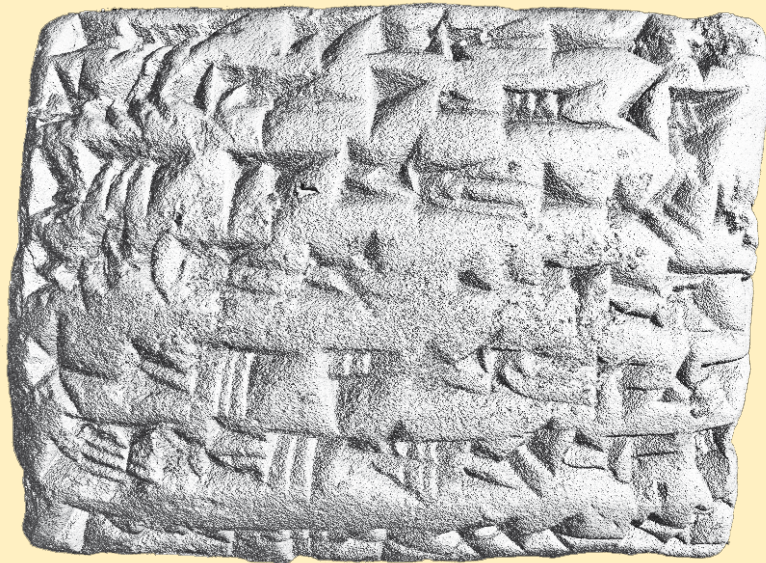


Buried History

**The Journal of the
Australian Institute of Archaeology**



2018 Volume 54

Buried History

Buried History is the annual journal of the Australian Institute of Archaeology. It publishes papers and reviews based on the results of research relating to Eastern Mediterranean, Near Eastern and Classical Archaeology, Epigraphy and the Biblical text, and the history of such research and archaeology generally for an informed readership. Papers are refereed in accordance with Australian HERDC specifications.

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Cover: Tablet imaged by the Australian Synchrotron inside a clay envelope IA5.074 (ND3420) (Siddall et al)

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Christopher J. Davey

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Editorial

This edition of *Buried History* includes a series of papers related to the collections of the Australian Institute of Archaeology. For over a decade the Institute has been systematically registering its collections, something which was previously done spasmodically. It has also discovered many documents associated with the origin of the collection. These have been arranged into an archive where they can be referenced to trace accession paths of the collection. In more than one of the following papers, this capacity was beneficial for understanding the objects being studied. It also helped to establish the authenticity and legitimacy of the artefacts, something now required by most journals, including *Buried History*.

The first paper describes what appears to be a world first; the imaging of a cuneiform clay tablet hidden inside an inscribed clay envelope by a synchrotron. The image produced by this means enabled the cuneiform text to be transliterated and translated. Disappointingly, a republication of a group of Assyrian tablets, which include the envelope, is imminent and would have benefitted from the inclusion of the tablet which has been hidden until now. Dr Luis Siddall and the reviewers of the paper have been at pains to ensure that his transliteration and translation closely follow the principles of the republication. Luis is a regular contributor to *Buried History*. He has undertaken doctoral studies in cuneiform and recently became a Research Fellow of the Australian Institute of Archaeology.

Dr Siddall's co-authors undertook the imaging of the tablet at the Australian Synchrotron and its tomography. Carla Raymond is a PhD student at Macquarie University where she is investigating aspects of imaging ancient artefacts with Neutron and X-ray Computer Tomography. Dr Joseph Bevitt, is one of her supervisors. Joseph is a scientist at the Australian Nuclear Science and Technology Organisation (ANSTO) and has recently been spending much time imaging and studying dinosaur fossils.

The paper on the Old Babylonian inscribed bullae held by the Institute describes a fascinating journey of discovery by the CANZ group of scholars demonstrating the relatedness of objects held in different collections. These objects have been left unstudied until the last couple of years. Professor Wayne Horowitz and Dr Peter Zilberg

of the Hebrew University of Jerusalem have contributed to several recent editions of *Buried History*.

The paper on the Institute's mummified animal by Carla Raymond and Dr Joseph Bevitt was the subject of Carla's Master's degree. Her research was published in the International archaeological science journal, *Archaeometry*. The paper published here draws on the results of her research, to inform Institute supporters, and explores some of the Egyptological and religious issues raised by her research. Papers such as this are used by presenters and teachers involved in the Institute's secondary school program.

The paper on the sail plan of Roman-period merchant ships distils ideas from two previous *Buried History* papers, discussions with several international scholars and feedback from some seminar presentations. Nautical archaeology in the Mediterranean is a rapidly developing field of research with the discovery and excavation of new shipwrecks every year. The paper encourages scholars to draw on more recent maritime experience to help interpret their finds.

The paper on Tauchira (Tocra) and Euesperides, Libya was submitted some years ago and not published. Since that time the identification and registration of the objects from these sites held by the Institute have been completed so that they could now be incorporated into the paper. We are pleased that Jody Mitchell, who manages a contract archaeology company and Professor Soren Blau, who has Senior Forensic Anthropological positions at Monash University and the Victorian Institute of Forensic Medicine, have been prepared to put the paper forward again with the updated information. The excavation, which is at the heart of the paper, was undertaken by G.R.H. (Mick) Wright in 1954; it is the only excavation solely funded by the Institute.

A significant number of papers and reviews have been in preparation for this edition but have not been finalised. We expect that they will appear in following editions. As usual we recognise our anonymous reviewers who have made significant contributions and often provided insightful comments.

Christopher J. Davey

Hidden Text: Imaging and reading an ancient tablet encased in an envelope

Luis R. Siddall, Carla A. Raymond and Joseph J. Bevitt

DOI: <https://doi.org/10.62614/4d1dinx98>

Abstract: A tablet from Nimrud, which is encased in an inscribed clay envelope IA5.074 (ND 3430), was imaged at the Australian Synchrotron Imaging Medical Beamline (IMBL). This confirmed that there was a cuneiform tablet inside the envelope, the text of which could be read. The paper provides the details of the imaging, describes the tomography, offers a reading of the enclosed tablet and comments on the variation between the text on the envelope and tablet and the significance of this for Assyrian contract law.

Introduction

In 1953, a collection of forty-seven tablets was found in a private residence at Nimrud, ancient Kalḫu (Biblical Calah), by archaeologist Sir Max Mallowan, who directed the excavation sponsored by the British School of Archaeology in Iraq. The residence belonged to a moneylender named Šamaš-šarru-ušur who lived during the reign of King Ashurbanipal (668 – 627 BC). The house had been burned in antiquity, which by a fortunate accident fired the clay tablets, preserving them in impeccable condition (Wiseman 1953: 135). All the tablets were deeds recording the transactions relating to items from slaves to barley, in which Šamaš-šarru-ušur was the creditor or buyer.

Donald Wiseman, the excavation's epigraphist, established that Šamaš-šarru-ušur was a high-official (*ša rēši* commonly thought to be a eunuch) who probably owned land in Calah and the house where the tablets were discovered. He had a four-decade career as a moneylender like many of his wealthy contemporaries during the reign of Ashurbanipal (Wiseman 1953: 135). Stephanie Dalley and Nicholas Postgate (1984: 2) identified Šamaš-šarru-ušur as the chariot driver of the crown prince.

Simonetta Ponchia (1990), Melanie Groß (2011) and Ran Zadok (2013) have undertaken the most recent significant studies of this archive. Zadok's study is particularly informative because he analysed the prosopographical data and assessed the nature of the documented transactions in order to come to an understanding of Šamaš-šarru-ušur's career and his status in the Assyrian empire. We now know that Šamaš-šarru-ušur was professionally active between the years of 671-619 BC and was indeed a high official of merit, who regularly engaged in business with significant members of the imperial and temple administrations at Calah (Zadok 2013: 401–405).

One of the tablet envelopes found in the archive, IA5.074 (ND 3430), is now in the collection of the Australian Institute of Archaeology (the Institute), a member



Figure 1: The obverse of the clay envelope IA5.074 (ND 3430), 48 mm x 36 mm x 27 mm, that contains the tablet. Photo: the Institute.

organisation of the consortium supporting Mallowan's excavation (Figure 1). Its locus was TW. 53, House III, Room 19, the House of the Merchant. The tablet arrived in Melbourne on 21 January 1955 as part of the 1954 division of finds from Nimrud (AIA Doc 5403).

The enclosed tablet

Although the envelope does not rattle when shaken, it was deemed to contain a tablet from the time of its discovery. Rather than break the envelope and risk destroying the inscription on it to gain access to the tablet it contains, imaging at the Australian Synchrotron's Imaging and Medical Beam Line (IMBL) and data processing at the Australian Nuclear Science and Technology Organisation (ANSTO) were undertaken to obtain an image of the enclosed tablet in October 2018.

The study of cuneiform tablets and envelopes has mostly been limited to surface studies, using photogrammetry, 3D modelling, and conventional X-ray micro-CT methods (Mara *et al.*, 2010; Hameeuw and Willems, 2011; Lewis

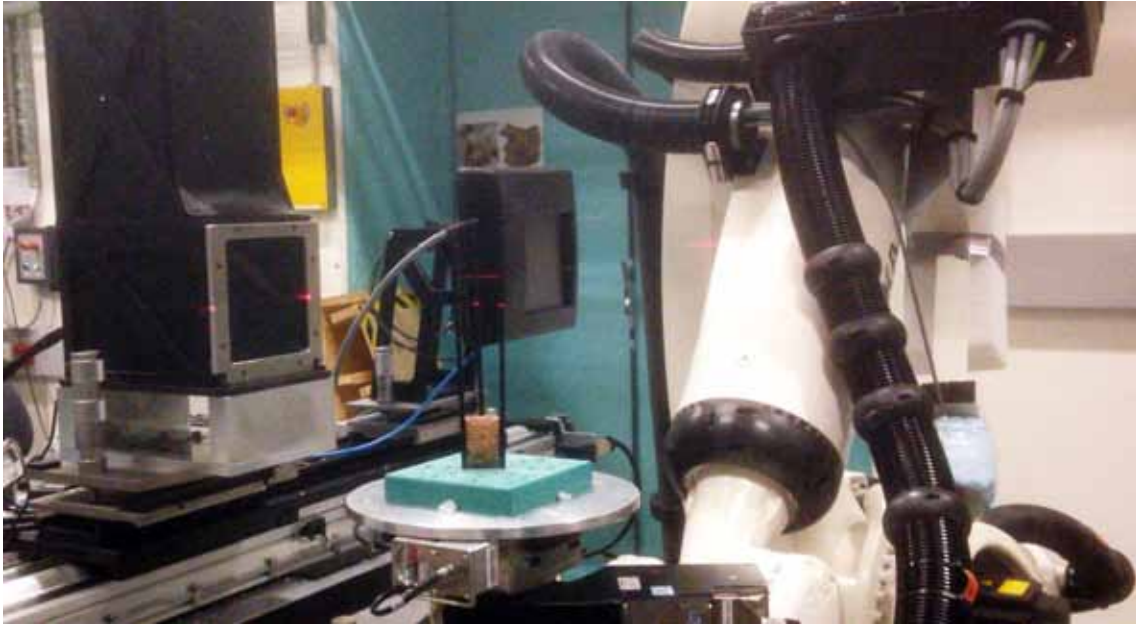


Figure 2: Tablet on the rotation stage of the Australian Synchrotron IMBL. Photo: C.J. Davey.

et al., 2015), and raster imaging (Massa *et al.* 2016) to visualise better or enhance etched scripts or seals. There is, to date, little published work on the internal study of cuneiform envelopes using tomographic methods, with the first X-ray CT study attained in 1994 by Nachum and Yaakov Applbaum. They presented their results at the Radiological Society of North America 84th Scientific Assembly and Annual Meeting at McCormick Place in 1998 and subsequently published a book chapter about their cuneiform and X-ray CT research (Applbaum & Applbaum 2005).

Additionally, Steven Dey noted the potential and limitations of his work with X-ray micro-CT and cuneiform tablets, where the results were used to create 3D printed replicas for further study (Dey 2018). Similar investigations have been done by the British Museum in 2017 by Dan O’Flynn¹, the University of Leiden (2018), Delft University of Technology (2018) and the Cincinnati Art Museum (2019). These works have been shared on social media outlets and do not yet appear in the peer-reviewed literature. We believe that this study reports the first application of synchrotron-based X-ray CT to the investigation of a cuneiform tablet and, more specifically, to reveal the hidden text of a cuneiform tablet that remains fully encased within its original, sealed clay envelope.

Method of analysis

This study utilised the Imaging and Medical Beamline (IMBL) at the Australian Nuclear Science and Technology Organisation’s (ANSTO) Australian Synchrotron, Clayton, Victoria, Australia to image this specimen non-invasively.

X-rays were converted to visible photons and detected using ‘Ruby’, a Gadox/CsI(Tl)/CdWO₄ scintillator screen coupled with a PCO.edge sCMOS camera (16-

bit, 2560 × 2160 pixels) and a Nikon Makro Planar 50 mm lens. The field-of-view was set to 25 mm high x 78 mm wide with a pixel size of 31.0 x 31.0 μm, monochromatic beam energy of 60 keV and sample-to-detector distance of 50 cm. A total of 1800 equally-spaced angle shadow-radiographs with an exposure length of 0.05 seconds was obtained every 0.10° as the sample was continuously rotated 180° about its vertical axis. One hundred dark (closed shutter) and beam profile (open shutter) images were obtained for calibration before initiating shadow-radiograph acquisition. Due to a limited beam height, two successive sets of radiographs were attained, with a vertical displacement of 25 mm between each tomographic dataset. Total time for the scan of 4040 projections (26 GB) was 5.2 min.

The raw 16-bit radiographs were stitched together and normalised relative to the beam calibration files using IMBL Stitch, the in-house software, and reconstructed using the X-TRACT [ref/CSIRO] available on Australian Synchrotron Computing Infrastructure (ASCI). The Gridrec reconstruction method was used to form a 16-bit, three-dimensional volume image of the sample. The reconstructed volume data were rendered and visualised using VGStudio Max 2.2 (Volume Graphics GmbH).

Segmentation of the inner tablet was achieved using VG Studio Max 2.2, using combinations of thresholding, region-growing and manual segmentation, to overcome the challenges of direct contact between portions of the inner tablet and outer envelope. This may have been due to the nature of how it was lying when the tablets were unintentionally baked, when the house was burned in antiquity. The segmented inner tablet was then volume-rendered and a clay tone overlaid for aesthetic purposes (Figure 3).



D
F A E
B
C

Figure 3: The enclosed tablet of IA5.074 (ND 3430) rendered from synchrotron X-ray CT imaging. The tablet is inscribed on sides A, B, C, D and F. Side E is inscribed with cuneiform signs that have run over from sides A and C. Images were made using VG Studio Max 2.2 and enhanced and arranged in Adobe Photoshop.

A transliteration and translation of the enclosed tablet

Obverse (AE)	1	é 2 anše ina u-šal-li	An estate of 2 homers on the river-flats
	2	gab-di ^m sanga-15	adjoining (that of) Sangî-Issār;
	3	é 2 anše ina mu-li	an estate of 2 homers on high grounds
	4	gab-di kaskal ^{uru} nina	adjoining the Nineveh Road.
	5	pab' é 4 anše a.šà	A total of 4 homers of fields.
	6	ku-um ru-bé-e šá kù.babbar	Instead of interest on the silver,
Lower edge (B)	7	^m dšá-maš-man-pab kú	Šamaš-šarru-ušur will have usufruct (of the pledged land).
	8	3 me-re-še 3 kar-ap-ḫi	Three (years) cultivated (and) three fallow:
Reverse (C)	9	pab 6 mu.an.na kú	a total of six years he will have usufruct.
	10	ina u ₄ -me šá kù.babbar sum-nu	When he pays back the silver
	11	a.šà-šú u-še-ša	he will redeem his field(s).
	12	nu ši-pi-še nu še nu-sa-ḫi	There will be no straw or corn tax.
	13	iti.bár u ₄ 28	28 th Nisannu,
	14	lim-me ^m en-kaskal-kur-u-a	Eponym of Bēl-Ḫarran-šadū'a.
	15	igi ^m šil-en-dal-	Before Šil-Bēl-dalli,
	16	igi ^m sanga'-15 igi ^m pa-ka-pab'-pab	before Sangî-Issār, before Nabû-pī-aḫi-ušur;
Upper edge (D)	17	ina igi ^m qur-d[^d i.u.g]ur	at the disposal of Qurdi-Nergal,
	18	ina igi ^m gig-šà-dingir	at the disposal of Limraš-libbi-ili;
Left edge (F)	19	igi ^m pa-zu	before Nabû-lē'i,
	20	igi ^m arba-il-a-a	before Arbailāiu.



Figure 4: The end of Line 1 of the enclosed tablet, which needed more detailed segmentation of the reconstructed tomographic data.

Comments on the enclosed tablet text

Line 1: Close study of the end of line 1 in Figure 3 is not possible because it is oblique in the traditional fat-cross representation and indistinct due to the challenge of segmenting that part of the tablet, which is in direct and intimate contact with the envelope. A more precise segmentation of that region, shown in Figure 4, was completed and achievable due to the high-resolution and inherent edge-enhancement of the synchrotron X-ray CT data. This clearly revealed the tablet's text, which was found to have a highly unusual writing of *ušallu* with a U-sign over the expected \dot{U} -sign. Our research suggests that this is the only attested occurrence of this orthography. If this reading is correct, then the scribe most likely elected for a rare, purely phonological writing of *ušallu* utilising the much smaller U-sign over the normal and longer \dot{U} -sign because of the lack of space on the corner of the tablet. The parallel section of text on the envelope in line 6 (see below) is obscured by surface damage, but the traces fit Postgate's reading in Herbordt et al. (forthcoming: no. 77) of the signs on the envelope as *a.š[à ina] ú-šal-li*. We follow Postgate's reading in our edition below.

Line 2: Singi-Issār's name is written without the divine determinative in this line, but in line 7 of the envelope the determinative sign is present.

Line 5: The word for field is written *a.šà* here, while on the envelope it is *a.šà.ga*.

Line 10: The scribe has written a *šá* on the tablet, where a *ša* appears on the envelope (line 15).

Line 10–11: There is a difference in grammatical number in the text of the tablet. Both the verb (*u-še-ša*) and the possessive pronominal suffix (*-šu*) are singular, whereas in the text of the envelope (lines 15–17) they are in the plural (*-šu-nu*, *u-še-šu-u*). The writing of *sum-nu* is unclear whether it is singular or plural, but has been

understood as singular in the present context. It is unclear why the scribe did this since there were two debtors for this contract listed in lines 17–18 of the tablet and lines 1–2 of the envelope.

Line 12: The negative particle is written with the logogram 'nu' here, while on the envelope (line 14) it is written in Akkadian, *lā*.

Line 15: *igi^mšil-en-dal-*: The scribe has not written the LI-sign to finish the name despite the ample space on the tablet.

Line 16–20: The witness list is in a different order from the envelope and has omitted Bēl-dūri. What is more curious is that the list is interrupted in lines 17–18 by the names of the debtors, who are recorded with their seals in lines 1–2 of the envelope (see below). The debtors are identified with *ina panī(igi)*, which equates to *ina panīšunu* in line 4 of the envelope. It is unclear why the scribe did this but it could be that he originally finished the text in line 18 neatly at the bottom of the reverse, and then as an afterthought, or by request, he added the names of some of the remaining witnesses on the left edge, but ran out of space for Bēl-dūri.

