Buried History

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2023 Volume 59

Buried History

Buried History is the annual journal of the Australian Institute of Archaeology. It is an open access journal that does not charge article processing fees and publishes papers, subject to double-blind peer review, short articles and reviews. The intended readership includes both academic researchers, teachers, and those with an informed interest in ancient history, archaeology and heritage. It publishes articles relating to the history of the Mediterranean, Western Asia, North Africa, involving archaeology, epigraphy and the biblical text. It also publishes papers about the history of archaeology more generally.

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Cover Image: An ancient sketch of a metalworker using a blowpipe to melt copper in a crucible from the Fifth or Sixth Dynasty Tomb of Ka-em-ankh at Giza. After: Junker (1940: 72–75, pl. 10).

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Editorial

This is the first edition of *Buried History* to be published online as an open access journal, free to readers and not charging article processing fees to contributors. The journal has a small endowment to cover the costs of preparation and the process is well defined, so that it is not onerous for voluntary staff. We have used Open Journal Systems software, created by the Public Knowledge Project, that provides a systematic procedure for handling submissions and managing publication.

The last twenty years of journal publication has been uncertain as digital systems have developed. It is now clear that the research community requires immediate, searchable publication of information that is made possible by using digital systems. The general readership and many academics, however, still appreciate the hardcopy, which they can read and handle at their leisure, and store on their shelves for casual reference, books remain important for modern human existence. *Buried History* will therefore continue to be published in hard copy for those who pay a subscription to cover printing and postage. During the last twenty years printing costs have not increased by very much, even with improved quality and the convenience of colour, while postage has increased over five times.

The first paper in this edition describes and discusses another modern practice, the repatriation of material culture collected previously by archaeologists. In this case, the gathering of the material was a form of rescue archaeology over fifty years ago. The collector, Will Rogers, was a devout Christian and, like many missionaries, was deeply concerned that Aboriginal material culture was being destroyed in one way or another without any record being made. As the paper describes, he collected the threatened artefacts, labelled and published them, and left some of them with the Institute to be returned to Coffs Harbour when practically possible. That happened in early 2023. The paper states that the Elders of the Gambaynggirr wanted no media involvement. The Institute was comfortable with that condition as the Australian national media seems bound to highlight disputation. This repatriation event, however, was a joyful coming together, which affirmed the importance of heritage and recognised all parties involved. The Institute is grateful to Dr Joanna Besley, who was the Senior Curator, Gallery & Museum, Cultural & Community Services, City of Coffs Harbour, and Uncle Richard Widders, also of the City of Coffs Harbour, for arranging the repatriation and writing about it for *Buried History.* The Institute also acknowledges the sound advice from Professor Mark Moore of the University of New England and New South Wales Heritage's John Duggan and Alexandra Simpson.

The paper on the Egyptian Old Kingdom metalworking industry draws together my research on the subject that has been carried out over nearly fifty years. While the concluding narrative is fairly comprehensive, the lack of reliable data means that the subject is still open to further interpretation. I am indebted to my co-author, Emeritus Professor Peter Hayes, for his insightful metallurgical assessments. The paper is offered to encourage more research and highlights the need for accurate analyses.

Some of the research on Egyptian metallurgy is in the hands of Dr Martin Odler, currently at Durham University. His 860-page book, *Copper in Ancient Egypt: Before, During and After the Pyramid Age,* is the subject of an extended review. Also reviewed by my colleague, Michael Lever, is Barbara Little's *Bending Archaeology toward Social Justice: Transformational Action for Positive Peace.* Neither book wraps-up their respective subjects, as it were, but they offer insights that will assist those who continue to investigate the respective subject areas.

The 2023 Petrie Oration was delivered by Associate Professor Andrew Jamieson, University of Melbourne. He has provided the text of the address with full documentation. Andrew has been a long-term supporter of the Institute and a regular contributor to *Buried History*. He has conducted archaeological research in Syria and more recently in Georgia. Andrew initially studied Fine Arts at the Royal Melbourne Institute of Technology with a focus on ceramics and was inspired to pursue archaeology at the University of Melbourne when he heard Ian Edwards speak about ancient pottery technology. Andrew and Ian have continued to share their interest in the history of ceramics. It was therefore most appropriate to celebrate Professor Ian Edward's contribution to the study of ancient ceramics and his forty years of service on the Institute Board at the 2023 Petrie Oration. Andrew's address places Ian's research on the pottery assemblage from Tell Ahmar, Syria, in context and an Addendum to the paper contains the citation for the Fellowship of the Australian Institute of Archaeology that was awarded to Ian on the night.

As always we recognise the service of the reviewers and those who contribute to the preparation of *Buried History*.

