. 1987. *Social Theory and Archaeology*. Cambridge, Polity Press

Shaw, I. 1991. *Egyptian Warfare and Weapons*. Shire Egyptology 16. Princes Risborough, Shire Publications.

Schäfer, H. 1908. *Priestergräber und andere Grabfunde vom Ende des Alten Reiches bis zur griechischen Zeit vom Totentempel des Ne–user–re*. Leipzig, Hinrichs.

Schäfer, H. 2002. *Principles of Egyptian Art*. Edited by E. Brunner–Traut. Translated and edited by J. Baines with a foreword by E. H. Gombrich. Oxford, Griffith Institute.

Scheel, B. 1985. Studien zum Metallhandwerk im Alten Ägypten I. Handlungen und Beischriften in den Bildprogrammen der Gräber des Alten Reiches. *Studien zur altägyptischen Kultur* 12: 117–177.

Scheel, B. 1989. *Egyptian Metalworking and Tools*. Shire Egyptology 13. Princes Risborough, Shire Publications.

Scheele-Schweitzer, K. 2014. *Die Personennamen des Alten Reiches. Altägyptische Onomastik unter lexikographischen und sozio-kulturellen Aspekten*. Philippika 28. Wiesbaden, Harrasowitz.

Schiaparelli, E. 1921. La Missione Italiana a Ghebelein. *Annales du Service des Antiquités de l'Égypte* 21: 126–128.

Schiffer, M. B. 1987. *Formation processes of the archaeological record*. New Mexico, University of New Mexico Press.

Schulze, M. and Lehmann, R. 2014. Model für Wachsfiguren und Bronzen im Museum August Kestner, Hannover: alte und neue Analyseverfahren an den Bronzen des Museum August Kestner und was sie uns verraten. In M. Fitzenreiter, C. E. Loeben, D. Raue, and U. Wallenstein (eds), *Gegossene Götter: Metallhandwerk und Massenproduktion im alten Ägypten*: 133–154. Rahden/Westf, Verlag Marie Leidorf.

Schwarz, S. 2000. *Altägyptisches Lederhandwerk*. Europäische Hochschulschriften, Reihe 28: Kunstgeschichte 265. Frankfurt am Main, Peter Lang.

Schweitzer, S. D. 2005. *Schrift und Sprache der 4. Dynastie*, MENES 3. Wiesbaden, Harrasowitz.

Simpson, W. K. 1965. *Papyrus Reisner II. Accounts of the Dockyard Workshop at This in the Reign of Sesostris I*. Boston, The Museum of Fine Arts.

Simpson, W. K. 1976. *Giza Mastabas, vol. 2. The Mastabas of Qar and Idu*. Boston, The Museum of Fine Arts.

Simpson, W. K. 1976. *The Mastabas of Qar and Idu. G 7101 and 7102*. Giza Mastabas 2. Boston, The Museum of Fine Arts.

Simpson, W. K. 1978. *The Mastabas of Kawab, Khafkhufu I and II. G 7110–20, 7130–40 and 7150 and Subsidiary Mastabas of Street G 7100*. Giza Mastabas 3. Boston, The Museum of Fine Arts.

Simpson, W. K. 1980. *Giza Mastabas, vol. 4. Mastabas of the Western Cemetery: Part I*. Boston, The Museum of Fine Arts.

Slater, R. A. 1974. *The Archaeology of Dendereh in the First Intermediate Period*. University of Pennsylvania Dissertation. Michigan.

Śliwa, J. 1975. *Studies in Ancient Egyptian Handicraft. Woodworking*. Zeszyty Naukowe Uniwersytetu Jagiellońskiego CCCCIV; Prace Archeologiczne 21, Studia z archeologii śródziemnomorskiej, z. 4. Warszawa – Kraków, Państwowe wydawnictvo naukowe.

Smith, W. S. 1933. The Coffin of Prince Min–khaf. *Journal of Egyptian Archaeology* 19: 150–159.

Smith, W. S. 1942. The origin of some unidentified Old Kingdom reliefs. *American Journal of Archaeology* 46: 509–531.

Smith, W. S. 1946. *A history of Egyptian sculpture and painting in the Old Kingdom*. London, Oxford University Press.

Soghor, C. L. 1967. Mendes 1965 and 1966: II. Inscriptions from Tell el Rub'a. *Journal of the American Research Center in Egypt* 6: 16–32.