The envelope

The envelope has two round stamp seals on the obverse and writing on the obverse, reverse and the edges. The text is clear but the seals are indistinct and were the subject of Reflectance Transformation Imaging (RTI) at the Institute in 2016 (Saunders *et al.* 2016: 46). Algorithmic Rendering and specular enhancement revealed the seals to be apparently identical images of a running quadruped such as a deer stag or oryx (Figure 6A). This is all the more interesting because the first two lines of the text on the envelope (see below) state that the seal impressions belonged to different individuals, Qurdi-Nergal and Limraš-libbi-ili.

The imaging at the IMBL also has the capacity to render the surface of the envelope. The result for the seals is shown in Figure 6B and can be seen to be comparable with the RTI image. Open source viewers are available for both RTI and tomographic data to manipulate the light direction when examining the image. Cost of equipment for data acquisition and processing is another issue. RTI can be undertaken by anyone with a camera, flashlight, computer and expertise but it is, of course, limited to surface analysis.

Comments on the envelope text

The transliteration and translation of the envelope text is opposite and has the following explanatory comment:

Line 15: ŠE-^rx': The reading of these signs is not clear. Postgate (Herbordt et al. forthcoming) has interpreted the traces as *še.k[i.u]d'* for the logogram *kislaḥ*, 'threshing floor'. We have tentatively followed Postgate's translation but leave the reading of the traces open to interpretation.



Figure 5: The external surface of the envelope IA5.074 (ND3430).

The envelope text

Obverse	1	^{na4} kišib ^m qur-di- ^d u.gur	Seal of Qurdi-Nergal.
	2	^{na4} kišib ^m gig-šà-dingir	Seal of Limraš-libbi-ili.
	3	10 gín ^{meš} kù.babbar luḫ.u	10 shekels of refined silver
			(Two seal impressions)
	4	ša ^{m.d} šá-maš-man-pab ina pa-ni-šú-nu	belonging to Šamaš-šarru-ušur, at their disposal,
	5	ku-um ru-bé-e ša kù.babbar	instead of interest on the silver
	6	é 2 anše ʿa.š[à ina] ú-šal-li	an estate of 2 homers of field
	7	gab-di ^m sanga- ^d 15	adjoining Sangi-Issār;
Reverse	8	é 2 anše ina mu-li-e/gab-di kaskal ^{uru} nina	an estate of 2 homers of high ground adjoining the Nineveh Road.
	9	pab 4 anše a.šà.ga	A total of 4 homers of field
	10	ina uru.še ú-sa-a-ni	in the village of Usāni.
	11	3 me-re-še 3 kar-ap-ḫi	3 (years) cultivated (and) 3 fallow;
	12	pab 6 mu.an.na ^{meš} kú	a total of 6 years they will have usufruct.
	13	la še-pi-ši la še nu-sa-ḫi	There will not be straw nor corn taxes.
	14	ina u ₄ -me ša kù.babbar ina ugu	¹⁴⁻¹⁵ When the silver is deposited on the
	15	ŠE-ʿx ʿi-šak-<kan>-u-ni	threshing floor ²
	16	a.šà-šú-nu u-še-ṣu-u	they will redeem their fields.
	17	iti.bár u ₄ .28.kam	28th of Nisan,
	18	lim-mu ^{men} kaskal-kur-u-a	Eponym of Bēl-Ḥarrān-šadûʿa.
	19	igi ^m šil-en-dal-li	Before Šil-bēl-dalli,
	20	igi ^{m.d} pa-zu	before Nabû-lēʿi,
Left edge	21	igi ^{m.uru} arba-il-a-a	before Arbailāiu,
	22	igi ^{m.d} pa-ka-pab-pab	before Nabû-pī-aḫi-ušur,
	23	igi ^m sanga-15	before Sangi-Issār,
	24	igi ^{men} bād	before Bēl-dūri.



Figure 6A: Inverted image of seals on obverse of tablet, IA5.074 (ND 3430) taken with RTI and processed as a PTM composite image rendered using specular enhancement. From Saunders, Collmann and Siddall (2016).



Figure 6B: Inverted image of seals on obverse of tablet, IA5.074 (ND 3430). VG studio Max 3.0 was used to create this visualisation of the seals, using directional light sources and shadow enhancers (2019).

Discussion

The text on the tablet records the same contract for a pledge of land as is inscribed on its envelope. However, the text of the tablet is much shorter than that of the envelope and the arrangement of the contract is different from that on the envelope.

The relationship between the texts on the tablet and the envelope has the potential to illuminate the practice of Neo-Assyrian contract law. According to Postgate it is not uncommon for Neo-Assyrian contracts to include more details in the version on the envelope than that on the enclosed tablet (Postgate 1976: 4). This appears to be the case here.

The text on the envelope is a far fuller record of the contract than that inscribed on the inner tablet. A comparison of the two versions of the contract reveals the following:

1. The text of the tablet is formulated more as a land pledge with associated silver loan, whereas the envelope is set out as a silver loan with associated land pledge.
2. As noted in the comments on the tablet, there is orthographic variation between the two texts.
3. There is less information about the location of the fields in the text on the inner tablet.

The relationship between the text on the envelope and the enclosed tablet has implications for the practice of contract law in Assyrian society. A full treatment of the relationship between tablets and envelopes is well beyond the scope of this paper but we postulate some possible reasons for the practice. The envelope text, with the seal impressions of the two debtors, appears to be the formal version of the contract, while the enclosed tablet has an abridged version of the contract that includes the

essential information to be used in the event of a dispute between the parties. Should a dispute occur and the envelope be unreadable because of damage, accidental or intentional, a city or imperial official could open the envelope to check the details of the contract according to the tablet. Hence, the enclosed tablet was insurance against accidental damage or corrupt alteration of the text on the sun-dried envelope, the principal contract between parties. It is also possible that the tablet might have had an archival purpose. Had the terms of the contract been fulfilled and the seals on the envelope, together with the envelope itself, be destroyed, then the tablet might have been kept by one of the parties as proof that the contract had been fulfilled.

The relationship between the texts of the tablet and envelope, as proposed here, is not straight forward when one considers the process of making the physical objects. Naturally, the tablet had to be inscribed before the envelope, which means the shorthand version was composed before the full text of the contract. Such a process seems counter-intuitive, but the materials dictate that this had to be order of composition.

In any case, the very existence of this tablet and envelope surviving intact up to the time of the house fire indicates that the obligations outlined in the contract were outstanding. Had the silver been repaid at the very least, the envelope would have been destroyed (Radner 1995: 68).

Concluding comments

Finally, it is appropriate to comment on the cost and accessibility for this technique. Merit-based access to the Australian Synchrotron is free, with proposals for consideration due 3-times a year.

If access is sought outside the peer-review process, IMBL time is charged at \$A650/h for use of the beam, plus \$A300/h for staff time (included data acquisition, analysis and image processing). Basically, if a scan takes 5-7 minutes, then approximately 10-12 specimens can be scanned per hour at a facility cost of \$A55-60 each, ignoring time for initial instrument setup.

The main issue for this research is the processing of the scanned data. Not many people are trained in the software used to visualise computer-tomography datasets and few are skilled enough to segment an image of this type. As described above, the challenge of dealing with curved surfaces of the tablet and the envelope occasionally in contact is not straight forward and is potentially very time consuming. The tomography is the limiting aspect of this form of research, with highly-trained instrument staff necessary for determining optimum CT scan quality, while the participation and training of research students in tomographic segmentation is essential for fast turnaround of processed data and building future expertise in tomographic data rendering, a skill that is increasingly in demand. However, the output can exceed that presented in this paper. A 3D directionally lit video sequence rolling the tablet from the first line to the last is possible using this technique.

It is understood that this is the first occasion a cuneiform envelope has been imaged by a synchrotron. The clarity of the text of the enclosed tablet obtained by this approach has provided an insight into the practice of Assyrian contract law.

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Endnotes:

- 1 O'Flynn Dan (2017, December 21) 'With X-ray CT imaging, we were able to virtually strip back the clay envelope surrounding this Cuneiform tablet, allowing us to read text that hasn't been seen in over 4000 years – without damaging the artefact @britishmuseum @JonTaylor_BM' [Twitter Post] retrieved from https://twitter.com/dan_oflynn/status/943816144061976577

Old Babylonian clay bullae from Lagaba in the Australian Institute of Archaeology and other collections

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Abstract: The paper identifies 16 bullae held by the Australian Institute of Archaeology, Israel Museum, Jerusalem, the Otago Museum, Dunedin, and Nicholson Museum at the University of Sydney that have a shared date and provenance. It discusses the nature of the Institute's bullae and identifies the provenance and accession paths to their respective institutions. They date specifically to either year 6 or 7 of the reign of Samsuiluna, King of Babylon (1744–1743 BC, middle chronology) and they come from the Old Babylonian city of Lagaba.

The Australian Institute of Archaeology (the Institute) currently holds 12 clay bullae that date to the Old Babylonian period, eleven of which are the focus of this study. They have been the subject of translation and study by the Cuneiform of Australia and New Zealand (CANZ) group of scholars.

In general terms, the inscribed bullae under discussion functioned as dockets for transactions of goods from one party to another. Dockets could be recorded on different styles of kneaded clay, usually on tablets or bullae. When bullae were used, they were formed by pressing a lump of clay on the knot of a cord that was attached to the goods being distributed. The shape of a bulla could be quite different and depended not on the goods to which they were attached, but came down to the choice of the scribe.¹

In the case of the bullae under discussion, the variation in shape seems to be consistent with the year in which they were made. That is, those bullae dating to Samsuiluna 6 are in the shape of a three-sided pyramid and those from Samsuiluna 7 are shaped like a three-sided Cornish pasty (see Figures 1, 2 & 3).

Samsuiluna was the 7th king of the Amorite dynasty of Babylon. He was the son of Hammurabi and succeeded him in 1750 BC (middle chronology). During his 38-year rule the empire he inherited from his father reduced in size with the loss of provinces in the south.

Accession

Letters kept in the Institute's archives show that Walter J. Beasley, founder of the Institute, purchased the bullae from Edward Jawahery, a Baghdad-based antiquities dealer, in August 1935 (AIA Docs 3514a and 3516b). The correspondence relates to Beasley's second trip to Iraq in which he purchased four consignments of antiquities for his collection (AIA Doc 3517; Davey 2012: 73–74). The bullae formed a part of the third consignment of 54 items including cuneiform tablets, coins, and cylinder seals (AIADoc 3514d). In a letter from Jawahery to Beasley dated to 10 August 1935, he refers to the bullae as 'inscribed clay amulets (as from Hillah)'.

In 1944 Beasley donated five cuneiform texts from those he had procured from Jawahery in 1935 to the Nicholson Museum, namely two Old Akkadian tablets (NM44.16 and NM44.17), two Ur III tablets (NM44.18 and NM44.19) and a bulla (NM44.20).

The date of purchase in 1935 and Jawahery's general description of their style is more useful for reconstructing the possible provenance of the bullae than what may be thought at first blush. The CANZ study of the triangular bullae in the Institute and the Nicholson Museum has revealed that they are from the same archive as two other bullae located in the Israel Museum, Jerusalem published by Oded Tammuz (1994). In his research, Tammuz recognised that the two bullae he studied originally came



Figure 1: Bullae from the Institute collection, from the left IA7.883, IA7.880, IA7.882, IA7.878, IA7.884, IA7.879, IA7.885, IA7.886, IA7.881, IA7.877 and IA7.887. Photo: the Institute.



Figure 2: An example of the 'Cornish pasty' shape.
Bulla IA7.886, 28 mm x 18 mm 19 mm.
Photo: the Institute.



Figure 3: An example of the 'Three-sided pyramid' shape.
Bulla IA7.880, 28 mm x 29 mm 28 mm.
Photo: the Institute.

from the Babylonian city, Lagaba, which was located on the watercourse between the ancient cities of Cutha and Babylon (1996) and belonged to the dossier of Ilī-ū-Šamaš (1993: 239–255) within the archive of Marduk-muballit (1993: 222–453).

This same Ilī-ū-Šamaš is named as the conveyor of the perfume in the docketts of the Institute and the Nicholson Museum. Indeed, Ilī-ū-Šamaš is also attested in two further bullae (E47.285 and E47.540) in the collection of the Otago Museum in Dunedin, New Zealand. Hence, on the basis of the named conveyor in these docketts, we are able to link 14 bullae in Australia and New Zealand to those in Jerusalem and, ultimately, identify their original provenance as the Old Babylonian city of Lagaba. It is also worth noting that a provenance of Lagaba legitimises Jawahery's statement that the bullae resembled others he had seen on the antiquities market from the region of Babylon, where the main modern-day city is Hillah.

The date of Beasley's purchase of the bullae also correlates with other texts understood to have originated in Old Babylonian Lagaba. It seems that all the known texts from this era were illicitly excavated and bought from the antiquities market in the 1930s. Indeed, texts from the site are now housed in collections in Leiden, Oxford, and Yale (Tammuz 1993: 1–11). Further, all these collections have similar sources of acquisition: Iraqi antiquities dealers in the early 1930s. F. M. Th. de Liagre Böhl purchased the Leiden collection from an Iraqi dealer in 1932 and 1939,

the Oxford collection was purchased from the same dealer in 1932 and it seems that some of the Yale collection was purchased from an Iraqi dealer named E. S. David in 1934 (Tammuz 1993: 1–8).

The two bullae from the Lagaba archive in the Otago Museum were acquired during a similar period. Dr Lindsay Rogers, the donor of a large collection of cuneiform texts to the Otago Museum, purchased the bullae and the other items in his collection while serving in the Royal Army Medical Corps during WWII and then as Professor of Surgery at the Royal School of Medicine, Baghdad, until his return to New Zealand in 1950 (Horowitz, Reeves, Stillman, White, & Zilberg 2015b; Horowitz, Stillman & Zilberg 2015a). Hence, the bullae in New Zealand were purchased not long after Beasley obtained his collection. It remains unclear whether the two bullae in the Israel Museum, Jerusalem, were also purchased in the 1930s. These bullae were donated from the collection of Joseph Ternbach, a noted art restorer and antiquities collector (Tammuz 1994: 46). Most of Ternbach's collection was donated to the Israel Museum, Jerusalem (Merhav 1981). Unfortunately, there is no published record of the date on which Ternbach purchased his collection.²

The purpose and date of the Bullae

All of the docketts in the different collections are receipts for the delivery of a type of perfume (Tammuz 1994; CAD R, 369). In each case Ilī-ū-Šamaš is the one who distrib-

uted the perfume to either Bēlšunu or Sīn-muballissu. As noted above, there is a clear correlation between the shape of the bullae and the year in which they were produced. Those dated to the ‘New Year’, probably the 6th year of Samsuiluna’s reign are pyramid shaped, while those dated to the seventh year of the same king’s reign are in the style of a three-sided Cornish pasty.

Tammuz (1993: 59-64) examines the use of MU GIBIL, which in the case of the archive of Marduk-muballit, of which Ilī-ū-Šamaš’s dossier was a part, uses this formula as ‘New Year’ during the period of Samsuiluna 6-8. Tammuz’s initial examination (1993, 59-64) of the use of the dating formula, MU GIBIL, in the archive of Marduk-

muballit found that it was used during Samsuiluna 6-8. Tammuz (1994, 171) later narrowed the date of its use to either Samsuiluna 6 or 7. Given the uniformity in shape and date formula of the ‘Cornish pasty’ bullae, we suggest a Year 6 date for these texts.

Hence, it is likely that either the fashion of forming bullae changed in Samsuiluna 7, or that there was a different scribe from the one operating at Lagaba in the previous year. The following table lists the 17 bullae from Lagaba in chronological order housed in the Institute (IA), the Israel Museum, Jerusalem (IMJ), the Otago Museum (E), and the Nicholson Museum (NM). We also note the shape of each bulla and the quantities of perfume recorded.

Museum no.	Shape	Size mm	Date	Transaction - Receipt for
IA7.883	Three-sided pyramid	32 x 29 x 24	16 Ayyaru (II), The New Year	x litres of <i>riqqu</i> -perfume
E47.540	Three-sided pyramid		6 Simānu (III), The New Year	20 litres of <i>riqqu</i> -perfume
IA7.880	Three-sided pyramid	28 x 29 x 28	20 Simānu (III), The New Year	30 litres of <i>riqqu</i> -perfume
IA7.882	Three-sided pyramid	30 x 22 x 27	20 Simānu (III), The New Year	20 litres of <i>riqqu</i> -perfume
IA7.878	Cornish pasty	29 x 19 x 20	1 Dūzu (IV), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.884	Cornish pasty	28 x 18 x 17	16 ² Dūzu (IV), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.879	Cornish pasty	31 x 20 x 19	16 Abum (V), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IMJ 87.196.652	Cornish pasty		4 Elūlu (VI), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.885	Cornish pasty	30 x 18 x 19	12 Elūlu (VI), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IMJ 87.160.653	Cornish pasty		13 Elūlu (VI), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.886	Cornish pasty	28 x 18 x 19	26 Elūlu (VI), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.881	Cornish pasty	30 x 20 x 19	20 Arahsamnu (VIII), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.877	Cornish pasty	29 x 19 x 18	1 Kislīmu II (IX/2), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
E47.285	Cornish pasty		4 Kislīmu II (IX/2)	40 litres of <i>riqqu</i> -perfume
NM44.20	Cornish pasty		16 Kislīmu II (IX/2), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume
IA7.887	Cornish pasty	27 x 18 x 19	10 Tēbētu (X), Samsuiluna 7	40 litres of <i>riqqu</i> -perfume

Table 1: A table in chronological order the 17 bullae from Lagaba housed in the Institute (IA), the Israel Museum, Jerusalem (IMJ), the Otago Museum (E), and the Nicholson Museum (NM), also noting the shape of each bulla and the quantities of perfume recorded



Figure 4: Bulla IA7.888 35 mm x 25 mm x 21 mm, which is not from the dossier of Ilī-ū-Šamaš at Lagaba.
Photo: The Institute

Postscript:

In addition to the 17 dockets discussed here, there are two further bullae from the region, one in the Institute and the other in the Otago Museum. They have not been included in this study because they are not from the dossier of Ilī-ū-Šamaš at Lagaba. The Institute's bulla IA7.888 (Figure 4) is in the shape of a rugby ball and records a receipt for barley. At this stage it is not possible to offer a more specific date for it than the Old Babylonian period. The Otago bulla (E47.15) dates to the 7th year of the reign of Amar-Suen of the Ur III dynasty (c. 2039 BCE).

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Endnotes

- 1 Keiser (1914, 10) made these comments in relation to the Ur III period, but this point seems appropriate to the bullae under discussion here.
- 2 It is tempting to wonder if Ternbach had purchased the bullae before his migration from Vienna to the United States of America in 1938-39.