Christopher J Davey
DOI: https://doi.org/10.62614/r3a70564

The repatriation of the Will Rogers Collection to Gumbaynggirr country: A journey of cooperation and learning

Joanna Besley and Uncle Richard Widders

DOI: https://doi.org/10.62614/0cbx3y56

Abstract: In March 2023 Elders of the Gumbaynggirr community welcomed back to country a collection of 331 stone artefacts, sourced from beaches near Coffs Harbour in the late 1960s, that had been in the keeping of the Australian Institute of Archaeology for several decades. This paper describes the course of events preceding this occasion, which were not straightforward. The repatriation was significant for the Gumbaynggirr community and highlighted the changing sensibilities about collecting Aboriginal cultural material and the challenges faced in securing the return of cultural material to communities. The repatriation was positive for all parties involved and justified the time and effort required to see the project through.

Keywords: Repatriation, Aboriginal material culture, Gambaynggirr, Heritage NSW, Will Rogers, Moonee Beach,

Introduction

Repatriation has become an important practice for archaeology and museology. In this instance the staff employed by the local Council, the City of Coffs Harbour, including Coffs Harbour Regional Museum and Gallery (the Museum), found themselves steering the project, working collaboratively with Council's Yandaarra Aboriginal Advisory Committee, supporting Elders and other community members, informing Council colleagues and advocating to management, while also working in collaboration with the Australian Institute of Archaeology (the Institute) to facilitate the repatriation, Figure 1. Our experience showed that this repatriation was in essence a form of cultural restoration that required cooperation and a willingness to learn.

Country and context

Gumbaynggirr country lies along the Pacific coast of the mid-north coast of New South Wales, stretching from the Nambucca River in the South, to the Clarence River in the North, and the Great Dividing Range in the West. Country ranges from ancient rainforest on the elevated escarpment of the Great Diving Range across fertile river valleys and coastal plains to a shoreline studded with grassed headlands and beaches. The localities of Woolgoolga, Coffs Harbour, Urunga, Bellingen, Dorrigo, Nymboida, Nambucca Heads and Bowraville are today located on Gumbaynggirr country. The contemporary Gumbayngirr community is visible, vibrant and strong in culture, making positive contributions to social, cultural and economic life.

Figure 1: *Preparation of the smoking ceremony for the repatriation of the Will Rogers Collection on 1 March 2023. Image: C.J. Davey.*

Figure 2: *Moonee Beach, looking south from Look At Me Now Headland. Figure 3 would indicate that prior to the sand mining, the 'axe factory' midden was about where the people are standing. Image: C.J. Davey, March 2023.*

Gumbaynggirr language revival is particularly noteworthy, led by Muurrbay Aboriginal Language and Culture Co-operative in Nambucca Heads. The *Gumbaynggirr Dictionary and Learner's Grammar* has over 2700 words and local primary school children across the region are learning the language. Gumbaynggirr people are known as the 'sharing people' because their land was so rich in natural resources they shared freely with neighbouring clans and other visitors. Extensive middens along the coast attest to the great numbers of people who gathered there for thousands of years, feasting on seafood and other delicacies. Another important Gumbaynggirr cultural heritage site is what was known as the 'axe factory' at Moonee Beach, just south of Look At Me Now Headland, 13 kilometres north of Coffs Harbour, Figures 2 & 3.

The name Moonee is derived from the Gumbaynggirr *Munim-Munim*, meaning 'rocky'. In Gumbaynggirr language, repetition of a word signifies plenty, so *Munim-Munim* means lots of rocky places, reflecting the original importance of this place for making axes and other stone tools. This area, the headland in particular, is significant as a mythological and ceremonial site; a powerful place in the Gumbaynggirr homeland. It was a place of many camp sites, especially in winter when the sun was warm and the mullet ran along the coast, and with extensive areas where stone axes, choppers and scrapers were made, due to a plentiful supply of smooth, water-worn stones from nearby beaches and dunes.

In the late 1960s, sand mining began along the Coffs Harbour coast and the Moonee 'axe factory' was destined for destruction. The use of the terminology 'factory' indicates that this was an important place of manufacture. William Rogers, a local amateur archaeologist, described the site as 'an area approximately 325 metres long by 50 metres wide … characterised by many large and small knapped implements including uniface hand-axes and choppers … and layers of different kinds of shells, some animal bones, thousands of chippings and broken pebbles' (1977: 2).