Soria–Trastoy, M.–T. 2012. Iconographic and archaeological analysis of the fishing tackle in the tomb of Niankhkhnum and Khnumhotep. *Oriental Studies: Journal of Oriental and Ancient History* 1: 13–56.

Soukiassian, G., Wuttmann, M. and Pantalacci, L. 2002. *Balat VI. Le palais des gouverneurs de l'époque de Pépy II. Les sanctuaires de ka et leurs dépendances*. Fouilles de l'Institut Français d'Archéologie Orientale 36. Le Caire, L'Institut français d'archéologie orientale.

Sowada, K. N. 2009. *Egypt in the Eastern Mediterranean during the Old Kingdom: an Archaeological Perspective*. Orbis Biblicus et Orientalis 237. Fribourg, Academic Press Fribourg.

Speidel, M. A. 1990. *Die Friseure des ägyptischen Alten Reiches: eine historisch-prosopographische Untersuchung zu Amt und Titel (jr-šn)*. Konstanz, Hartung-Gorre.

Spencer, A. J. 1980. *Catalogue of Egyptian antiquities in the British Museum, 5. Early dynastic objects*. London, The British Museum.

Spiekermann, A. 2011. Forschungen auf dem Giza–Plateau – Georg Steindorff und die frühen Grabungsjahre. In K. Lembke, and B. Schmitz, *Giza: Am Fuß der großen Pyramide:. Katalog zur Sonderausstelung*: 37–55. München, Roemer– und Pelizaeus–Museum.

Spiekermann, A., and Kampp–Seyfried, F. 2003. *Giza: Ausgrabungen im Friedhof der Cheopspyramide von Georg Steindorff.* Kleine Schriften des Ägyptischen Museums der Universität Leipzig 6. Leipzig: Ägyptisches Museum der Universität Leipzig.

Stadelmann, R. 1994. Die sogenannten Luftkanäle der Cheopspyramide Modelkorridore für den Aufstieg des Königs zum Himmel. *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 50, 285–94.

Steindorff, G. 1913: *Das Grab des Ti*. Leipzig, Hinrichs.

Steindorff, G. 1935. *Aniba I*. Glückstadt – Hamburg, Augustin.

Steindorff, G. and Hölscher, U. 1991. *Die Mastabas westlich der Cheopspyramide: Herausgegeben und bearbeitet von Alfred Grimm*. Frankfurt am Main, P. Lang.

Stephens, M. A. 2012. *A categorisation and examination of Egyptian ships and boats from the rise of the Old to the end of the Middle Kingdoms*. BAR International Series 2358. Oxford, Archaeopress.

Stępniak, K. 2006. Egyptian Mirrors from the French–Polish Excavations in Tell Edfu. *Bulletin du Musée National de Varsovie* XLII: 84–94.

Stocks, D. 2003. *Experiments in Egyptian Archaeology: stone–working technology in ancient Egypt*. London – New York, Routledge.

Strudwick, N. C. 1985. *The Administration of Egypt in the Old Kingdom. The Highest Titles and their Holders*. London, KPI.

Strudwick, N. C. 2005. *Texts from the Pyramid Age*. Atlanta, Society of Biblical Literature.

Subramanian, P. R. and Laughlin, D. E. 1988. The As–Cu (Arsenic–Copper) system. *Bulletin of Alloy Phase Diagrams 9* (5), 605–617.

Svoboda, J. A. 2006. The King's Knives: Chipped Lithics from the Raneferef's Mortuary Complex. In:

M. Verner et al., *Abusir IX. The Pyramid Complex of Raneferef I. The Archaeology*: 502–512. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Swain, S. 1995. The Use of Model Objects as Predynastic Egyptian Grave Goods: An Ancient Origin for a Dynastic Tradition. In S. Campbell and A. Green (eds.) *The Archaeology of Death in the Ancient Near East*, Oxbow Monograph 51: 35–37. Oxford, Oxbow Books.

Tadmor, M. 2002. The Kfar Monash Hoard Again: A View from Egypt and Nubia. In E. C. M. van den Brink – T. E. Levy (eds.), *Egypt and the Levant. Interrelations from the 4th through the Early 3rd Millenium BCE*: 239–251. London – New York, Leicester University Press,

Tallet, P. 2012. Ayn Sukhna and Wadi el-Jarf: Two newly discovered pharaonic harbours on the Suez Gulf. *British Museum Studies in Ancient Egypt and Sudan* 18: 147–168.