Charlie ‘unwrapped’: a scientific investigation of a mummified votive offering in the Australian Institute of Archaeology collection

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Abstract: The research undertaken on the mummified animal (IA1.2402) to establish its authenticity, identity, age and provenance is described. A combination of established and novel non-destructive imaging techniques, including X-ray computed tomography (CT) and neutron computed tomography (NCT) made possible a detailed study of the mummy’s content, which was found to be a partial skeleton of a juvenile cat. Use of both techniques allowed for dual contrast and complementary study of bones, soft tissue, and textile components. NCT provided valuable insights into wrapping techniques used in the mummification process. Acquisition of radiocarbon dates provided quantitative results to compare with morphological observations and conclusions based on partiality of the contents. All techniques were employed to better define and profile the specimen within its historical, social and religious contexts, while causing as little physical disruption as possible

Introduction

The mummified animal, IA1.2402, is held by the Australian Institute of Archaeology (the Institute) where it features in educational programs as a mummified cat known by students as *Charlie* (Figure 1). The scientific journey described in this paper aimed to uncover the story of *Charlie*, which was largely obscure. Its identity as a cat was uncertain and its history and purpose unknown. The research program was carried out by the author to satisfy the requirements of a Master of Research at Macquarie University with oversight from the Australian Nuclear Science and Technology Organisation (ANSTO) and the results were published in the scientific journal *Archaeometry* (Raymond et al 2019). This paper summarises those results and discusses some of their broader implications.

Animals were revered by ancient Egyptians because they were seen to be manifestations of or representatives of the gods and sometimes oracles for them. Ibises, for example, connected to the god Thoth, canines to the god Anubis and cats to the goddess Bastet. Cats were an integral part of ancient Egyptian domestic life from the predynastic times, acting as protectors of stored food from rodents and snakes. The goddess Bastet was also connected to lionesses and the goddess Sakhmet until the 22nd Dynasty (943–716 BC) and symbolised protection, beauty, fertility and sexuality (Linseele et al 2007; Remler 2010; Kurushima et al 2012; Bleiberg et al 2013). Bastet was worshipped in the temple at the delta city of Bubastis and honoured at the necropolis of Saqqara where many thousands of mummified cats were buried and where Sakhmet was the consort of Ptah the principal god of nearby Memphis and an important goddess in her own right (Ejmsmond & Przewlocki 2014: 245; Zivie & Lichtenberg 2015: 108).



Figure 1: The mummified animal IA1.2402, 21.3 x 4.8 x 7.8 cm. Photo: the Institute.



Figure 2: Map of Egypt showing a spread of animal cemeteries. Drawing: adapted from Ikram (2015: xv) originally drawn by Nicholas Warner.

The ancient Egyptians were prolific in their practice of animal mummification, as seen from the millions of mummies found in multiple animal cemeteries in Upper and Lower Egypt (Figure 2). The mummification of animals began in the Old Kingdom Period (2649 – 2150 BC) and continued until the beginning of the Islamic Period (AD 642) (Harrell & Lewan 2002; Maurer et al 2002; Ikram 2015). Changes in wrapping design and style occurred during this time.

When introducing a recent volume on animal mummies, Ikram identifies four reasons for the practice of animal mummification: beloved pets buried with their owners; victual mummies as funerary food offerings for the dead; sacred animals that were worshipped when alive and; votive offerings (2015: 1). The context is important when assessing the meaning of the animal mummy

categories. The first two mummified animal burial types are commonly associated with human burials, while the last two are found in animal cemeteries generally associated with temples. Ikram defines a votive offering as a mummified animal ‘dedicated to its corresponding divinity so that the donor’s prayers would be addressed to the god throughout eternity’ (2015: 9). She likens the practice to worshippers who burn candles in church. Documentary evidence for the practice of votive offering in ancient Egypt is found in John Ray’s *Archive of Hor* (1976; Bleiberg et al 2013: 91-7). The archive contains documents written by Hor, who was a scribe at the sacred animal temple complex at North Saqqara.

At the large animal cemetery of Tuna el-Gebel, Kessler distinguished between two different kinds of mummified animals based on their style of wrapping: votive animals that were deliberately killed for ritual purposes, and sacred animals that died from natural causes within sacred temple precincts (2015: 155). However, it is recognised that by far the greatest number of mummified animal burials were votive offerings that were made from remains of animals that were intentionally bred and killed for the purpose of mummification (Armitage & Clutton-Brock 1981; Ikram 2009; Hartley et al 2011; Petaros et al 2015; Plessis et al 2015; Nicholson et al 2015: 647). Evidence of this can be seen in cat breeding grounds (Armitage & Clutton-Brock 1981; Malek 1993: 96; Zivie & Lichtenberg 2015: 118) and several cemeteries that had catacombs for mummified cats, namely Bubastis, Tanis, Mostagedda, Hierakonpolis, Saqqara, Abydos and Speos Artemidos near Beni Hassan (Malek 1993: 96; Ejsmond & Przewlocki 2014: 245; Zivie & Lichtenberg 2015: 108). From these sites, many examples of votive mummified cats have been found, displaying a wide variety of wrapping styles and decorations (Figure 3).

Votive offerings were purchased by pilgrims and citizens and were dedicated at the temple as gifts for the gods in exchange for particular blessings such as health, protection or prosperity (Bleiberg et al 2013; Plessis et al 2015), or to request something particular from them in this life or the afterlife (Wasef et al 2015; Nicholson et al 2015).

The Accession Story

The Institute has documentation for most of its collection but there is nothing referring to a mummified animal. David Searle, the curator of the collection in 1969, confirmed its presence in the collection at that time but there was no knowledge of its accession path (per. comm. C.J. Davey).

In 1950 James Stewart, the Assistant Curator of the Nicholson Museum, The University of Sydney, arranged for transfer of an embalmed head to the Institute (AIA doc. 393). Between 1938 and 1954 several other objects were exchanged between the Nicholson Museum and the Institute for which there is no documentation and it appears that the mummified cat may have been amongst



Figure 3: Variety of wrapping styles of mummified cats, from various periods. a) 37.1991Ea-c Third Intermediate period, (760 – 390 BC) unprovenanced 24.1 x 15.2 x 88.9 cm; b) 37.1988E Third Intermediate period (750 – 400 BC), unprovenanced 14 x 9.5 x 62.2 cm; c) X1179.3 Late Period (664 – 308 BC) unprovenanced 5.4 x 7.6 x 26.4 cm; d) 05.307 Graeco-Roman Period, unprovenanced (305 BC – 395 AD) 37.8 x 7 x 9.5 cm; e) EA6753 Roman period (post 30BC), Thebes EA37348 Roman period, Abydos 53 cm long; f) EA37348 Roman period, Abydos, 46 cm long. Images from the Brooklyn and British Museum collections; a. www.brooklynmuseum.org/opencollection/objects/118492, b. www.brooklynmuseum.org/opencollection/objects/4197, c. www.brooklynmuseum.org/opencollection/objects/179037, d. www.brooklynmuseum.org/opencollection/objects/17360, e. www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=117351&partId=1&searchText=cat+mummy&page=1 f. www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=117617&partId=1&searchText=cat+mummy&page=1.

them. A mummified cat is included as item No. 30 in the 1891 catalogue of the Nicholson Museum, *Ægyptiaca* (Nicholson 1891). Artefacts and materials that appear in this catalogue were acquired by Sir Charles Nicholson between 1856-7 on an expedition to Egypt. When visiting Saqqara, Nicholson acquired several animal mummies, so it is possible that the IA1.2402 was one of them (Sowada 2006: 4).

Object Description

The mummy is a total height of 21.3 cm from base to tip of the ears (white dashed line on Figure 4). Across the broadest section of the specimen, the width measures 4.8 cm, and the breadth, 7.8 cm (orange line on Figure 4). The outside of the wrapping is in overall good condition and is made to appear as a small cat. The general shape is an irregular cylinder, with a column-like ‘body’ and a small rhomboidal ‘head’ on top. The left side of the specimen appears to be in good condition, as most of the textile is still well secured. The right side is in good-to-poor condition, with a few loose ends of textile near the base of the specimen, and a small worn area just below the band markings. While the mummified specimen has been protected in the box, the right side has been the reverse and is rarely seen. There is a considerable opening in the base of the body, where the textile is mildly frayed. The opening appears to have been deliberately made and is not the result of wear. The remains are partially



Figure 4: Diagram of measurements.

visible through the opening with blackened, dry skin, hair follicles and reddish-yellow to red-brown fur clumped together with remnants of organic residue.

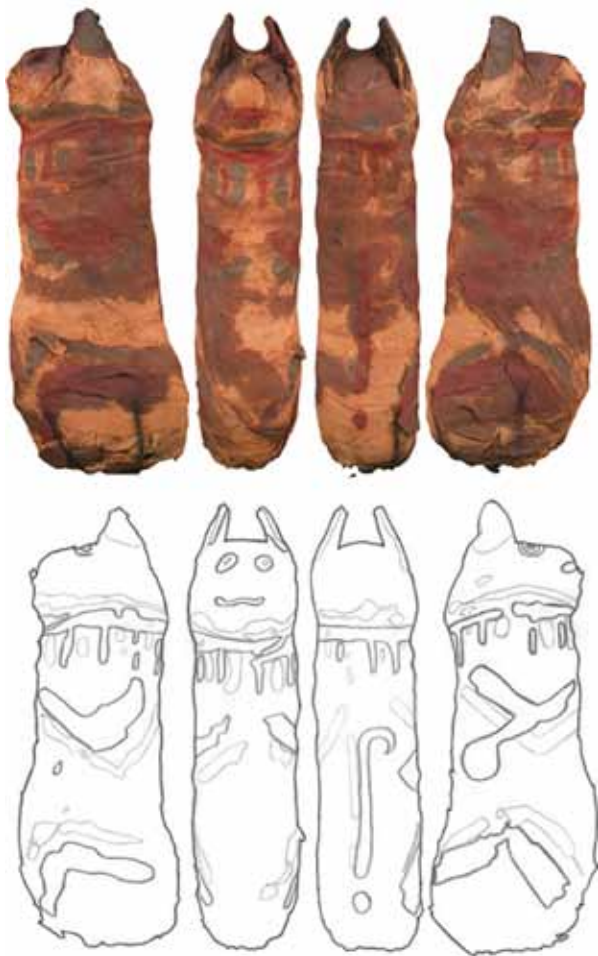


Figure 5: Images and drawings of the decoration on IA1.2402.

There are painted, albeit crude, decorations covering the entire object mimicking a cat's collar, anatomy, tail and pelage. On the 'head' there are two red circles with black dots in the centre for eyes. Around the narrow section between the 'head' and 'body' are two coloured bands, one green and one red. The painted features on the rest of the specimen are depicted in both green and red pigments. The first set of markings from the top are chevron shaped, pointing downwards, while the lower markings are also chevron shaped, pointing upwards. It appears that the red paint has been applied after the green, as it overlays the green in places. On the rear, there is a long red straight line which curls over to the right at the midpoint of the back. Beside the red is also a straight green line, which does not curl over to the right. Below these lines is a single, red spot. A sketch of these markings can be seen in Figure 5. An extensive search indicates that this type of colourful painted markings was not common at Saqqara (Zivie & Lichtenberg 2015: 117).

The linen bandages spiral down from the narrow section below the 'head' towards the base. The end of the bandage is wrapped around the bottom of the specimen, coming back up on an angle and secured with a brown substance. There are no patches, or signs of stitching or mending. The

textile itself is a plain, coarse weave without selvages. The weave is loose, with S-spun individual threads, some more tightly wound than others.

Research Aims

The initial aim of the research was to confirm the artefact's authenticity using radiocarbon dating. Its unusual appearance and lack of provenance made this essential. A second important aim was to define the contents of the mummy and identify any animal remains. A third objective was to investigate the mummification techniques using 3D imaging to distinguish layers and style. This study was dependent on the use of non-destructive methods including NCT and X-ray CT from both medical and synchrotron sources.

Methods of Analysis

Two 3D imaging techniques were chosen for this study, X-ray CT and NCT. X-ray CT has been widely applied to mummy research in the last 50 years (Harwood-Nash 1979; Isherwood et al 1979; Raven & Taconis 2005; Adams 2015; Adams et al 2015; McKnight 2015; Bewes et al 2016). NCT is a relatively new technique in archaeological studies, as it is harder to access nuclear facilities and it can be expensive. With the construction of the OPAL nuclear research reactor and associated neutron imaging instrument 'DINGO' at ANSTO, there has been greater accessibility to NCT through merit-based access in Australia, enabling variety of metallurgical studies in the last few years, for example on swords, and coins (Salvemini et al 2014; Olsen et al 2015; Salvemini et al 2016), and increasingly in palaeontology (Mays et al 2017; Bevitt 2018; Gee et al 2019). However the application of NCT to mummified remains has been much less explored (Salvemini et al 2016; Raymond et al 2019).

Both NCT and X-ray CT methods are used to achieve three-dimensional images of the internal features and contents of objects. In each case, a beam of radiation (neutrons or X-rays, respectively) is passed through an object and the shadow image is captured as a radiograph behind the object. By capturing hundreds of thousands of radiographs as the object is being rotated, computational algorithms can be used to convert these two-dimensional images into three-dimensional reconstructions. The fundamental difference in interaction between these forms of radiation, and atoms within materials, yields different views and insights into the object being studied. Specifically, while X-rays interact with the electrons surrounding each atom and are highly attenuated by dense materials, they pass straight through soft tissue and can be used to image materials such as bone and metal in medical applications. Neutrons, however, interact with and are scattered by atomic nuclei of materials, resulting in different absorptions and interactions in the material. For example, neutrons can pass through steel and lead, but are highly attenuated by hydrogen atoms, thus are effective in showing organic materials even when encased within metallic objects. It was therefore hypothesised that



Figure 6: X-ray (left) and Neutron (right) images. A. Wrapping direction and markings; B Sagittal slice; C. Coronal slice; D. Transverse slice near the paws showing the highly attenuating object only seen in X-ray data. Adapted from Raymond et al (2019).

using a combination of the two techniques would provide a more complete view of the contents of the mummy, including any bones present, the wrapping layers and any amulets that may be inside.

X-ray CT scans were undertaken by Prof. John Magnussen at Macquarie Medical Imaging, Macquarie University Hospital. NCT scans were undertaken at the ANSTO, by Dr Joseph Bevitt and Ms Carla Raymond, on the DINGO beamline. The parameters of these experiments can be found in Raymond et al (2019).

Radiocarbon dating and pigment analysis both required small samples to be removed from the mummy. The samples were collected from discrete areas that would not affect the appearance or structural integrity of the artefact. One sample of skin and fur was taken from inside the wrappings through the opening in the base. Another two samples were taken from the outer wrapping, one with green pigment on it, and the other two loose threads from the base at the opening. A final sample was collected from the box in which the cat usually resides, as it had some red pigment on it and so there was no need to remove further samples for pigment analysis. Samples of the wrapping, the skin and fur were sent to Beta Analytic Inc. in Florida for radiocarbon dating. This is a lengthy process of removing organic acids, reducing the remaining material to 100% graphite, and passing it through an Accelerator Mass Spectrometer (AMS).

Summary of Results

The X-ray scan shows the painted markings clearly in the bright areas on the outer wrapping in Figure 6A, while the neutron data does not show the paint at all. The benefit of using NCT however is that it shows the textile wrapping direction, which matches the visual observations where it wraps downward in a spiral fashion.

X-ray results of the internal features revealed a partial skeleton of a cat, including an articulated tail (23 vertebrae) and two hind legs with metatarsals (Figure 6B-C). There is no visible trace of a spine, ribcage, skull or fore-limbs. The textile layers were to some extent discernible, as there was a density contrast between the bandages closest to the skeleton and those further out. Additionally, the X-ray scans revealed a small (4 x 2 mm), highly attenuated object next to the paws which can be seen in Figure 6D. Because of its high absorption, it is likely to be a metallic object. It may be an amulet but, as it is amorphous in shape, it is difficult to identify. Higher resolution x-ray CT studies will be employed to identify this object. Interestingly, this metallic object was not initially observed in the neutron 3D digital reconstruction because of the low relative neutron attenuation of the constituent metal.

The reconstructed neutron data also showed the partial skeleton and it revealed coarseness and layering of the wrapping because of the higher attenuation of neutrons by the fabric and skin relative to X-rays (Figure 6B-C). The contrast between bones and textiles is not as clear as in the X-ray data, however it reveals much about mummification style and materials. The textile close to the skeleton is more tightly wrapped, and is a finer quality fabric, as the individual threads are smaller and closer together. The outer wrapping is much coarser and is wrapped more loosely, which correlates well with the density contrast seen in the X-ray data. The neutron data also revealed that the 'head' of the cat was actually a wad of fabric that had been folded to give the shape, which was not visible in the X-ray radiographs. A combination of both data sets helped to reveal not only the presence of bones but more details about the nature and quality of the textile. More comprehensive results are provided in Raymond et al (2019).

Radiocarbon dates revealed some unusual information about this mummy. The sample of the remains was re-categorised as 'plant material' by Beta Analytic, as there was apparently a large amount of plant material present. Following the AMS dating process, the mummified remains, mixed with plant material gave a date of 2690 ± 30 BP (before present). This would place the skeleton between 900 – 804 BC (Third Intermediate Period) to 95.4% probability. The external wrapping sample dated to 2230 ± 30 BP or 367-204 BC, placing it between the Late Period and Ptolemaic Period. Therefore, there is a difference of approximately 500 years between the skeletal remains and the wrapping. Another check sample is being secured for dating as is standard practice.

Discussion

The novelty of this study is two-fold. It is the first of its kind to apply NCT to the study of mummified Egyptian remains and also the first to employ both neutron and X-ray CT in a multi-modal imaging study of the same mummified animal. It thus serves as a comparative study of the individual techniques. A combination of the two data sets has yielded unprecedented insights into this mummy, shown the undisturbed skeletal remains in relation to the wrapping style and the textile quality. This allowed for comparison with the accounts of Ginsburg (1999), where he unwrapped several cat mummies from the Bubasteion at Saqqara. Ginsburg described the outer layers of wrapping as coarse and loose, distinguishing them from an inert set of finer and tighter wrappings directly surrounding the remains. He noted that larger cat mummies had up to three layers of wrapping, however smaller ones only exhibited two layers of wrapping. The combined use of both X-ray CT and NCT as a multi-mode imaging methodology has achieved enhanced contrast based on simultaneous, dual-segmentation of individual components of these remains using a two-dimensional matrix of neutron and X-ray attenuation values.

A close study of the skeletal remains revealed that the animal inside the wrappings was a small feline. This was determined with the help of zoo-archaeologist, Dr Tyr Fothergill, who identified that there were 23 caudal vertebrae in the tail, a feature of felid skeletons. Additionally, Dr Tyr Fothergill identified from the growth plates that this cat would have been approximately 11 months of age at death. The species of cat was difficult to determine, as typically this is determined by shape of skull or pelvis. In the absence of these bones, analysis of the calcaneus can also give information about about the species. According to the study by Van Neer et al (2014) regarding the shape of the calcaneus, this cat can be classified as *Felis silvestris* (Figure 7), an ancestor to the domestic cat. There are insufficient skeletal remains to determine if an injury was inflicted to either the spine or skull therefore the cause of death is indeterminate.