As such, the site itself was of great significance as it demonstrated the practices, technical achievements and way of life of Gumbaynggirr people for thousands of years. There was no cultural heritage legislation protecting the site at that time and there was a broadly held view that Aboriginal culture was something of the past. An extraordinary 'salvage' operation ensued, with massive amounts of cultural material collected by professional and amateur archaeologists, historians including the Coffs Harbour and District Historical Society (the Historical Society), tourists and opportunists. The *Coffs Harbour Advocate* reported on 1 May 1968 that:-

> *Even now, there are barren squares of sand in the factory site where university teams have removed every pebble and shell to be transported away for study. Hundreds of axes have been taken officially*

Figure 3: *The midden, or 'axe factory', on Moonee Beach, looking north with Look At Me Now Headland in the background. Photograph: Will Rogers, January 1969, AIA Archive.*

> *to as far away as Adelaide and Sydney. The (historical) society believes hundreds more have been taken away by tourists—some by the sugar bag load (McCracken 1968: 3).*

The president of the Historical Society, George England, expressed regret about the destruction but told the *Advocate* 'Why should we try to prevent a half-a-million dollar industry starting, when these relics would probably have disappeared anyway in 8 to 10 years?' (McCracken 1968: 3). The society organised an expedition in April 1968 of 'over 250 members and friends' (Rogers 1977: 15) and collected numerous items, Figure 4. Some of this material was eventually displayed when the Historical Society opened the Coffs Harbour Museum in 1980. Other material made its way into private and public collections

Figure 4: *Coffs Harbour and District Historical Society expedition to the Moonee site. Photograph: Captain E.N. Fletcher 1968, courtesy of the Coffs Collections.*

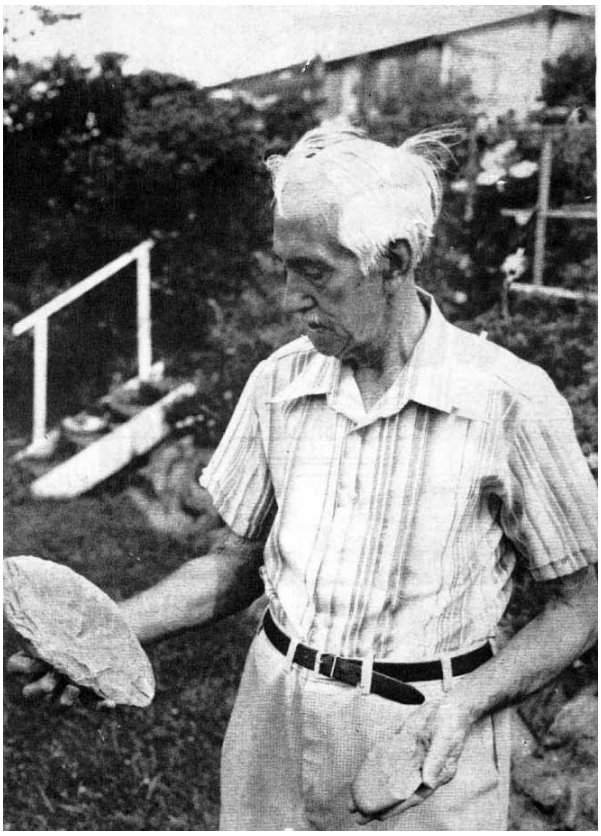

Figure 5: *Will Rogers. Photograph:* Coffs Harbour Advocate *1981.*

across the country, and locating it has been difficult, as discussed later. Some of the artefacts in the Will Rogers Collection (the Collection) appear to be wastage or debitage as they exhibit little evidence of use, although a comprehensive analysis is yet to be undertaken and it is likely that the manufacture and use of tools both took place at the site.

Will Rogers and his lifetime of collecting

William Rogers was involved with the Historical Society's expedition and later wrote that 'several excellent implements [were] found amid the chippings and broken pebbles [were] strewn about' (1977: 15). Rogers was a committed amateur archaeologist who spent much of his life collecting and studying the cultural heritage of Aboriginal people across Australia, Figure 5. He found his first artefact as an eight-year-old in Altona, Victoria and together with his wife Edith, went on to amass a significant collection. He retired from working in the tailoring industry in Melbourne in 1967 and moved to Sawtell, south of Coffs Harbour. Believing their collecting days were over, the Rogers donated their collection to various museums before they left Victoria. Nature intervened, however, and just prior to arriving at their new home, there was a massive storm accompanied by huge tides and lashing winds that left the coastline in a state of devastation. The Rogers found themselves collecting and researching once again, scouring local beaches for Aboriginal artefacts uncovered by this climatic intervention.