Tallon, F. 1987. *Metallurgie susienne: De la fondation de Suse au XVIIIe avant J.-C (Notes et documents des musees de France)*. Paris, Louvre.

Tassie, G. J. 2014. *Prehistoric Egypt: socioeconomic transformations in North-east Africa from the last glacial maximum to the Neolithic, 24,000 to 6,000 cal BP*. London, Golden House.

Theis, C. 2011. *Deine Seele zum Himmel, dein Leichnam zur Erde: zur idealtypischen Rekonstruktion eines altägyptischen Bestattungsrituals*. Studien zur Altägyptischen Kultur, Beihefte 12. Hamburg, Helmut Buske Verlag.

Thickett, D. and Odlyha, M. 2000. Note on the Identification of an Unusual Pale Blue Corrosion Product from Egyptian Copper Alloy Artifacts. *Studies in Conservation* 45: 63–67.

Thompson, E. 2014. *The Old Kingdom cemetery at Tehna. Volume I: The tombs of Nikaiankh I, Nikaiankh II and Kaihep*. Australian Centre for Egyptology Reports 35. London, Aris and Phillips.

Tillmann, A. 1999. Dynastic stone tools. In K. A. Bard (ed.), *Encyclopedia of the Archaeology of Ancient Egypt*: 262–265. London – New York, Routledge.

Török, L. 2008. *Between Two Worlds. The Frontier Region between Ancient Nubia and Egypt 3700 BC – 500 AD*. Probleme der Ägyptologie 29. Leiden – Boston, Brill.

Tylecote, R. F. 1990. *Metallurgy in archaeology: prehistory metallurgy in the British Isles*. London, Edward Arnold Publishers.

Tylecote, R. F. 1992. *A History of Metallurgy*. London, Institute for Materials.

Tylecote, R. F., Ghaznavi, H. A. and Boydell, P. J. 1977. Partitioning of trace elements between the ores, fluxes, slags and metal during the smelting of copper, *Journal of Archaeological Science 4*: 305–333.

Vachala, B. 2004. A*busir VIII: die Relieffragmente aus der Mastaba des Ptahschepses in Abusir*. Prague, Set Out.

Valbelle, D. 1990. *Les neuf arcs: l'égyptien et les étrangers de la préhistoire à la conquête d'Alexandre*. Paris, Armand Colin.

Valloggia, M. 1986. *Balat I: Le mastaba de Medou–Nefer*. Le Caire, L'Institut français d'archéologie orientale.

Valloggia, M. 1998. *Balat IV: Le monument funéraire d'Ima–Pepy/Ima–Meryre. T. 1–2*. Le Caire, L'Institut français d'archéologie orientale.

Valloggia, M. 2004. *Les oasis d´Égypte dans l´Antiquité. Des origines au deuxième millénaire avant J.–C*. Bischheim, Infolio.

Valloggia, M. 2011. *Abou Rawash I: Le complexe funéraire royal de Rêdjedef*. Le Caire, L'Institut français d'archéologie orientale.

Vandier d'Abbadie, J. 1972. *Catalogue des objets de toilette égyptiens*. *Musée du Louvre, département des antiquités égyptiennes.* Paris, Éditions des Musées nationaux.

Varille, A. 1938. *La tombe de Ni–ank–pepi à Zâouyet el–Mayetîn*. Le Caire, L'Institut français d'archéologie orientale.

Velemínská J, Krajíček V, Dupej J, *et al.* (2013) Technical note: geometric morphometrics and sexual dimorphism of the greater sciatic notch in adults from two skeletal collections: the accuracy and reliability of sex classification. *American Journal of Physical Anthropology 152*: 558–65. doi: 10.1002/ajpa.22373.

Vercoutter, J. 1977. Les poids de Mirgissa et le «standard-cuivre» au Moyen Empire. In E. Endesfelder, K. H. Priese, W. F. Reineke, and S. Wenig (eds), *Ägypten und Kusch: Fritz Hintze zum 60. Geburtstag*: 437–445. Berlin, Akademie Verlag.

Verner, M. 1976. *Preliminary report on Czechoslovak excavations in the mastaba of Ptahshepses at Abusir*. Prague, Charles University.

Verner, M. 1977. *Abusir I. The Mastaba of Ptahshepses. Reliefs I/1*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Verner, M. 2006. The early temple. In: M. Verner *et al.*, *Abusir IX: The pyramid complex of Raneferef: the archaeology*: 29–66. Prague, Czech Institute of Egyptology, Charles University in Prague.