Radiocarbon dates of the internal contents and external wrapping revealed a 500-year difference between the two samples. The difference prompts discussion about the concept of recycling and re-wrapping of votive offerings. The most plausible suggestion for this age gap is that the original remains were mummified in the Third Intermediate Period and deposited in a catacomb or cemetery. After 500 years, with increased demand that could not be met by breeding facilities, this mummy was removed from its resting place, re-wrapped and re-sold. It is uncertain if the unique painted markings were added at this time or later.

New questions arise from this conclusion however. Did this mummy always contain a partial skeleton, or was the original mummy a complete skeleton that was separated 500 years later? The partiality of the remains is not unusual in mummified votives As mentioned

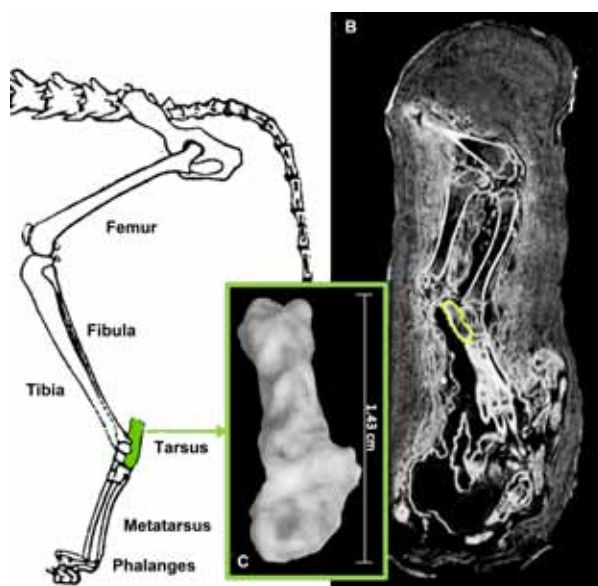


Figure 7: Skeleton of the hind quarters of a cat with calcaneus highlighted (Adapted from Jayne 1898);
B. X-ray slice showing calcaneus of IA.2402 and
C. a 3D reconstruction of it.

previously, it was quite common for mummy bundles to contain mixed selections of bones or sticks and mud. There are no visible fractures or breaks on the fibula or tibiae, nor the metatarsals. The tail is dis-articulated in three places (Figure 8), which may have occurred because of handling during the re-wrapping process or over time due to desiccation and fragility. It is expected that after centuries of decay, any substantial manipulation of the bones and remains would result in some breakages. The intact nature of the tip of the fragile tail suggests that this mummy has had minimal interference in the re-wrapping process and may have only ever contained these partial remains.

The origin of the mummy remains uncertain and its decorated appearance is unlike others in published reports. Other features such as the spiral wrapping pattern and the false ears, resemble a few examples from the Brooklyn Museum, Walters Art Museum, Baltimore, and the Nicholson Museum. Unfortunately, these artefacts also lack provenance information in the online databases. The wrapping style of two distinct layers of different textiles corresponds to the work of Ginsburg (1999) at Saqqara. It is therefore possible that this cat was from Saqqara, however, recent cat mummy finds at the Bubasteion in November 2018 did not resemble IA1.2402.

Future Research and Outcomes

A more detailed study of the pigments used to decorate the external wrappings is ongoing, involving a suite of geo-analytical techniques that is present at Macquarie University Geo-Analytical laboratories and ANSTO, namely Scanning Electron Microscopy, Raman Spectroscopy, X-ray Diffraction and Neutron Activation Analysis. It is anticipated that once the pigments have

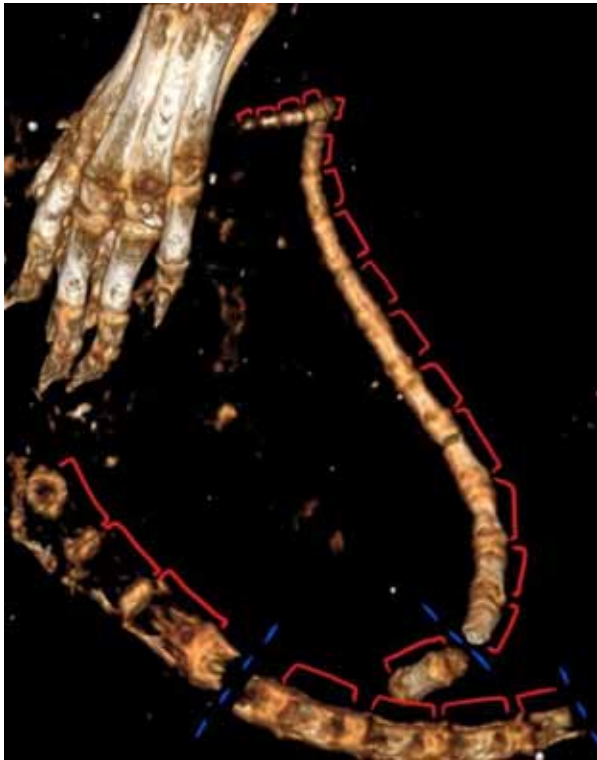


Figure 8: A 3D reconstruction of the partially articulated tail. The 23 caudal vertebrae are denoted in red, and the blue dashed lines indicate breaks.

been characterised, their antiquity may be confirmed and their origin identified.

The successful analysis of *Charlie* has led to the need for comparative data from other animal mummies. Access is now being sought to other animal mummies in collections in Australia and overseas to undertake similar research.

The outcomes of this project contributed to a successful Telematics Trust grant proposal, *Revealing Mummies: The Inside Story* by the Institute. This funding will enable the research team to make the details and results of this research program available to students using visual and digital platforms. A short documentary will be produced that summarises the research process and findings. Interactive 3D reconstructions of the IA1.2402 will assist students to explore the nature of the mummy and there will be files for 3D printing and accompanying educational resources for these multimedia outputs. These outputs will serve the aim of broadening the accessibility of these important cultural resources for education and remote communities.

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The Roman merchant ship sail plan

Christopher J. Davey

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Abstract: Two papers about the introduction of the spritsail during the Roman-period in previous editions of *Buried History* are updated with additional references and hypotheses. A revised interpretation of Problem 7 in the Aristotelian corpus *Mekhanika* is given but the foregoing proposition that the introduction of spritsails made sailing to windward routine for Roman merchant sailing ships is retained. It is suggested that extremes of wind strength were the main inhibitors of windward sailing because it reduced boat speed, which in turn diminished lateral resistance and increased leeway.

Introduction

Recent issues of *Buried History* have included two papers by me discussing the significance of the spritsail, which first appeared in merchant sailing ships during the Roman-period (Davey 2015; 2016). Some of the material in those papers has been presented at public events, including a maritime conference in October 2017. The subsequent discussions have confirmed, modified and developed the original ideas leading to this paper, which also draws on the contents of the earlier papers.

In his discussion about the economic environment of ancient Rome, Hopkins suggested that maritime trade became a vital component of the economy of the Roman Empire partly as a result of advances in technology and practice, which involved ‘increases in the sizes of ships and improvements in their handling’ (2000: 260). This paper and the two before it explore the specifics of Hopkins’ comment as it relates to the introduction of the spritsail.

It is argued that the spritsail was deployed on the bowsprits of merchant sailing ships from the Late Republican period and provided sailors with the necessary control to sail close-hauled and to go about routinely. The manoeuvrability it afforded also meant that sailing ship size could increase beyond that which was manageable with oars.

The small square-sail rigged on the bowsprit of sailing ships until the 19th century was called a spritsail and that is the term adopted in this paper (Figure 1; Davey 2015: fig. 1). The ancient Greek and Latin names for this sail were *artemon* and *artemo* respectively. It should not be confused with the fore-and-aft mainsail used on some coastal and river craft from the Roman-period onwards, which is also called a spritsail (Casson 1971: 243). A second term needing clarification is that of bowsprit, which is used in this paper to refer to an unstayed forward-raking mast extending beyond the bow on which the spritsail was rigged.



Figure 1: Relief of a merchant ship on a sarcophagus from Sidon, 2nd century, National Museum, Beirut. The ship has sails typical of a Roman-period grain ship. The spritsail is the small sail at the bow.. Image: Wikicommons.



Figure 2: An Egyptian river boat under full sail from the Chapel of the 6th Dynasty Tomb of Mereruka c2300BC, Saqqara. (note the cat in the rigging) Photo: the author.

Recently Dr Julian Whitewright published a paper entitled *Sailing and Sailing Rigs in the Ancient Mediterranean: implications of continuity, variation and change in propulsion technology*, tracing the early development of sails in the Mediterranean (2018a). Whitewright does not agree with two opinions expressed in the two previous papers. He maintains the view originally proposed by Casson that the use of the spritsail began in the mid-5th century BC because of the *Tomba della Nave* image of a ship with a foresail (Davey 2015: fig. 3). I have argued, and continue to do so in this paper, that there is currently no evidence for spritsails, which Whitewright calls *artemons*, prior to the 2nd century BC. The differentiation between foresails and spritsails may be at issue here: foresails were comparatively large and rigged on stayed masts while spritsails were small and rigged on unstayed spars protruding beyond the bow. Figure 6 illustrates the point. It is possible that some pre-Roman-period artists may not have been fully aware of the distinction.

Secondly, he does not agree that Roman-period merchant ships could sail to windward routinely. He believes that square-sailed ships could sail close-hauled, but that nothing we know about Roman-period sailing ‘allowed concerted long-distance upwind sailing to become a normal part of seafaring activity, in the sense of a crew deliberately setting out from harbour with the intent to sail continuously to windward until their destination was reached’ (2018: 39). There are however, many other points on which this and my two previous papers have agreed with Whitewright.

Iconography

Depictions of ancient merchant ships were prolific during two periods, the Old and Middle Kingdoms of Egypt and post-Republican Rome. One room of the 6th Dynasty Tomb of Mereruka at Saqqara has over a dozen depictions of ships (Figure 2) and the 12th Dynasty tomb enclosure of Senwosret III has a room with more than 120 ship images (Wegner 2017). In the Roman-period the Square of the Corporations (*Piazzale delle Corporazioni*), Ostia, has black and white floor mosaics of at least 23 ships, of which only four do not have a second sail near the bow (Becatti 1961). Outside of these periods there are very few illustrations of non-military ships. Shipping in the Old and Middle Kingdoms of Egypt and the Roman-period appears to have had a significant status, which was probably the result of its economic importance, community awareness and technological achievement.

The iconography of Roman merchant sailing ships began with images at Pompeii and was discussed with numerous illustrations in Davey (2015: 31-7). In summary, Lucien Basch (1987) depicts about 46 Roman-period merchant ships without oars. Of these, ten have large foresails, while 28 have spritsails or bowsprits on which to rig spritsails. Of the eight ships depicted to have no sail at the bow, only three have square mainsails. There are also images of merchant ships with spritsails not included in Basch, especially on coins (Torr 1895: pl. 6 No. 27; Smith & Smith 1880: 201).

The graffiti of merchant ships with spritsails found throughout the Roman Empire are especially notable

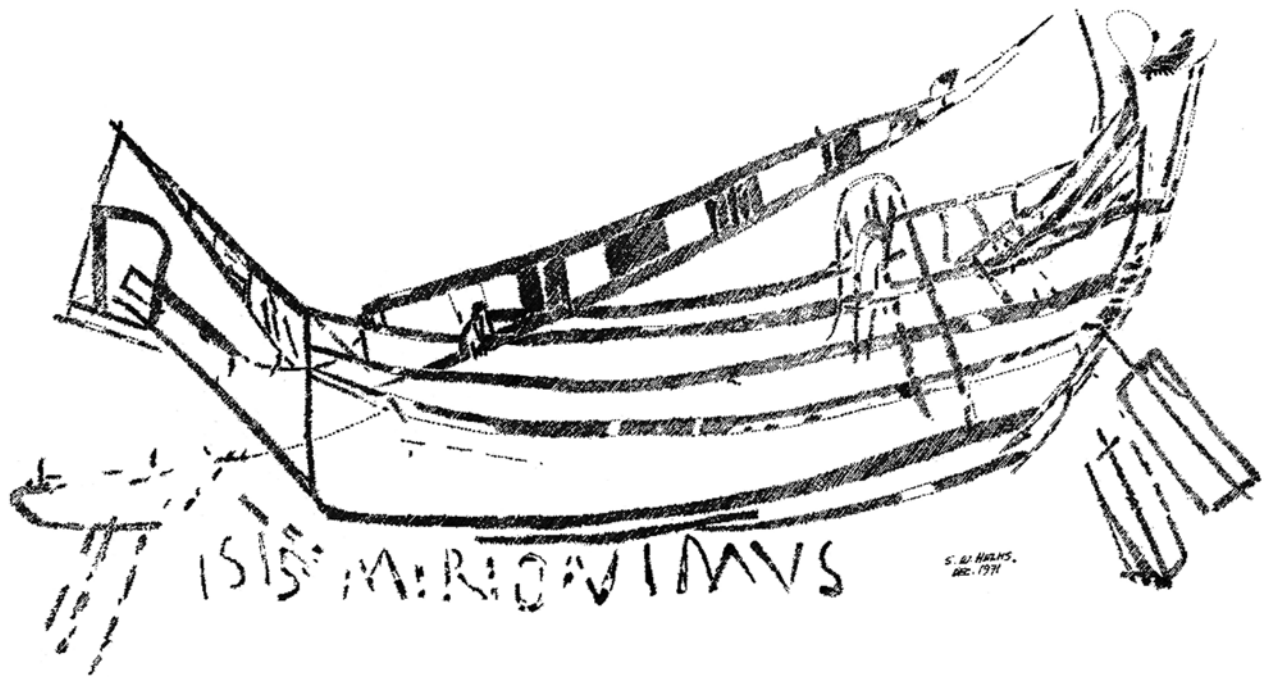


Figure 3: Graffito from the Holy Sepulchre Church Jerusalem 4th century showing a ship with its mast lowered but the bowsprit still in place. Image from Basch (1987: fig. 1036) drawing by S. Helms 1971.

because the people responsible for these many depictions were not part of an artistic tradition and could only have drawn what they had seen and knew about, ships with spritsails. These appear at Pompeii (Benoît 1961: fig. 73; Basch 1987: fig. 1051), Leptis Magna market (built c 8 BC) (Vergara Caffarelli & Caputo 1966: pl. 66A; Basch 1987: fig. 1102), the Palatino in Rome (Castrén & Lilius 1970: 109, 117; Basch 1987: figs 1025, 1096) and Sidi Khrebish (Berenike) near Benghazi (Pye 1974: pl. 4; Basch 1987: fig. 1103).

The graffito reported to be from the quay at Utica (Moore 1911; Basch 1987: 234, fig. 483; Davey 2016: fig. 6) and in a Roman Villa at Cucuron (Vaucluse) occupied between the 1st and 4th centuries (Gassend et al 1986; Davey 2016: fig. 7) both depict spars raked forward of the bow and stepped into the keel of the ship in front of the main mast. Both authors conclude that the artist must have been a seaman because the detail shown was not apparent to the casual observer (Moore 1911: 280; Gassend et al. 1986: 30). Basch also depicts images of four ships that have the main-mast lowered to the deck but with an unstayed bowsprit still in place (1987: figs 1035, 1036, 1098 and 1108; Figure 3). It seems that the bowsprit was secured as an integral part of the hull and was not easily removed; it was not an afterthought.

Shipwreck evidence for Spritsails

Beltrame identified one shipwreck, the Saint Gervais 3, where there was a slot in the keelson near the bow that would secure a bowsprit, and three other shipwrecks where there may have been such a slot: the Punta Ala (Livorno), Torre Santa Sabina (Brindisi) and Torre Sagarrata (Puglia) (1996 & pers. comm.; Davey 2016: fig.

5). These ships all exceeded 17m in length and belonged to the period when spritsails were common.

It can be inferred, from the fact that the keelson of the Saint Gervais 3 was not reinforced to withstand vertical forces, that the spar was unlikely to have been held upright by tensioned stays. The slot in the keelson indicates that the inserted spar, with a spritsail rigged on it, acted as lever applying tangential forces to the hull.

Shipwrecks without evidence for bowsprits include the 2nd century BC Cavaliere (Charlin 1978), AD 300 Laurons 2 (Gassend et al. 1984) and the 5th century Dramont E (Santamaria 1995; Poveda 2012). These ships were all under 18m length overall and could be sailed close-hauled without a spritsail. Recent discoveries in the Black Sea have included three Roman-period ships 15-25m in length. One has a bowsprit visible and a second may have had one, which was lost when the bow section broke up (Whitewright 2018b).

It is therefore reasonable to believe from the iconography and archaeology that Roman-period large sea-going merchant ships were normally rigged with spritsails, while those shorter than 20m sometimes had spritsails. This has been generally recognised, but the implications of the extra sail have often been only partly appreciated.

Pre-Roman Experience

Mekhanika ('Mechanical Problems'), an Aristotelian treatise, is a short work on levers written by a Peripatetic. It was discussed in Davey (2015: 39). A further translation and comment are given here to explain its context. The Peripatetic School began in about 335BC and fell into decline by the mid-3rd century BC. It revived during the

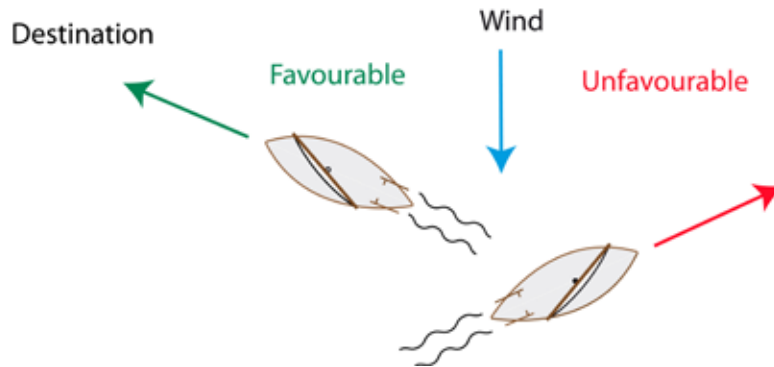


Figure 4: A diagram illustrating *Mekhanika Problem 7*. While the ship sails close-hauled away from its destination the wind is deemed to be unfavourable, but after going about the ship sails toward its objective and the wind is regarded as favourable. Drawing by the author.

Roman-period but the focus at that time was on the study of Aristotle's own works. *Mekhanika* was not written by Aristotle, and so it probably belongs to the earlier period. *Problem 7* therefore describes a situation faced by Classical period sailors:

Why, if the wind is not favourable when (sailors) wish to go about for a favourable breeze, do they shorten/furl the section/part of the sail that is towards the helmsman, but loosen/slacken the forward (part of the) sail at the foot? Is it because the rudder cannot hold the vessel back against a strong wind, whereas they draw it up when it (the wind) is light. So, whereas the wind carries them forward, the rudder settles the boat into the favourable breeze, holding back and making the sea heave. As well, the sailors at the same time are struggling with the wind, for they lean against its opposite direction (Aristotle & Hett 1936: 361 amended).

This translation follows that of Hett, Loeb Classical Library, except for the two parts in italics. Hett's translation, 'Why is it that, when the wind is unfavorable and they wish to run before it...' does not make sense because a wind, which sailors wanted to run before, would not be unfavourable. Casson's translation (1971: 276 n.24), 'Why is it that sailors, after sailing with a favorable wind, when they wish to continue on their course even though the wind is not favourable...', is not much clearer. In the second instance Hett assumes that οὔριον, a fair or favourable wind, must be a 'following' breeze, which is not necessarily the case. In fact, a fair wind may be one that is steady and suitable for sailing to windward.

The context of the passage is a discussion about levers, which is relevant to the steering of a ship and going about. It is proposed that the text describes the situation illustrated in Figure 4, where a ship is close-hauled and finds itself heading away from the desired destination, so the wind is deemed unfavourable. By going about, the ship sails on a heading toward the desired destination and so the wind is considered favourable. This terminology may seem rather strange to non-sailors, but the idea of going

about to get a 'good wind', that is a wind that will propel the boat quickly toward the desired destination, is still a common expression amongst sailors. Arnaud, drawing partly on Aristotle, discusses similar wind-based nautical terminology of orientation (2014: 52).

The text focuses on going about. Sailing boats with a properly balanced sail plan will comfortably go head to wind but as the wind strength increases, their ability to continue the manoeuvre by turning away from the wind to a new close-hauled heading is often problematic. The measures described in the text aim to turn the bow of the ship away from the wind. Applying the theoretical concepts explained by Davey (2015: 38), the sailors reefed or brailled up ('shorten/furl') the aft part of the sail to move the Centre of Effort forward, they loosened the forward part of the sail, so that it would catch the wind on the leeward side adding to the turning moment, and they moved their body-weight to counteract the heeling of the hull and to prevent the Centre of Lateral Resistance from moving forward.

Torr, who was writing when merchant sailing ships were still common, did not offer a translation of *Problem 7* but used it to describe going about: 'The passage shews that, when the yard was braced round, the sail was furled upon the arm that came aft, and left unfurled upon the arm that went forward' (1895: 96 n.206). The sequence of going about is thus: brail up (furl) the forward part of the sail so the ship rounds up into wind, as the ship goes head to wind the sheets are released and the yardarm is braced round so that the unfurled sail goes toward the bow, all the while leaning the boat away from the turn. This approach was discussed with Glafkos Cariolou, skipper of the *Kyrenia II*, who considered that 'it would work'.

Experience of the *Kyrenia II*

The 1986-7 sea journeys of the replica *Kyrenia II* between Piraeus and Paphos were documented by Katzev (1990) and were later commented upon by Cariolou, who was the skipper for the return voyage (1997). The ship carried ballast and supplies of about 10 tons out of a possible 30 tons to Paphos and 7 tons on the return. Cariolou reported that they went about twice in wind speeds of

less than 16 knots, but that tacking in stronger winds was very dangerous for the integrity of the sail and was not practised (1997: 93). The voyage to Paphos was sailed mainly on reaches and runs, while the return journey involved a significant amount of close-hauled sailing and a couple of storms with winds reaching 8 Beaufort (34-40 knots). Breakages to the steering gear occurred during the return voyage, demonstrating that significant turning forces were generated when going to windward. Katzev concluded that the *Kyrenia II* voyages demonstrated a 'remarkable ability to sail into the wind' (1990: 255) but, without the capacity to go about comfortably, an overall course directly into the wind was not achieved.

There is currently a belief that to sail close-hauled, a boat's hull must have a wine-glass section. Such a shape appeared during the 5th century BC and is taken as an indication that ships were then sailing to windward (Steffy 1994: 40-49; Harris 2011: 16; Pomey 2011: 50; Wilson 2011: 217). Whitewright follows the conventional wisdom with respect to the 'wine-glass' hull shapes of the *Kyrenia* and *Ma'agan Michael* ships (2018a: 39). Neither ship had any evidence for a spritsail, and the *Mekhanika* quotation implies that such a sail was unknown at the time it was written. The experience of sailing the *Kyrenia II* highlights the limitations faced by Classical ships sailing to windward.

Recent spritsail experience

Contemporary illustrations of 17th and 18th century ships at sea nearly always show a spritsail to be set. The details associated with rigging a spritsail continue to be described in rigging manuals (Anderson 1955: 111-120; Lees 1984: 99-105; Marquardt 1992: 54-59, 186, 224f; Anderson 1994), but Harland's comprehensive study *Seamanship in the Age of Sail* states that 'it is difficult to get much information about how the [sprit]-sail was actually used' (1984: 86). He quotes sixteenth-century Dutch experience that the spritsail was never set at night, in rough weather or when approaching land or sailing in convoy.

The power of the spritsail to alter a ship's course is described by Alan Villiers (1903-1982), a Melbourne-born seaman and author, who gained experience with spritsails when he skippered the *Mayflower II* on its passage to America in 1957. He is quoted at length in Davey (2015: 40-1). In summary, he wrote, 'As for the spritsail, this was so good a manoeuvring sail that I could well understand how it had persisted down the centuries, even after the use of jibs, ... had long been general' (1958: 253). However, its handling was not so straightforward, and he believed that this, more than anything else, led to its replacement by the jib (1958: 254). Villiers described the manoeuvrability of the *Mayflower II*: 'with the spritsail, the lateen mizzen, and the good positioning of the masts carrying the real driving sails, our *Mayflower* both tacked and wore quite well, swinging either across the wind or round before it very fast, with little loss of way.... She went to windward well in a good sailing

breeze, and she could be made to lie up six points' (1958: 255), that is 67.5 degrees from the wind (*Points of sailing*, Dear & Kemp 2005).

Villiers viewed square sails, such as the spritsail, as 'real sails', an attitude that contrasts with many recent commentators, who regard the square sail in antiquity as inferior to fore-and-aft sails such as lateen rigs (Casson 1971: 243; Campbell 1995: 2). However, fore-and-aft sails never replaced square-rigged sails, which remained standard on merchant ships to the end of the Age of Sail. Whitewright has argued that the fore-and-aft lateen sail was not technically superior to the square-sail, and its adoption in the Late Roman-period was for more complex reasons (Whitewright 2008).

Modern scholars are inclined to deem the references to people such as Villiers as anecdotal. However, before any maritime archaeological university department was even contemplated, he had sailed on numerous working sailing ships and full-size replicas systematically documenting his experiences. He wrote 44 books and his archive (MS 6388) at the National Library of Australia runs to 25.05m (143 boxes + 2 phase boxes + 12 map folios) (<http://nla.gov.au/nla.obj-234431689/findingaid>, accessed 10.7.2019). His informed experience must be admitted as evidence for commercial sailing technology.

The relevance of comparatively recent ships such as the *Mayflower* to Roman merchant ships has also been questioned. Merchant sailing ships from at least the Classical period had full flat-bottomed sections amid-

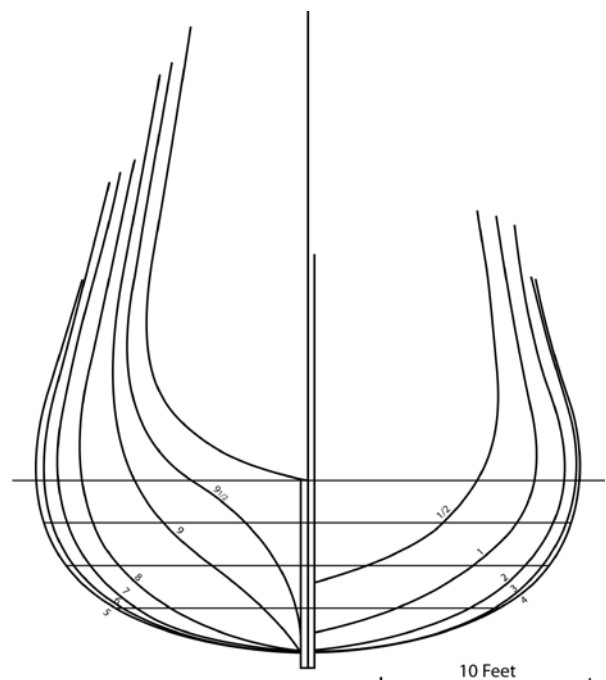


Figure 5: The lines of the *Mayflower*, based on a model by R.C. Anderson. They show that the stern, drawn on the left, was above the waterline and that there was a wine-glass section near the stern. (Redrawn from Magoun 1987: Plan 5).

ships, to increase their carrying capacity, and a keel protruding along the length of the hull. The reconstruction of the Ma'agan Michael shipwreck's hull shape illustrates the relationship between displacement and the fullness of the hull (Davey 2016: 35-8). Another notable feature is that, except for some medieval and non-European merchant ships, sea-going sailing ships from Classical times onward were generally double-ended below the waterline, that is, they came to a point at both ends, and many had fine or wine-glass sections near the bow and stern.

The lines of the *Mayflower* shown in Figure 5 were derived from a model at the Pilgrim Society, Plymouth, Mass. made by R.C. Anderson, a distinguished maritime historian, who obtained typical sections for 1600-1610 ships from the Samuel Pepys collection (Magdalene College, Cambridge) and the Scot collection of the Institution of Naval Architects (London) (Magoun 1987: 44, Plan 5). Judged on the criteria currently applied to ancient ships, that is the need for a deep wine-glass section, the *Mayflower* would be deemed unlikely to be able to sail to windward. However, we know that it could sail a course at 67.5 degrees from the wind (Villiers 1958: 255). Indeed, Villiers' experience of the *Mayflower* and 20th century clipper ships led him to suggest that all square-rigged ships with a balanced sail plan could achieve that point of sailing. At about 33m overall length and 180 tons, the *Mayflower* was comparable in size to many Roman-period merchant ships, which should be included in Villiers' suggestion.

Smith agreed that Roman ships could sail to windward (Smith & Smith 1880: 215), and his comments are discussed in Davey (2015: 41). The capability of ancient ships to sail to windward has also been discussed by Whitewright using modern replica data and ancient voyage records (2008; 2011; 2018a).

Most merchant ships in the Age of Sail are like modern sailing dinghies in that they had flat bottoms amidships and comparatively small area of underwater vertical surfaces. Merchant ships had keels while dinghies have foils and rudders. For these surfaces to provide effective lateral resistance, boat speed must be maintained. If wind speed drops causing the boat to slow, or the wind becomes strong causing the sails to stall aerodynamically, the boat will drift sideways or wallow. Moderate, steady breezes are ideal for sailing to windward.

Successful windward sailing by boats such as the *Mayflower* required good boat-speed, which is achieved by constantly adjusting the boat's angle to the wind direction. Sailing close-hauled is a skill involving a compromise between pointing (toward the wind) and boat-speed; point too close to the wind, the boat slows and its sideways movement increases; point away from the wind and the boat gathers speed, sideways movement reduces, but the boat's progress toward the wind also reduces. The application of this skill requires effective

controls that can be easily and precisely manipulated, and indicators to guide those in charge. For Roman-period sailors, the controls were the braces and sheets of the spritsail, and the indicator was the maintenance of a full shape of the mainsail.

Commentators ancient and modern have described the function of the spritsail as an aid to steering ships (Augustine, *Enarratio in Psalmum* 32.4; Smith & Smith 1880: 201; Arnaud 2011: 153; Whitewright 2018a: 32). At a macro-scale, the spritsail enabled sailors to gain command of a ship that was 'in irons' (out of control head-to-wind), and at the micro-scale, it permitted fine adjustments to balance the sail setting to maintain boat speed when sailing a close-hauled course. Villiers' comments emphasise the importance of this purpose, and they lead to the conclusion that the spritsail made the sail plans of Roman-period ships comparatively complete and capable of efficiently sailing to windward in good sailing breezes. Wind strength was more of a limitation than wind direction because both light and strong winds made it difficult to sustain adequate boat speed.

Origin of the spritsail

The origin of the spritsail may never be known with certainty, but the evidence already referred to gives some indications. Casson deemed that all sails forward of the mainsail were called *artemon* and had substantially the same purpose even though some were large and others small. He argued that the reconstructed wall painting from the Tomba della Nave, Tarquinia, which is dated to the 5th century BC and depicts a ship with a second sail between the mainsail and the bow, reveals the origin of the *artemon* (Casson 1971: 70, 240, fig. 97; Basch 1987: fig. 880; 1976; Moretti 1961). The absence of additional evidence in the following few centuries has cast some doubt on his claim (Harris 2011: 19; Arnaud 2011: 152).

Arnaud has advocated a distinction between the unstayed bowsprit with a spritsail and the stayed, near-vertical foremast carrying a foresail (2011: 152-4). The purpose of these sails was substantially different; the spritsail was to help steer the ship, while the foresail was primarily for propulsion.

The situation described in *Mekhanika* Problem 7 could have been resolved with the application of a spritsail, which seems to have been unavailable at that time. Indeed, it is hard to identify a better example of a lever to manoeuvre a ship than the spritsail and bowsprit. Instead, Classical-era sailors tried to use the partial brailing of the mainsail to assist with steering of the ship, and they manipulated the forward section of the mainsail. It was not such a great leap of imagination to rig a small sail at the bow to do this work much more effectively. This sail had to be rigged on an unstayed spar or bowsprit, so it was not hindered by the standing rigging. This represents a logical development of the spritsail from the function of the mainsail.

When reviewing the progress of maritime technology, Harris used the dates of Roman ship images to argue for a 2nd century AD introduction of the spritsail, instead of accepting a 5th century BC date (Harris 2011). I have argued that the spritsail appeared in the Late Roman Republican period (2nd century BC), because of textual references to the *artemo*, which begin in about 100 BC: Lucilius, *apud Charisium*, 99; Labeo and Seneca, *Controversiae*, vii. i. 2; *The Pandects*, 1.16. 242 (Davey 2015: 37-8). This is a moderate position, which is compatible with the history of ship sizes.

Ship size

The experience of the *Kyrenia II* described above revealed that when sailing to windward, emergencies sometimes required the application of oars. This intervention may have been an option when sailing ships of 15m length displacing 30 tons or less, but it was not a reasonable possibility for larger merchant sailing ships. Merchant galleys on the other hand were narrower, had less free-board, smaller displacement and were crewed by enough oarsmen to row the ship when necessary.

Wilson discusses the change in ship sizes in terms of displacement tons derived from shipwreck data between 600 BC and AD 1500 (2011). I did a similar analysis with respect to overall length (Davey 2016). Prior to mid-2nd century BC, ship displacements were 30 tons or less, with one exception, the Alonnisos wreck, which Hadjidaki determined to be a merchant galley (1996).

The economics of merchant galleys and sailing ships would have been substantially different. The cost of procuring, training and maintaining a large crew made merchant galleys a higher operating cost enterprise, so that cargoes of such ships needed to be strategically important or of high value. Merchant galleys would have been at a severe disadvantage when considered for long-range, large-volume, low unit value commodity trade.

Wilson's shipwreck data reveals that from the mid-2nd century BC ship displacements increased dramatically to as much as 600 tons (2011: 213, fig.14.1). He identified the Late Roman Republican trade of wine for slaves between Italy and Gaul, which ended with Caesar's capture of Gaul mid-1st century BC, as an intensive



Figure 6: A mosaic of two ships from Station 23, Square of the Corporations, Ostia c AD 200. The ships have contrasting rigs and hull shapes. The ship on the right has a spritsail at the bow while the ship on the left has a foresail and may have a sail plan like the *Madrague de Giens* shipwreck. Image by Bill Storage and Laura Maish at <http://www.ostia-antica.org/piazzale/corp.htm>, accessed 20.7.2015, used with permission (Becatti 1961: 73, pl. 179).

and highly profitable activity. Large merchant galleys may have been used for this trade. If they were, it would account some of the large ships built during that period, but it does explain the development of large grain ships.

Ancient authorities describe the Egyptian and Maghreb to Rome grain trade being conducted by large ships (Casson 1971: 183-190). According to Wilson, such vessels do not appear in the archaeological record because of the perishable nature of their cargoes; they did not leave heaps of amphora. He concluded that ‘merchant ships of over 200 tons were not uncommon between 1st century BC and 4th century’ (2011: 217; Casson 1971: 170-173).

It is proposed that it was the introduction of the spritsail that gave comparatively small crews the means to manoeuvre large merchant sailing ships, and that this made long-range, high-volume commodity trade technically feasible and economically viable. It is further proposed that it was the importance and ubiquity of this trade that prompted the large number of representations of ships with spritsails from the 1st century onwards.

Cutwater bow ships with foresails

Of the ten Roman merchant sailing ships with large foresails depicted in Basch, eight have cutwater bows. The images are from the 2nd century AD or later. The shipwreck at Madrague de Giens was the first ship with a cutwater bow to be excavated (Tchernia et al. 1978). Pomey discusses the sail plan and concludes, ‘In any case, the convergences appear to be sufficiently numerous and important so that we can identify the vessel of La Madrague of Giens the great sailing ship of the mosaic of the Baths of Thémétra’ (1982: 150; trans. CJD).

The Thémétra mosaic depiction specifically referred to is Basch (1987: fig. 1109), which has a foresail on a forward-raked mast. Pomey argues that, while the foresail provided power, it also helped to balance the sail plan. He considers that the proportions of the Madrague de Giens’ hull were like the asymmetric ship depicted in the mosaic of Syllectains in the Square of the Corporations, Ostia (Figure 6; Basch 1987: fig. 1076). He suggests that the Madrague de Giens could also have been rigged with three masts and that this ‘should significantly improve its stability, its sensitivity to the rudder and its capacity to go toward the wind’ (1982: 151 trans. CJD).

The hydrodynamics of cutwater bows would have helped to balance large foresails because the Lateral Resistance was concentrated nearer the bow of such hulls. The Madrague de Giens wreck had a 1 metre deep wine-glass section, which may have given it the capacity to sail closer to the wind than six points.

As Pomey has argued, the foresail of the Thémétra-type boats provided power and control when sailing into the wind. However, the adjustment of such foresails would have been more physically demanding than the smaller spritsail; and it would have been much less discriminating. While the foresail may have helped balance the sail plan,

it was not a sail that could be used for steering. The addition of a small mizzen sail may have overcome this situation, but such ships still needed larger crews than ships rigged with only a mainsail and spritsail. They consequentially also had higher operating costs and more logistical constraints.

The Madrague de Giens shipwreck reveals a complex development path for multi-masted vessels. While it may be tempting to suggest that the spritsail and foresail had similar origins and parallel histories, this would not explain the development of the cutwater bow to balance the foresail. It is also unnecessary because the spritsail appears to have a feasible technological development path from the way the mainsail was used when going about, according to *Mekhanika* Problem 7. The development of the unstayed bowsprit, on which the spritsail was rigged, is another component that does not relate directly to the stayed foremast on which the foresail was rigged.

Conclusions

This paper draws attention to the dynamics of sailing to windward and especially the importance of maintaining boat speed when so doing. A ship’s ability to sail close-hauled is now generally thought to depend on its hull shape amidships, but it has been argued that sailing technique was also important. *Mekhanika* Problem 7 provides evidence that sailors of the Classical period were sailing to windward; and it illustrates how they used sail adjustment and hull inclination to try to control ships as they tacked, a manoeuvre essential for windward sailing.

Sailing to windward is a skill relying on the effective controls and indicators. Representations of merchant sailing ships during the Roman Empire were prolific, demonstrating their importance at that time. The greater portion of the ships depicted were rigged with spritsails, or with bowsprits on which to rig spritsails. This sail gave the crew the manoeuvrability they needed to handle windward sailing by maintaining boat speed while close-hauled, and providing a turning moment to assist with going about. Texts mention the *artemo* – spritsail from about 100 BC, revealing that it had been developed by that time. It continued in use until the last century of merchant ship sailing.