Verner, M. *et al.* 2006. *Abusir IX: The pyramid complex of Raneferef: the archaeology.* Prague, Czech Institute of Egyptology, Charles University in Prague.

Verner, M. and Callender, V. G. 2002. *Abusir VI: Djedkare's family cemetery*. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Vlčková, P. 2006. 'Great Beard has shaved this Pepy's head and Sothis has washed this Pepy's arm...'. The earliest attestation of 'grooming model implements from the Old Kingdom. In M. Bárta – F. Coppens – J. Krejčí (eds.), *Abusir and Saqqara in the year 2005*: 385–396. Prague, Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague.

Vogelsang–Eastwood, G. 1992: *The Production of Linen in Pharaonic Egypt.* Leiden – New York – Köln, Brill.

Vogelsang–Eastwood, G. 1993: *Pharaonic Egyptian Clothing.* Leiden – New York – Köln, Brill.

Vogelsang–Eastwood, G. 1995. *Die Kleider des Pharaos. Die Verwendung von Stoffen im Alten Ägypten*. Hannover, Kestner–Museum.

Vymazalová, H. and Dulíková, V. 2012. Sheretnebty, a King's Daughter from Abusir South. *Archiv Orientální* 80/3: 339–356.

Vymazalová, H. and Dulíková, V. 2014. New evidence on Princess Sheretnebty from Abusir South. *Archiv Orientální* 82/1: 1–19.

Waitkus, W. 2003. Zur möglichen Identifizierung einer weiteren Konstellation des nördlichen altägyptischen Sternhimmels. In N. Kloth, K. Martin, and E. Pardey (eds), *Es werde niedergelegt als Schriftstück: Festschrift für Hartwig Altenmüller zum 65. Geburtstag*: 453–470. Hamburg, Helmut Buske Verlag.

Walle, B. van de 1978. *La chapelle funéraire de Neferirtenef.* Bruxelles, Musées royaux d'art et d'histoire / Koninklijke Musea voor Kunst en Geschiedenis.

Walsem, R. van 2008. *MastaBase: the Leiden Mastaba Project*. Leuven, Peeters.

Ward, W. 1964. The inscribed offering-table of Nefer-seshem-Ra from Byblos. *Bulletin du Musée de Beyrouth* 17: 37 –46.

Warden, L. A. 2013. *Pottery and Economy in Old Kingdom Egypt*. Leiden, Brill.

Weeks, K. R. 1994. *Mastabas of Cemetery G 6000: including G 6010 (Neferbauptah); G 6020 (Iymery); G 6030 (Ity); G 6040 (Shepseskafankh)*. Giza Mastabas 5. Boston, The Museum of Fine Arts.

Weill, R. 1958. *Dara: campagnes de 1946–1948*. Le Caire, L'Institut français d'archéologie orientale.

Weinstein, J. M. 1974. Foundation deposits in ancient Egypt. *Dissertation Abstracts International A: the humanities and social sciences* 34 (4): 1902.

Weker, W. 2013. Metal. In K. Myśliwiec (ed.), *Saqqara V: Old Kingdom structures between the Step Pyramid complex and the Dry Moat 2*: 545–547. Warsaw, Neriton.

Welc, F. 2010. Installing a Stone Sarcophagus in the Burial Chamber of an Old Kingdom Shaft. *Études et travaux* XXII: 179–211.

Wengrow, D. 2006. *The Archaeology of Early Egypt. Social Transformations in North–East Africa, 10,000 to 2650 BC*. Cambridge, Cambridge University Press.

Wild, H. 1953. *Le tombeau de Ti II: la chapelle (première partie).* Mémoires publiés par les membres de l'Institut français d'archéologie orientale 65 (2). Le Caire, L'Institut français d'Archéologie orientale.

Wild, H. 1966. *Le tombeau de Ti III: la chapelle (deuxième partie).* Mémoires publiés par les membres de l'Institut français d'archéologie orientale 65 (3). Le Caire, L'Institut français d'Archéologie orientale.

Wilde, H. 2013. Grabbeigaben und ihre symbolische Bedeutung anhand eines Konvolutes aus Giza (Mastaba D 208): Überlegungen zum privaten Jenseitsglauben im Alten Reich. *Zeitschrift für ägyptische Sprache und Altertumskunde* 140: 172–187.