Shipwreck data reveals that from the time of the spritsail’s introduction, ship sizes increased. The largest ships until then had been merchant galleys. It appears that the spritsail provided the means to command larger sailing ships overcoming the economic limitations of merchant galleys and achieving economies of scale to facilitate reliable long-range bulk-commodity seaborne trade.

The Roman-period ship depictions portray a variety of ship sizes and sail plans. This paper has focussed on the most common, those with spritsails. It is probable that smaller vessels plying river and coastal trade did not use spritsails as their itineraries were more flexible and they could set sail at the time of their choosing.

Scholars have often been reticent to accept the capability of Roman-period ships to sail to windward. Alan Villiers' experience sailing the *Mayflower II*, a ship with a spritsail and without a wine-glass section amidships, is a strong indication of the capabilities of comparably sized ships with spritsails. It may be time to set aside the longstanding scholarly approach and to adopt Villiers' suggestion, that all square-rigged ships with spritsails and balanced sail plans could sail to windward in good sailing breezes as a matter of routine, and that constraints were more likely to stem from extremes in wind strength rather than wind direction.

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The 1954 Excavation of Tombs at Tauchira and Euesperides, Libya

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Abstract: In 1954, Walter Beasley, the founder of the Australian Institute of Archaeology (the Institute), financially supported a young Australian archaeologist, G.R.H. Wright, to excavate tombs at Tauchira, near modern Tobra, and Euesperides, in present day Benghazi, Libya. Excavations produced artefacts some of which were sent to the Institute for its museum collection. This paper alerts scholars to the Institute's holdings from the excavations at Tauchira and Euesperides.

Introduction

A young Australian field archaeologist, G.R.H. (Mick) Wright, was undertaking the excavation of tombs on Cyprus for the Museum in Nicosia in 1953 when he was asked to escort Walter Beasley, founder of the Institute, about the island (Wright 2006: personal communication; Davey 2013a). During the course of their travels Wright mentioned to Beasley his intention to excavate at Tauchira¹ in Libya. Beasley was promoting the study of ancient world archaeology in Australia and believed that to foster an interest in the subject it was necessary to display artefacts (Davey 2014). He had been involved in the appointment of an archaeologist, James Stewart, at the University of Sydney and knew how important the Nicholson Museum had been for the creation of that position (Davey 2013b).

The Australian Institute of Archaeology was a significant supporter of the Ashmolean-sponsored 1950-51 excavations at Myrtou Pigadhes, Cyprus, and subsequently Donald Harden of the Ashmolean was seeking further funding from the Institute for excavations near Benghazi. The news that Wright also intended to excavate at another city of the Cyrenaican pentapolis was therefore of considerable interest to Beasley. In a letter to Wright, who was then excavating with Seton Lloyd in Turkey, Beasley indicated that Harden required significantly more funding than Wright and that previous experience at Myrtou Pigadhes indicated that Harden was unlikely to offer a satisfactory division of finds (7 June 1954 AIA Doc 763). Beasley went on to explain how, at the time, the Institute had financial obligations associated with the establishment of an exhibition at Ancient Times House in Melbourne and how finds from Tauchira would help the Institute's lecturing program at the University of Melbourne, which he hoped would follow The University of Sydney and 'break away from the usual narrow viewpoint', that limited ancient history to the Classics (AIA Doc 763).

A subsequent letter from Beasley to Wright on 15 June 1954 implies that Wright had also been in touch with Harden and that he would need to manage that relationship if he were to excavate on his own behalf (AIA Doc. 762).

The Institute holds a copy of the Excavation Permit issued to Wright on 26 October 1954 authorising him to excavate during November 1954 (AIA Doc. 5408). It was signed by Richard Goodchild, Controller of Antiquities in Cyrenaica. Wright wrote to Beasley four times during the excavations giving accounts of progress and on 26 April 1955 he sent from London hand-written and typed reports, which were subsequently published in *Palestine Exploration Quarterly* (Wright 1963, AIA Doc. 5408).

The Wright Archive, held by the Institute, contains a letter from Richard Barnett to Wright written on 15 December 1954. Barnett had been with Wright in Turkey earlier in the year. He congratulated Wright on the 'successful digging' and then wrote, 'I don't suppose old Rowe will be very pleased to find you have beaten him to the target of Tobra'. He then went on to give Wright advice and references to assist in the preparation of the publication. Wright's excavation of a significant site sought after by significant archaeologists, such as Alan Rowe, and Museums, such as the Ashmolean, is worthy of comment. Rowe was the Egyptian Antiquities Service's Inspector of the Prohibited Military Area, Western Desert, and Conservator of the Graeco-Roman Museum in Alexandria during World War II and was called upon to assess the wartime damage to North African antiquities (Desplat, 2016). He was therefore well established in the area by the time Wright came on the scene.

Wright had excavated with C.N. Johns at Euesperides for three seasons, the last coinciding with his season at Tauchira (Wright 1993). Johns had been the first Controller of Antiquities in Cyrenaica after World War II. Wright's experience with Johns gave him standing in the Libyan Department of Antiquities and afforded him the local knowledge to conduct an excavation economically and efficiently. Wright's resources were limited and he initially lacked transport as Pauline, his wife, had crashed her Morris Minor in Turkey and it did not arrive in Libya until November (per. comm. via C.J. Davey). Wright's experience and enthusiasm and no doubt the organisational ability of Pauline brought the project to fruition. Wright later dug with Professor Carl Kraeling of the Oriental Institute, University of Chicago, at Ptolemais



Figure 1: A map of eastern Libya, ancient Cyrenaica, showing the cities of the Pentapolis.
Map: adapted from Google Earth.

in 1956-8 (Kraeling 1962) and at Apollonia in 1965-6 with the University of Michigan (White 1966), which meant that he eventually worked at four cities of the Cyrenaican pentapolis (Figure 1).

Many of the finds from Tauchira were sent to Australia and are listed below with their registration details. Wright also excavated at Euesperides at the site of es-Selmi. The manuscript of this excavation was mislaid and a 'rescue account' of Euesperides was eventually published in *Libyan Studies* (Wright 1995). Objects from this excavation also found their way to Melbourne.

Wright's work at Tauchira intersected the unpublished excavation by the British Royal Air Force (R.A.F.) personnel during WWII (Anon 1970). Finds from these earlier excavations are included in Wright (1963). The Institute received a human skull from Tomb C and a lamp from Tomb E of the 1944 R.A.F. excavations. The skull is the subject of a second part of this paper. A letter from Wright to Beasley on 24 November 1954 (AIA Doc 762) implies that, as he had left skeletal remains in one of the tombs, objects from the earlier R.A.F. excavations were intended to be substitutes so that displays in Australia may be comprehensive.

Despite these intentions, the material from Tauchira and Euesperides was never exhibited and Wright's reports made no reference to the Institute. The existence of the finds at the Institute has therefore been unknown to the archaeological community. This paper provides details of the material held by the Institute.

Excavations at Tauchira

The ancient city of Tauchira lies on the coast of Libya, some 67 km east of Benghazi. The modern village of Tocra is situated south of the ruins of an Italian fort,

which was built upon an earlier Turkish castle. Ancient Tauchira is walled on three sides and is thought to have been founded from the Greek colony of Barce. Evidence of occupation has been found from the Greek, Hellenistic, Roman and Byzantine periods through to modern times (Boardman & Hayes 1966). Notable studies of the area include the mapping and exploration by the Beechey Brothers (1828), which remains a standard text, and excavations by the British School in Athens between 1963 and 65, which revealed archaic Greek pottery dating to the 7th century BC in deposits within the city walls (Boardman 1965-66). Adjacent to the walls is a series of disused quarries containing chamber tombs and cyst graves. It is these tombs that were the subject of investigation by Wright in 1954.

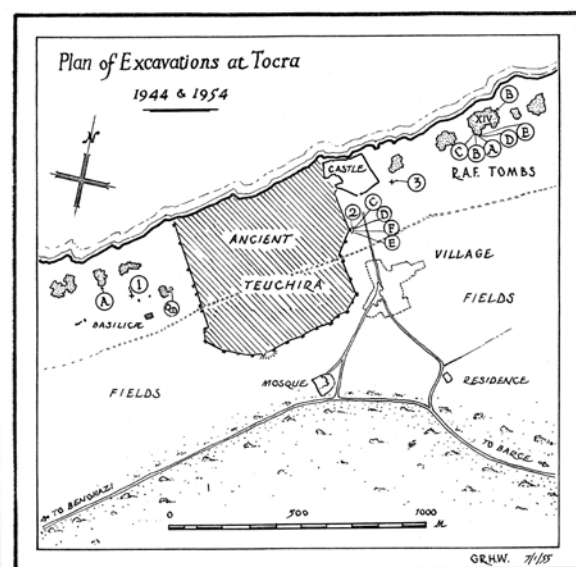


Figure 2: Plan of Tauchira. From Wright (1963: 27).



Figure 3: A selection of lamp wasters from the kiln dump, 1 IA6.96, 2 IA6.94, 3 IA6.98, 4 IA6.93, 5 IA6.92, 6 IA6.91. 7 IA6.107.

R.A.F. Excavations 1944

Information gained from previous excavations conducted by the R.A.F. in 1944 suggested that the site would yield information on the mortuary history of a typical Cyrenaican settlement (Wright 1963). The R.A.F. excavated five chamber tombs east of the city in Quarry XIV and three cyst graves from a large cemetery located between the east wall and Quarry XIV (Barnett 1945). Barnett also mentions the cyst graves, two being dated to the fourth century BC and the third containing two burials dating to the fifth century BC and later. It is assumed the dates were based on objects found within the graves. The chamber tombs in Quarry XIV were adjacent to one another and, on the basis of finds, were dated to AD 100 by both Barnett (1945) and Wright (1963). The human skull comes from this group of chamber tombs. Material from the R.A.F. excavations was set out in a room in the village but by the 1963-65 excavations it was housed by the Department of Antiquities in a more formal museum (Boardman & Hayes 1966).

1954 Excavations

A detailed account of the 1954 excavations and the objects is presented in Wright (1963). What follows is a brief overview extracted from that publication together with lists of the objects identifying their current location.

Kiln Dump Q.D.

A small quarry (marked on Figure 2 as 'QD') on the outside of the west wall was found to have no tombs. There was however a solid mass of potsherds in the fill at the bottom of the east wall of this quarry, comprising plain domestic ware and lamps (Table 1). An area immediately

above the potsherds had a small mound with ash and 'wasters' and this was presumed to have been the location of the kiln itself. The material is the same as found in the R.A.F. Roman tombs and the lamps were dated to around AD 100. The Institute received lamp samples from the kiln dump (Figure 3)

Reg No.	H mm	W mm	Description
IA6.91	20	40	Secutor and Retarius
IA6.92	18	47	Thraex and Hoplomachus
IA6.93	10	47	unidentified animal
IA6.94	23	50	Bed scene
IA6.95	30	60	Bed scene
IA6.96	28	55	Astarte
IA6.97	27	20	outer rim with handle
IA6.98	10	80	Cupids playing
IA6.99	48	70	Cupids playing
IA6.100	43	82	Cupids playing
IA6.101	50	60	
IA6.102	27	20	
IA6.103	8	39	Medusa's head
IA6.104	10	48	
IA6.105	8	70	winged humanoid
IA6.106	4	42	Secutor and Retarius
IA6.107	32	60	Secutor and Retarius
IA6.108	28	88	Secutor and Retarius
IA6.109	23	39	

IA6.110	8	48	crossed legs
IA6.111	10	60	crossed legs
IA6.112	10	50	
IA6.113	25	50	human figure
IA6.114	15	60	
IA6.115	25	40	animals
IA6.116	25	40	animals
IA6.117	25	70	pattern around rim
IA6.118	10	70	fruit
IA6.119	25	40	

Table 1: Lamp fragments from the kiln dump.

Quarry of Tomb A

Another sanded-up quarry west of the kiln dump had a large unsealed chamber tomb on the south scarp. Two of the three entrances were cleared, leading to interconnecting chambers. A third chamber was half-full of sand and contained a quantity of bones. One crude lamp was received by the Institute from this tomb. The façade of the tomb had carved niches, a seven-branched candlestick (a Menorah) and inscriptions suggesting that it was a Jewish tomb from the Greco-Roman period.

R.A.F. Quarry 1954 Tomb B

A large chamber tomb on the north-east side Quarry XIV, diametrically opposite the 1944 tombs, was excavated. It was a large rectangular chamber with six niches carved into the walls. There were 26 objects in total, predominantly ceramic but also glass, shell and bronze (Table 2). The bowls were identical with those found in the kiln dump and this, together with the glass ware, indicated that it belonged to the Roman period of the first and second centuries. It was therefore contemporaneous with the five chamber tombs excavated in the same quarry by the R.A.F. in 1944.

PEQ No	Name	Reg No.	H mm	W mm
1	Amphora	IA6.25	500	320
6	Glass frags	IA6.31	0	0
7	Glass frags	IA6.32	0	0
10	Jar	IA6.35	530	320
11	Ostrich Egg frags	IA6.36	0	0
12	Tear Bottle frag.	IA6.39	0	0
13	Glass Handle	IA6.38	8	2
14	Amphora	IA6.40	0	0
18	Unguentarium	IA6.43	95	17.5
19	Glass Button	IA6.44	10	25
20	Glass Button	IA6.45	10	25
21	Beads	IA6.46		

22	Bronze Mirror	IA6.47	0	0
23	Bowl	IA6.48	20	4
24	Sherd	IA6.49	28	125
25	Bowl	IA6.50	40	5

Table 2: Objects held by the Institute from Tomb B.

East Rampart Quarry Tombs

The area in front of what appeared to be two entrance shafts was cleared to the bedrock, a depth of 2.5 metres. This was the quarry scarp into which chamber tombs had been cut (Figure 4). The two ‘shafts’ were probably earlier cyst graves from the third century BC that were undercut by the later excavation of the tombs, the cyst graves thus becoming openings in the roof of the chamber tomb.

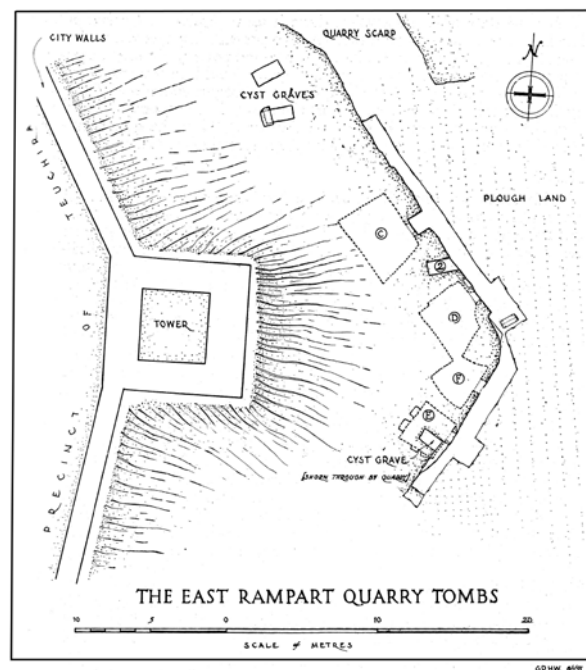


Figure 4: East Rampart Quarry Tombs. From Wright (1963).

East Rampart Quarry Tomb C

Tomb C was intact, the stonion stone still being in place with its original surrounding packing material. Six inhumations were present, two on the floor at the back and side of the tomb, three in loculi carved from a bench along one wall and two in broken amphora ossuaries in a corner. There was a total of five pottery and bronze funerary objects, three of which are in Melbourne (Table 3). The bronze cymbals associated with the ground burial along the side wall were traditionally associated with female burials. The amphorae in the tomb have been dated to c AD 100.

PEQ No	Name	Reg No.	H mm	W mm
3	Bronze Cymbals	IA6.53	10	40
4	Bronze strap	IA6.54	10	40
5	Bronze tack	IA6.55	10	40

Table 3: Objects held by the Institute from East Rampart Quarry Tomb C.

East Rampart Quarry Tomb D

Tomb D had elaborate funerary arrangements comprising a small stone sarcophagus just outside the door, another inside and three cysts cut into the floor, two with capstones. Aside from one crude lamp just inside the door, most of the 15 grave goods found were beneath the sarcophagus in the tomb, which was raised 20cm on boulders (Table 4). The range of lamps together with the colourless glass tumbler, suggest a continued period of use of a century or more from around AD 100.

PEQ No	Name	Reg No.	H mm	W mm
3	Lamp	IA6.56	45	85
4	Lamp	IA6.57	45	100
5	Cooking Pot	IA6.58	105	125
7	Lamp	IA6.59	50	84
9	Lamp	IA6.60	38	104
10	Lamp	IA6.61	65	130
11	Lamp	IA6.62	60	105
12	Juglet	IA6.63	104	95
15	Bronze Pin	IA6.65	0	0

Table 4: Objects held by the Institute from East Rampart Quarry Tomb D.

East Rampart Quarry Tomb E

Tomb E was neat, squarely cut and had been emptied of its contents in antiquity. All four niches in the wall and one cyst in the floor were empty. A crude inscription above the door indicated it was the tomb of '... the brothers Philokalos and Eutyichides'. The stonion stone was broken and piled just inside the doorway allowing the quarry fill to tumble down into the chamber and almost filling it.

East Rampart Quarry Tomb F

Tomb D broke into what appears to be an earlier tomb. The lower portion of fill in the tomb consisted of a mixture of bones and earth from earlier burials, the top layer comprising the red earth of the quarry seeping in the open doorway. Objects found along the north wall were in situ and are listed in Table 5. The lamps are the same as those found in the kiln dump, dating this tomb to *c* AD 100.

PEQ No	Name	Reg No.	H mm	W mm
1	Lamp	IA6.66	50	99
2	Cooking Pot	IA6.67	68	82
3	Lamp	IA6.68	45	90
4	Bowl	IA6.69	125	165

Table 5: Objects held by the Institute from East Rampart Quarry Tomb F.

Cyst Graves 1954

These were simple graves cut into the rock measuring 2m length by 0.4m width and 0.4m depth and were ubiquitous at Tauchira, sprawling to the east and west of the city walls. They were often found near the edge of the quarries and some were cut into the quarry. It thus seems that many graves may have disappeared as the quarries were enlarged. All six cyst graves excavated in 1944 and 1954 pre-date the Roman period and are thought to belong to the classic Hellenistic Tauchira era.

Cyst Grave 1, 1954

Cyst Grave 1 was situated between Chamber Tomb A and the Kiln Dump QD west of the city walls. It was a simple cyst grave containing several objects which dated it to the middle of the third century BC (Table 6).

PEQ No	Name	Reg No.	H mm	W mm
b	Unguentarium	IA6.2	205	38
c	Unguentarium	IA6.3	100	35
d	Unguentarium	IA6.4	74	37
e	Unguentarium	IA6.5	130	37
f	Unguentarium	IA6.6	102	35
g	Unguentarium	IA6.7	137	35

Table 6: Objects held by the Institute from Cyst Grave 1, 1954.

Cyst Grave 2, 1954

Cyst Grave 2 was on the edge of the East Rampart Quarry above Chamber Tombs C and D and was sheared through by the quarry in ancient times. Attic pottery dated this grave to early fourth century BC however glass unguentaria and later styled pottery date to the first and second centuries AD (Table 7). This intrusion of later objects could have been introduced when the grave was disturbed by quarrying.

PEQ No	Name	Reg No.	H mm	W mm
a	Askos	IA6.8	67	105
b	Lamp	IA6.9	102	74

c	Bowl	IA6.10	28	95
f	Lagynos	IA6.12	204	125
g	Unguentarium	IA6.13	78	35
h	Bowl	IA6.14	40	75
i	Tear Bottle	IA6.15	115	20

Table 7: Objects held by the Institute from Cyst Grave 2, 1954.

Cyst Grave 3, 1954

Cyst Grave 3 was between the East Rampart Quarry and Quarry XIV and is thought to have been near the tombs excavated by the R.A.F. in 1944. The finds date this grave to the second half of the fourth century BC (Table 8).

PEQ No	Name	Reg No.	H mm	W mm
b	Bowl	IA6.18	35	114
c	Lamp	IA6.19	94	65
d	Bottle	IA6.20	108	49
e	Jar	IA6.21	114	90
g	Juglet	IA6.22	134	90
h	Juglet	IA6.23	105	50

Table 8: Objects held by the Institute from Cyst Grave 3, 1954.

Overview

The chamber tombs in quarries east of the city appear to have been the favoured form of burial during the Roman period in the first and second centuries AD. Often several interments are found in each tomb varying from simple placement on the tomb floor, in carved niches in the walls or cysts in the floor and the use of large amphora as ossuaries. As can be seen in Figure 5, the predominant material for grave goods is pottery followed by glass and a few bronze items.

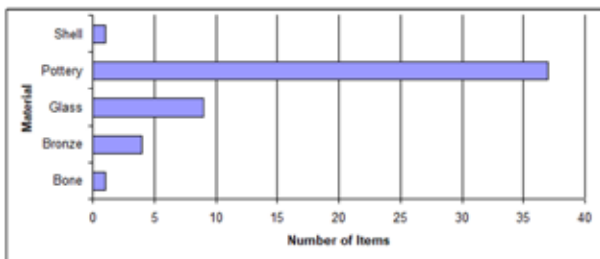


Figure 5: Chamber Tombs material.

Simple cyst graves are ubiquitous throughout the landscape to the east and west of Tauchira's walls, often near quarries and sometimes disturbed by the expansion of a quarry. The six graves excavated, three by the R.A.F. in

1944 and three by Wright in 1954, contain predominantly pottery grave goods dating to the Hellenistic period in the second through early fourth centuries BC. The inclusion of glassware and later pottery forms in Cyst Grave 2 date to the first and second centuries AD and these items are thought to have intruded into this grave when it was sheared by quarry works in ancient times.

Euesperides, Site: Sebkhā es-Selmani

Another area of interest was the ancient city of Euesperides, a Greek city founded in the 6th century BC and today located in the immediate area of Benghazi, the second largest city in Libya. The later Ptolemaic, then Roman city of Berenice is situated further south of Euesperides, both bordering the large salt lagoon known as Sebkhā es-Selmani (Figure 6). Advice from the then Controller of Antiquities led Wright to investigate an area southeast of Euesperides along the road to Benina, thought to contain intact graves (Wright 1995). Soundings against the rocks uncovered the presence of an unusual rock-cut grave containing funerary offerings. Results from this excavation were sent for publication but lost en-route, a brief 'rescue account' being published in *Libyan Studies* in 1995, the original photographs and drawings of the objects being lost along with the original report. The Institute holds eleven of the seventeen objects in its collection and is therefore able to provide plates and drawings in the following pages. Four of the objects were retained by the Department of Antiquity presumably for their museum and the remaining two objects are presently unaccounted for.

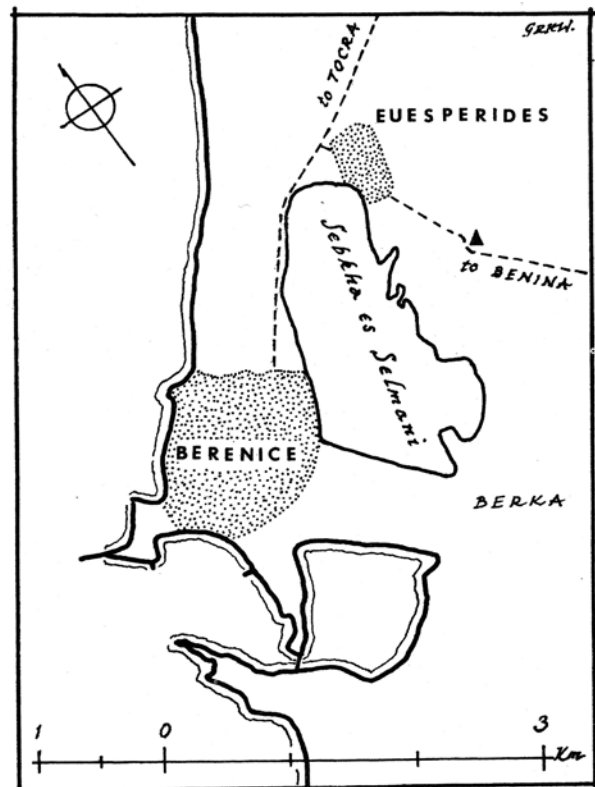


Figure 6: Plan of Euesperides. From Wright (1995).

Because a description of the grave was published by Wright (1995) a brief account only will be given here, followed by some thoughts as to its purpose. At first glance the grave appears to be a dromos for a chamber tomb and the presence of a stonion stone leaning against the back wall of the shaft with a Medusa's head pendant wedged behind appears to confirm this (Figure 7). There was, however, no chamber behind it, only some tool marks suggesting the beginnings of a chamber. The fill was a dry loose brown earth containing rock fragments and chips, the lower levels containing some charcoal and a small piece of coccyx.

The grave goods were found in a neat undisturbed pile resting almost on the rock floor and these have been dated to the Hellenistic period in the second half of the fourth century BC. As further investigations were not possible the purpose of the shaft and the grave goods is unknown.

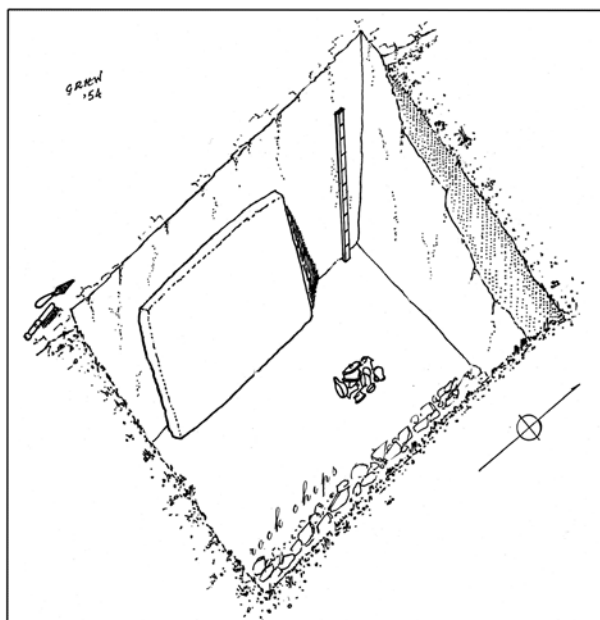


Figure 7: Euesperides Tomb drawing. From Wright (1995).

One suggestion could be that the carving out of a small chamber tomb had commenced, evidenced by the dromos, stonion stone and incipient chipping in the back wall where the entrance to the main chamber would have been. For reasons unknown, work was discontinued on the tomb at this stage so the grave goods and interment were placed in the dromos and covered in. The presence of a small piece of coccyx with charcoal is unusual but could indicate a hurried cremation prior to interment, perhaps due to disease or invasion.

The dating of the objects renders the grave almost contemporaneous with the cyst graves excavated in Tauchira 67 km east of Euesperides. As this grave dates to the later half of the fourth century BC and the Tauchira graves the second to early fourth century BC it could demonstrate a transitional funerary period in Cyrenaica from simple cyst

graves to small rock cut chamber tombs as a reflection of emerging Roman influences in the region. These are of course speculative interpretations only as its original purpose may now never be known.

PEQ No	Name	Reg No.	H mm	W mm
2	Juglet	IA6.73	77	0
3	Pot Stand	IA6.74	26	46
4	Juglet	IA6.75	62	44
5	Lamp	IA6.76	26	60
6	Bowl	IA6.77	0	31
8	Bowl	IA6.79	44	107
11	Alabastron	IA6.82	90	0
12	Pendant	IA6.83	40	44
14	Pendant	IA6.84	32	35
15	Pendant	IA6.86	35	35
17	Bronze Pin	IA6.88	52	20

Table 9: Objects held by the Institute from Sebkh es-Selmani.

Human Skull – R.A.F. Tomb C

The human skull sent to the Institute (Figure 8) came from Tomb C of the R.A.F. excavations in 1944 in Quarry XIV, which was dated from the grave goods to about AD 100 (Wright 1963). The inscription containing Jewish names and images of the suppression of Cyrenaican Jews suggests the date may in fact be AD 115-118 (Wright 1963). The stonion stone was secured at the base but leant outwards at an angle at the top, which had allowed two distinct layers of fill to enter the chamber over a period of time. The top layer was of relatively loose material whilst the lower level was of hard concrete consistency, making excavation of objects difficult. An oriented primary burial was discovered lying on the floor but proved impossible to lift due to the hard-compacted lower fill. Ossuaries were also discovered in this lower fill but it is not mentioned whether they contained bones, as is the case with the wall niches. A cyst covered with slabs and sealed by pinkish coloured cement was found at the bottom of the fill and, upon removal of the slabs, it was found to contain three skulls and other bones.

The skull held at the Institute was listed on the original inventory as coming from R.A.F. Chamber Tomb C and described as follows:

Skull c150 AD Graeco-Libyan provincial Greek colonists mainly Dorian – some admixture of blood with natural Libyans – a hamitic?? Race akin to the modern Berber.

It is very clean with no encrustation of sand as would be expected if it were the skull from the oriented primary burial on the floor of the tomb enveloped within the hard cement-like sand. The published detail that ‘... impossible...lifting of the skeleton...’ also indicates that the burial was left in the tomb and therefore could not be the skull held at the Institute (Wright 1963). The ossuaries and wall niches were not reported to have contained any human remains, so the skull is unlikely to have come from them. Its most likely location was the sealed cyst in the floor of the tomb. The lack of fill in the cavity indicates that the seal was probably intact. It is therefore assumed that the skull held by the Institute is one of the three found in the cyst with other bones.



Figure 8: Right anterio-lateral view of the skull from R.A.F. Tomb C, IA6.90.

Ancestry

The morphology of the cranium includes a lack of keeling, relatively complex sutures, rectangular orbits, ovoid external auditory meatus; pronounced cheek bones, average nasal opening, projecting nasal bones (although partially damaged post-mortem), ambiguous nasal spine, and a relatively pinched nasal root. While these features indicate a person of mixed ancestry, a metric assessment of the cranium (Appendix 1) using CRANID (Wright

2002; 2007) suggests, however, that the individual was more than likely of European/Mediterranean ancestry.

Sex

The morphology of the skull (Table 10) indicates the individual was more than likely male.

Skull (Score 1-5)	Left	Right
Glabella	5	5
Supraorbital Margin	5	5
Mastoid Process	5	5
Suprameatal crest	5	5
Nuchal Crest	5	5
Mental Eminence	5	5
Gonial angle flare	5	5
Estimated Sex Skull	M	M

Table 10: Scoring of cranium morphology for the determination of sex.

Age

The skeletal remains are those of an adult. The third molars have erupted, indicating that the individual was at least over 25 years of age. Assessment of the degree of closure of the cranial sutures (Meindl and Lovejoy 1985) suggests that the individual was more than likely to have been aged within the 50-60 year age range. It must be noted, however, that compared to other ageing techniques (which involve assessment of the post-cranial skeleton), the use of ectocranial suture closure is not a reliable method (Cox 2000: 67-68).



Figure 9: Inferior view of the cranium. Image: VIFM.



Figure 10: The buccal surface of the mandibular right canine showing evidence of enamel hypoplasia (white arrows). Image: VIFM.

Dentition

Some teeth have been lost post-mortem, while the left second premolar, first and second left molars, right canine and right second premolar have evidence of post-mortem damage. Those that are present show a significant degree of attrition. The left and right first mandibular molars, for example, have lost the entire enamel on the mesial/buccal surface (Figure 9). This corresponds to extreme wear on the mesio-lingual surface of the right first maxillary molar (see Figure 10).

The mandibular right canine has been broken post-mortem, however, it is still possible to observe evidence of enamel hypoplasia on the buccal surface (Figure 11).

There is also evidence of small deposits of calculus (mineralised plaque) on the buccal surfaces of the left second mandibular premolars and the first left mandibular molar.



Figure 11: View of the left mandibular teeth showing evidence of small deposits of calculus on the buccal surfaces. Image: VIFM.

Pathology/Trauma

There is evidence of fine capillary-like lesions on the left and right orbits (Figure 12) suggesting early stages of cribra orbitalia (Stuart-Macadam 1991).



Figure 12: Detail of left orbit showing fine capillary-like lesions. Image: VIFM.

There is also a healed depressed fracture on the left side of the frontal bone, approximately 27 mm superior to the superior border of the orbit (Figure 13).

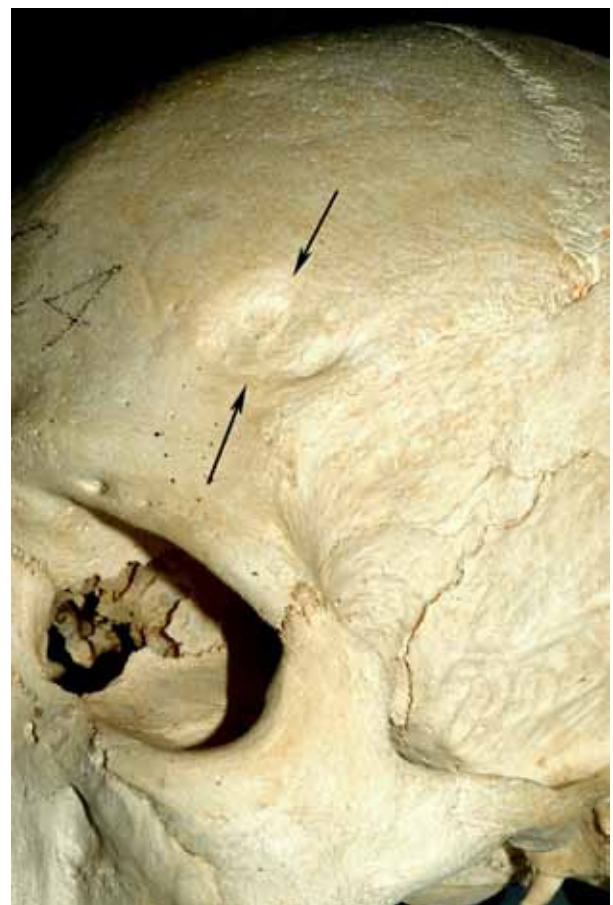


Figure 13: Close up view of the left frontal bone showing evidence of the healed depressed fractured (black arrows). Image: VIFM.

Discussion

The individual from Tauchira had alterations to the dentition, orbits and frontal bone.

Dental Attrition

It is difficult to ascribe a single aetiology to wear patterns (Foley and Cruwys 1986: 16) because factors which potentially influence dental wear are multi-factorial: age (and possibly sex in terms of differential food acquisition), diet, size of teeth, as well as paramastication (non-dietary use of teeth as tools) are all contributors. The wear patterns observed on the skull from Tauchira suggest the individual's diet consisted of foodstuffs with a relatively high amount of grit. This may have included food which naturally has grit in it such as marine foods, or was perhaps a result of the ways in which food was prepared (e.g., foods were inadequately cleaned, butchering techniques in which meat was prepared on the ground. Cooking techniques which incorporated particles of sand and ash into the food could also have contributed to this abrasion (Townsend *et al.* 1994: 40).

Enamel hypoplasia

Enamel hypoplasias are the most common form of enamel defects (Roberts and Manchester 1995: 58) and are characterised by a reduction in enamel thickness due to a disruption of ameloblast activity during the early stages of tooth crown formation (Lukacs 1989: 267; Skinner and Goodman 1992: 155; 159). These defects tend to occur most frequently on both the permanent and deciduous maxillary central incisors and the mandibular canine (Goodman *et al.* 1980: 526), and manifest as "irregular horizontal linear grooves or pits in the enamel surface" (Lukacs 1989: 267).

The disruption of ameloblast activity results from a hereditary anomaly, localised trauma, or systemic metabolic stress, the most common in archaeological situations being the latter (Goodman and Rose 1991: 281). While many illnesses are known to cause metabolic stress (particularly infectious disease and malnutrition), which in turn may result in enamel hypoplasias, the exact aetiology of this defect is unknown (Skinner and Goodman 1992: 160). Thus, enamel hypoplasias have been described as non-specific markers of physiological stress (Ibid: 162; Goodman and Rose 1990: 59; Hillson 1996: 166).

Cribræ Orbitalia

The skeletal change observed in the orbits (eye sockets) on the skull from Tauchira is indicative of the early stages of cribræ orbitalia. Cribræ orbitalia is a skeletal change indicative of anaemia, either a genetic form (such as thalassaemia and sickle-cell anaemia) or that caused by iron deficiency, often associated with dietary changes (Klepinger 1992: 122) and/or diseases such as gastro-intestinal or parasite infections (Mays 1998: 142; *cf.* Holland and O'Brian 1997). Based on the skeletal evidence alone, it is impossible to determine the exact type of anaemia because of the similar ways the different types are expressed on the bones.

Trauma

Trauma represents extrinsic influences on the skeleton (such as physical force, cold, heat, chemicals and irradiation) which can be the result of either natural or cultural acts (Zimmerman and Kelley 1982: 7, 42). The presence of head trauma on the individual from Tauchira perhaps indicates some kind of inter-personal violence. However, without knowledge of the wider context of the individual's habitational environment it is impossible to comment in any detail.

Conclusion

Excavations conducted in 1944 by the British R.A.F. and in 1954 by Wright at the site of ancient Tauchira in Libya provided information on mortuary practices during the Hellenistic and Roman periods in that region. The objects found by both excavation projects were listed, described and interpreted by Wright (1963). Many of the objects from the 1954 excavations were sent to the Institute for inclusion in its museum collection. Two types of burial were common at Tauchira, simple cyst graves dating to the earlier Hellenistic period and rock cut chamber tombs dating to the later Roman period *c*100 AD. An investigation at the site of Euesperides 67 km west of Tauchira led to the discovery of an unusual rock-cut shaft with grave goods and perhaps the remains of the intended inhumation and some charcoal. This shaft grave is contemporaneous with the Hellenistic cyst graves at Tauchira but of a slightly later date, possibly reflecting a change in funerary practices and external influences, although this can be conjecture only.