Wilkinson, T. A. H. 2000. *Royal Annals of Ancient Egypt: The Palermo Stone and its associated fragments*. London and New York, Routledge.

Willems, H. 1988. *Chests of life: a study of the typology and conceptual development of Middle Kingdom standard class coffins*. Mededelingen en Verhandelingen van het Vooraziatisch-Egyptisch Genootschap "Ex Oriente Lux" 25. Leiden, Ex Oriente Lux.

Williams, B. B. 1989. *Excavations Between Abu Simbel and the Sudan Frontier. Parts 2, 3 and 4: Neolithic, A–Group, and Post A–Group Remains from Cemeteries W, V, S, Q, T and a Cave East of Cemetery K*. Chicago, The Oriental Institute.

Wilson, J. A. 1947. The Artist of the Egyptian Old Kingdom. *Journal of Near Eastern Studies* 6: 231–249.

Winlock, H. E. 1955. *Models of Daily Life in Ancient Egypt from the Tomb of Meket–Re' at Thebes*. Cambridge MA, Harvard University Press.

Wolf, W. 1926. *Die Bewaffnung des altägyptischen Heeres*. Leipzig, Hinrichs.

Wreszinski, W. 1936. *Atlas zur altägyptischen Kulturgeschichte III. Gräber des Alten Reiches, Lieferung 9.* Leipzig, J. C. Hinrichs.

Wuttmann, M. 1986. Annexe III. Analyse et étude du métal cuivreux de certains objets. In M. Valloggia *et al.*, *Balat I: Le Mastaba de Medou–Nefer*: 215–222. Le Caire: L'Institut français d'archéologie orientale.

Wuttmann, M. 1992. Annexe I. Analyse et étude du métal cuivreux de certains objets. In A. Minault–Gout and P. Deleuze, *Le mastaba d'Ima–Pépi. Tombeau d'un gouverneur de l'oasis à la fin de l'Ancien Empire*: 208–222. Le Caire, L'Institut français d'archéologie orientale.

Wuttmann, M. 1998. Early Metallurgy of Copper and Copper Alloys in Egypt. In F. A. Esmael (ed.), *Proceedings of the First International Conference on Ancient Egyptian Mining and Metallurgy and Conservation of Metallic Artifacts (10–12 April 1995)*: 183–187. Cairo, Ministry of Culture, Supreme Council of Antiquities.

Zelenková, Ľ. 2010. The royal kilt in non-royal iconography? The tomb owner fowling and spear-fishing in the Old and Middle Kingdom. *The Bulletin of the Australian Centre for Egyptology* 21: 141–166.

Ziegler, C. 1993. *Le mastaba d'Akhethetep. Une chapelle funéraire de l'Ancien Empire*. Paris, Editions de la Réunion des musées nationaux.

Ziegler, C. 1999. Sculptor's Tools. In J. P. O'Neill (ed.), *Egyptian Art in the Age of Pyramids*: 280. New York, The Metropolitan Museum of Art.

Ziegler, C. 2007. *Fouilles du Louvre à Saqqara I. Le mastaba d'Akhethetep*. Paris – Louvain, Musée du Louvre; Peeters.

Web sources

Collection Online – The British Museum: https://www.britishmuseum.org/research/collection_online/search.aspx
Giza Archives – www.gizapyramids.org
http://www.giza–projekt.org/Mastaba/Mastaba_D20.html
http://www.giza–projekt.org/Mastaba/Mastaba_D20.html
http://www.giza–projekt.org/Mastaba/Mastaba_D203.html
http://www.giza–projekt.org/Mastaba/Mastaba_D207_208.html
http://www.giza–projekt.org/Mastaba/Mastaba_D24.html
http://www.giza–projekt.org/Mastaba/Mastaba_D37.html
http://www.giza–projekt.org/Mastaba/Mastaba_D44.html
Oxford English Dictionary, entries spear, n.; harpoon, n.: http://www.oed.com/
The Egyptian Museum Turin, Collections online: http://collezioni.museoegizio.it/eMuseumPlus?service=ExternalInterface&
The Museum of Fine Arts, Boston, Collections online: http://www.mfa.org/collections
TLA – Thesaurus Linguae Aegyptiae: http://aaew.bbaw.de/tla/index.html
UCL Petrie Museum Online Catalogue: http://petriecat.museums.ucl.ac.uk/

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