The Roman period chamber tombs contained human bones located in wall niches, amphora ossuaries, sarcophagi, oriented ground burials or cysts. It is the latter of these from which the human skull held by the Institute is thought to originate. The skull belonged to an adult Caucasoid male, possibly Jewish, with evidence of enamel hypoplasia, early stages of cribræ orbitalia and healed head trauma.

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Endnotes

1. There are a range of spellings used for the ancient site. Tauchira is the form used on the excavation permit and is used herein.

Appendix 1

Tauchira Skull: Cranial Measurements

	CODE ID		Mean (mm)		Result (mm)
1.	Maximum cranial length	GOL	179	g-op	192
2.	Nasio-occipital length	NOL	177		189
3.	Cranial base length	BNL	99	ba-n	103
4.	Basion-bregma height	BBH	132	ba-b	139
5.	Maximum cranial breadth	XCB	137	eu-eu	143
6.	Maximum frontal breadth	XFB	114		121
7.	Biauricular breadth	AUB	121	au-au	126
8.	Biasterionic breadth	ASB	107		115
9.	Basion-prosthion length	BPL	97	ba-pr	96
10.	Upper facial height	NPH	66	n-pr	77
11.	Nasal height	NLH	50	n-ns	54
12.	Orbital height	OBH	34		30
13.	Orbital breadth	OBB	39	d-ec	43
14.	Bijugal breadth	JUB	115		125
15.	Nasal breadth	NLB	26	al-al	26
16.	Maxillo-alveolar breadth	MAB	63	ecm-ecm	67
17.	Bimaxillary breadth	ZMB	95		106
18.	Zygomaxillary subtense	SSS	23		24
19.	Upper facial breadth	FMB	97	fmt-fmt	103
20.	Nasion-frontal subtense	NAS	16		21
21.	Biorbital breadth	EKB	97	ec-ec	103
22.	Interorbital breadth	DKB	22	d-d	23
23.	Cheek height	WMH	23		28
24.	Frontal chord	FRC	110	n-b	116
25.	Nasion-bregma subtense	FRS	26		25
26.	Parietal chord PAC 9	PAC	111	b-l	116
27.	Bregma-lambda subtense	PAS	24		28
28.	Occipital chord	OCC	95	l-o	106
29.	Lambda-opisthion subtense	OCS	28		32

Reviews

Yosef Garfinkel, Saar Ganor, and Michael G. Hasel, *In the Footsteps of King David: Revelations from an Ancient Biblical City*, New York: Thames and Hudson, 2018; Pp. 240, Cloth ISBN 978-0-500-05201-3; US\$34.95

Review by Christopher J Davey

The phrase, *In the footsteps of...*, recalls a time when scholars wrote about biblical figures such as Paul, Moses and Jesus in historical and biblical contexts. It may attract readers who have a respect for the biblical narrative and who are willing to take the archaeological journey the site of Khirbet Qeiyafa offers, but it should not be assumed that the outcome of the sophisticated scientific journey the book portrays will be conventional.

The site was excavated between 2008 and 2012, and there has been prompt publication; four excavation report volumes are in print and others are in press or the final stages of preparation. While it is now appropriate for a popular book about Khirbet Qeiyafa to be written, the role of this book is not entirely clear. A version of it was published in Hebrew in 2012. In 2016 a more scholarly discussion of the interpretations it presents was published, Y. Garfinkel, I. Kreimerman and P. Zilberg, *Debating Khirbet Qeiyafa: A Fortified City in Judah from the Time of King David*, (Jerusalem: Israel Exploration Society). This book characterises the debate about Khirbet Qeiyafa as deteriorating ‘into rather ugly statements, sometimes including unfounded accusations’ (12). For those who do not want to engage with the often-bitter debate about the site, *In the Footsteps of King David* is a good place to start.

The first chapter introduces the period of Iron Age I in the southern Levant, the Philistines and the story of David and Goliath, which are relevant because of Khirbet Qeiyafa’s location adjacent to the Elah Valley and the time of its occupation. The writers believe that the geographical information we now have suggests ‘that the biblical author had access to historical information originating in the 10th and 9th centuries BCE’ (18).

Chapter 2: *Bible, History, and Archaeology* reviews the data and current debate, arguing that ‘instead of entertaining ourselves with speculation concerning when the final redaction of one text or another occurred, it is more productive to look at the deeper historical question: does the text before us [biblical] preserve some historical memory’ (36). It concludes that the ‘excavations at Khirbet Qeiyafa have produced sound data on which to base our proposals, including radiocarbon dating that undermines the low chronology paradigm’. This contrasts with the minimalist model, which is described to be based ‘on an absence of data and the negation of the biblical tradition as a source of information’ (50). The historiography used in the book is characterised by the writers, ‘In our

opinion, a historical event does not generally change the way of life immediately; rather, a process begins and its effects can often be seen only decades later’ (32). Thus, the approach is evidence-based and follows the *Annales* school of thought.

The background to the site, the story of the excavation and its original layout and architecture are described in chapter 3. This is comprehensively illustrated with clear maps and plans. Referencing the later cities of Beth Shemesh, Tell en-Nasbeh, Tel Beit Mirsim, and Beer Sheba, it is argued that Khirbet Qeiyafa reveals a new concept of urban planning that emerged at the time of David (91). Much is made of the casemate city walls, which existed at all these sites. The chapter concludes by describing the radiocarbon dating of the site using olive pits, and its preservation after the excavation concluded.

The finds are dealt with in chapter 4 and again everything referred to is carefully illustrated. There were hundreds of restorable pots, stone implements, much bronze and iron, beads and rare ritual and art objects. The existence of iron is noteworthy. The site is almost a time capsule having a couple of short periods of occupation defined by radiocarbon dates.

The two inscriptions that were discovered are discussed in chapter 5. The text, language and meaning of the ostrakon are inconclusive, but the name *Eshbaal* incised on a storage jar is well attested in the 10th century BC. The cultic standing stones, objects, model shrines and rooms are described in chapter 6. This material has the potential to substantially revise current knowledge of religion in ancient Israel. The writers depart from their normal practice by suggesting architectural and iconographic parallels from as far afield as the Aegean and Mesopotamia.

Chapter 7 discusses that ancient name of Khirbet Qeiyafa. The writers follow Anson Rainey suggesting that it is biblical Shaaraim. Some alternatives are considered, but Levin’s suggestion (BASOR 367, 2012, 73-86) that it is the *ma’gāl* of 1 Sam 17:20 is not mentioned and while Na’aman is mentioned (165) but his identification of Qeiyafa with Gob (2 Sam 21: 18f) is not. The distinctive culture of Khirbet Qeiyafa is explained and leads to a settlement analysis of Judah based on Hebron as the capital. The 700 storage jars with finger impressions on them are deemed to be the fore-runners of *lmlk* jars and part of Judah’s distinctive taxation system.

The biblical description of Solomon’s buildings in Jerusalem (1 Kings 6) is discussed in the light of the cultic finds from Khirbet Qeiyafa. Specifically, the entrance and window designs of the model shrines are considered in relation to some of the technical architectural terms used in the biblical description. In the context of the argument here, the appearance of these features at Khirbet Qeiyafa is seen to support the possibility that Solomon’s buildings were constructed in the 10th century BC. Most previously recognised parallels post-dated that time.

The final chapter, *Linking Bible, Archaeology, and History* summarises the book and offers useful observations about Khirbet Qeiyafa. It is seen to be a Judahite administrative and military centre that illustrates the role religion played in war and it has cultural and iconographic features later seen in Judah and especially in the buildings of Solomon.

The opening comments notwithstanding, Khirbet Qeiyafa is a point of departure for future research into the Iron Age of southern Levant. Minimalist scholars have cleared away much of the history of Iron Age I and the 10th century BC leaving Professor Garfinkel and his colleagues a clear space to occupy with their new evidence. Khirbet Qeiyafa and its archaeological assemblage is chronologically and geographically defined affording a firm foundation for the re-assessment of material culture at other nearby sites. While archaeological evidence is soundly based the minimalist enterprise is redundant. To reclaim relevance Finkelstein, a leading minimalist, queried the archaeological method at Khirbet Qeiyafa (*Tel Aviv* 39, 2012, 38–63), but he wrote before the site's publication and, as those reading *In the Footsteps of King David* will observe, he misrepresents the excavators' interpretations; his approach was premature and superficial.

The writers argue that their data support the existence of the kingdom of Judah under King David from the beginning of the 10th century BC. But they do not follow the biblical narrative and recognise the United Monarchy and King Saul. In isolation this does re-cast the biblical narrative significantly.

Comparative archaeological analyses that may characterise the Kingdom of Judah is not attempted, except where the cultic material is concerned. Casemate walls and iron for example, are common in Hittite Anatolia; there is plenty of room for further research.

The book represents outstanding value for money. It is hardcover, has many high-quality illustrations, including colour plates, that directly relate to the text, it is also documented with endnotes and has an index and a bibliography. Students will find it attractive.

In the Footsteps of King David is a good resource for those interested in exploring the archaeology of the southern Levant in the 10th century BC. It explains how archaeological evidence is obtained and demonstrates the ways it can be analysed and the kind of the information that may be obtained from it. There are many opportunities for further study, there is plenty to discuss and much to disagree with, but do not expect a quick resolution of issues. Geography, topography, demography, town planning, architecture, material culture and epigraphy are all brought to bear in one way or another. With its evidential base and reliance on scientific, rather than literary, dating the book is significant demonstration of archaeology as an autonomous discipline in the Old Testament period.

Mobile Subject Review

Mobile Ed: AR101 *Archaeology in Action: Biblical Archaeology in the Field*, Logos Mobile Education and Lexham Press, 2015–2016, <https://www.logos.com/product/54903/mobile-ed-ar101-archaeology-in-action-biblical-archaeology-in-the-field>, USD66

Reviewed by Christopher J. Davey

This package is one of an increasing number of mobile education subjects now offered by the Faithlife Corporation based in Bellingham, Washington. This company was previously known as Logos Bible Software and began in 1992. It offers over 43,000 digital texts, biblical and general in many languages, between Logos and their ebook store Vyrso, and it is now developing into the education area.

The Faithlife Mobile Education subjects are cross-platform integrating video instruction with Logos digital library resources and media and links to additional external resources and suggested readings found on sites such as Wikipedia. The AR101 courseware textbook is the primary resource. It has a transcript of the videos and links to suggested readings and the activities, guides and tools. The activities are carried out in a 'workbook' where reflections may be recorded and there are short multi-choice quizzes and a final test. It is not moderated and does not offer any accreditation.

The subject is presented on-line and videos do not download onto the host computer so that in countries such as Australia, where connectivity and internet speeds are variable and generally at the slow end, there will be limited access to the visual material. The courseware textbook may be downloaded. Other ways to view the videos include FaithlifeTV.com, Logos iOS/Android mobile apps, AppleTV, and Roku. It is recommended that those subscribing to Mobile Education have Logos Bible Software, Platinum Edition, that retails for USD 2,150.00.

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The context of this review is archaeological, which some biblical scholars may deem to lack relevance. However, archaeology is a professional discipline with defined principles that scholars and practitioners ignore at their peril. Archaeology often handles the heritage of people other than the excavators and failure to discharge the responsibilities in this situation can be grievous.

The AR101 courseware textbook begins by saying that it,

is an introduction to biblical archaeology, filmed entirely on-site in Israel. Throughout the course, distinguished scholars in the field provide

descriptions of the tools and techniques they use at dig sites. They explore the process of uncovering artifacts and describe the insights these articles provide into life in biblical times.

At the completion of the subject it is stated that students should be able to,

Describe several ways archaeological discoveries shed light on the biblical text

Summarize the stages of archaeological work, from identifying a site to publishing the findings

Understand the important role that amateur volunteers play in biblical archaeology

Explain how stratification indicates dating when archaeologists excavate a tel

Describe some of the modern technology that archaeologists use

Explain the general significance of several archaeological sites presently being excavated and processed

These objectives are good as far as they go, but the reality is that the subject is primarily intended to prepare American students who intend to volunteer on excavations in Israel. The basic text is John D. Currid, *Doing Archaeology in the Land of the Bible, a basic guide*, Grand Rapids, Michigan: Baker Books, 1999. This is a reliable text that covers the history of archaeology reasonably well and acknowledges some non-American contributions to the discipline. Students who read all of it, not just that which is required, will be well-prepared to begin field archaeology. The question is whether the subject adds very much to the information provided by this text.

The 3 hours of videoed interviews with archaeologists, all of whom dig in Israel does add to the text. Included are, Dr Jodi Magness, University of North Carolina at Chapel Hill, Dr Rami Arav, University of Nebraska Omaha, Dr Scott Stripling, Wharton County Junior College, Dr Mordechai Aviam, Kinneret College on the Sea of Galilee, Dr James F. Strange, University of South Florida, Dr James R. Strange, Samford University †, Dr Itzhaq Shai, Ariel University, Chris McKinny, Bar-Ilan University, amongst others.

Some scholars are not easy to understand, and others ramble, so it is good that a transcript is provided. After the first hour of the video my fellow reviewers, a group of archaeological graduates, commented that 'Jodi [Magness] is carrying it' because of her clear and well-structured explanations. Students do listen well to talking heads.

Segment 1 asks the question *What is Archaeology?* and appropriate answers are given by the scholars interviewed. Segment 2 then asks the question *How is Archaeology informed by the Bible..?* Magness appears to have nothing to say about the matter, neither does *Doing Archaeology* and those who do comment actually claim that the reverse

is the case. The fact is that many archaeologists would lose interest in the subject at this point as the question implies a serious failure to understand the roles of archaeology and biblical studies. The following segment repairs the damage a little by contrasting the study of text and material culture. Textual study is defined to be in the original ancient language, but oddly the study of material culture is limited to excavated objects and does not include excavation reports and archaeological analyses. The activities for this segment involve reading translations of several ancient texts and there is nothing archaeological.

The following unit deals with the Archaeological Process and starts with site selection, obtaining approvals and building a team. There is no idea that a site may be selected for any other reason than its biblical name and significance. The digging process is explained in relation to documentation and finds management and conservation. Currid goes into more detail, but at this point no-one explains the fundamental concept of digging by locus. Publication is rightly seen to be the essential outcome of the process.

The third unit describes a volunteer's life on a dig and defines the roles of directors and field supervisors. The section about becoming an archaeologist claims that there are many different types of archaeologist defined by the language of the culture that is being excavated. There is no allowance made for the possibility that the language of the culture being excavated is not known or that it is prehistoric.

Unit 4 *Anatomy of a dig-site* has four segments, *Squares, Baulks and Stratigraphy, Importance of a Sealed Locus for Stratigraphy and Importance of Determining Location within a Tel*, which deal with the control of an excavation. There are some unusual descriptions in this section, particularly in relation to the idea of sealed loci. Stratigraphy is determined only by soil colour and there is no use of a Harris Matrix.

By way of general comment, historical geography is not done well, images of bad excavation practice abound, there is no mention of architecture or the role of open space in the built environment. The demonstrations of technique are not very helpful.

In addition to its limited application the subject has two serious shortcomings. The archaeological methodology espoused is a throw-back to pre-1960 when the interpretive approach is known as culture history. This system adopts the Bible as the interpretive framework into which archaeology is placed; no serious archaeologist now follows this process. The subject envisages that finds will always relate to the biblical text and it does not seem to be aware that many excavations in Israel are excavating in non-biblical contexts.

A case in point is Khirbet el-Maqatir. When introducing the site, the excavator Scott Stripling, says that the reason for digging there is to establish that it is the site of biblical

Ai. In YouTube videos released by the excavators, for example <https://youtube/8nbvgHpA9iI> it is stated that they have established that the site is Ai because there is a Late Bronze Age burnt layer and that ‘the Bible is a serious historical text because it is confirmed by archaeology.’ This line of thinking needs discussion, to what extent can the Bible be confirmed by archaeology, and indeed, why it is in need of confirmation? By over-looking these questions, the subject promotes a superficial ‘treasure hunting’ or ‘Bible feature seeking’ mindset and does not encourage professional archaeological practice.

The second more significant issue relates to the respect and obligations archaeologists must comply with when they work in countries of which they are not citizens. Khirbet el-Maqatir is again a case in point. The site is in the West bank, that is in occupied territory. The Nazi looting of occupied Europe and the flagrant strategic utilisation and destruction of heritage structures during World War II led to *The Convention for the Protection of Cultural Property in the Event of Armed Conflict*, The Hague, 14 May 1954. It formalises the obligations of states in relation to cultural heritage in times of war and in occupied territory, see http://portal.unesco.org/en/ev.php-URL_ID=13637&URL_DO=DO_TOPIC&URL_SECTION=201.html. This document was signed in 1954 by nearly all Middle Eastern states including Israel, but not Turkey. Nearly all archaeologists have abided by these requirements for occupied Cyprus and only very rarely have non-Israelis ignored the obligations in the West Bank.

The excavators of Khirbet el-Maqatir claim that they have received permission to excavate. It is understood by the reviewer that the permission was granted by the occupying military force and not any recognised archaeological authority; this is not permission in any meaningful sense. Neither is there any hint that the excavation is rescuing endangered heritage. The excavators state that volunteer students can take home to America pottery sherds that are not needed for analysis, which under the aforementioned international law is illegal. The subject seems to imply that for Christians it is more important to investigate archaeology relating to the Bible than to practice archaeology professionally and to behave ethically within the constraints of national and international law.

Archaeologists are becoming increasingly aware of their role in demonstrating and fostering respect for heritage in both sponsoring and host countries. These matters are often directly related to people’s own self-image and identity. The use of archaeology for unsophisticated political or theological aims may extinguish any positive social influence it may afford. The ethics governing the handling of antiquities and excavating in foreign countries is at the core of professional archaeology and respect for foreign owned and regulated heritage is essential for anyone travelling abroad. AR101 cultivates a colonialist attitude to antiquities and heritage and does nothing to

discourage the illegal practices such as those previously followed by the Museum of the Bible in Washington DC.

The awareness of people and place names used in AR101 may help students feel at home in the Israeli archaeological environment. There will, however, be many Israeli archaeologists who will want to distance themselves from this subject.

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Papers should generally be between 3,000 and 10,000 words. Papers should be set out with:-

- Title
- Author's Name
- Abstract of about 150 words
- Text with headings and subheadings, preferably not numbered.
- Author's name and affiliation/contact details
- Bibliography
- A short biography of the Author should be included.
- References should follow the Harvard convention of in-text referencing, for example (Smith 1997: 32). Endnotes may also be used.
- Bibliographic format is as follows:
Lambert, W.G. & A.R. Millard 1969 *Atra-Hasis: the Babylonian story of the flood*, Oxford: Oxford University Press.
Dever, William G. 1995 The Death of a Discipline, *Biblical Archaeology Review* 21 (5), 50–5.
Meyers, C. & E.M. Meyers 2013 Sepphoris, in Daniel M. Master ed. *The Oxford Encyclopedia of the Bible and Archaeology*, Oxford: Oxford University Press Vol 1, 336–48.
- Captions for any illustrative material should follow.

Book Reviews:

Book reviews should be between 800-3000 words. They should begin by referencing the book to include author, title, publisher, date, ISBN, pages, illustrations, cover type and price. The review should conclude with the name and affiliation/contact details of the reviewer.

Brief Communications:

Brief communications should have less than 3000 words and should address a specific issue or describe a particular situation. The arrangements for papers should be adopted.

Address:

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