Over the next decade, Will Rogers organised their extensive new finds into geographic collections and documented them in a series of booklets published by the Historical Society and others. Twelve publications are listed by the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) in Canberra and six are now digitised on the Museum's digital collection platform, Coffs Collections https://coffs.recollect.net.au, Figure 6. Rogers regularly displayed these collections locally and gave many public talks. Regrettably, the covers of the booklets feature images of traditional Aboriginal people in Central Australia and the Northern Territory despite being about Gumbaynggirr material culture, and the language reflects the lack of sensibilities of the time. However, the booklets contain valuable detail, information, drawings and analysis of many different items found from Station Creek in the north to Sawtell in the south. The text indicates that Will Rogers had an abiding respect for Aboriginal people, their craftsmanship and skill, and was unhappy about the destruction of their material culture. He concludes 'a sand mining enterprise has moved in and completely wiped out the ancient Moonee midden. Not a dune, not a sea-shell, and not an implement remains to show the spot that was so important to the Aboriginal tribes for thousands of years' (1977: 15).

Will Rogers died in 1983 aged 81, having collected and documented extensive amounts of cultural material in the 16 years he lived on the Coffs coast (*Coffs Harbour Advocate*, Saturday 2 April, 1983). He had maintained his network with museums and other archaeologists, including friendships with staff at the Institute, to whom he entrusted some of his collection in 1978 (pers. Comm. C.J. Davey). The Institute neither accessioned nor displayed the material it received. For a period, some of it was stored at Macquarie University but it was not displayed there either. The number of objects reported in Rogers' publications far exceed those held by the Institute in 2020. In mid-1989, the Institute repatriated a significant amount of Gumbaynggirr cultural material to Boogilmar Aboriginal Ministries at Tabulam, near Casino, on Bundjalung country, which was at the time the only Aboriginal corporation on the north coast of NSW in a position to receive it. This material has now been located and its return to the Gumbaynggirr community is under discussion. The Collection that is the subject of this repatriation is the Rogers' material that remained in the Institute's possession after 1989. There was no awareness locally in Coffs Harbour of Rogers passing on his collections to interstate organisations, and there is nothing in the Museum's records that assists in understanding how it happened. Of critical importance, however, is that Will Rogers recorded the provenance by inscribing location on the objects themselves, which makes his collections clearly identifiable.

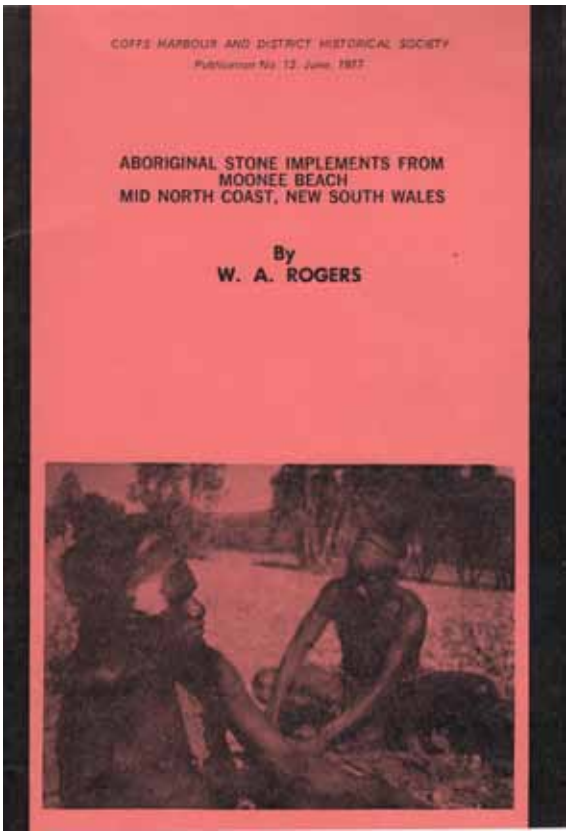

Figure 6: *Rogers' 1977 publication of the Moonee site.*

Locating collections and making connections

The Museum continued to display Gumbaynggirr cultural material alongside Aboriginal artefacts from other places. In 1996, the Museum was flooded and suffered damage to its collection and displays. This significant blow, along with the challenges of being run by volunteers with no ongoing funding, led to the demise of the Historical Society and in 2005 Coffs Harbour City Council took ownership of the collection and operation of the Museum. In 2009, the Museum was flooded again, this time catastrophically, and despite the valiant efforts of staff and volunteers, many collection items and records were lost. The Museum was permanently relocated and closed until 2014. Upon reopening, the Museum gradually gained more professional staff, however, this brief history highlights how collections, records—and indeed memories—about those collections, can be lost. The Gumbaynggirr community were, however, always aware that the Museum held some of their cultural material.

The Museum had around 14 archive boxes of stone tools, but with very little information about the items. Most were unmarked and records were scant, but it was understood that the majority had been collected from Moonee Beach, with a few other items donated by individuals at various points in time. In 2018, Museum volunteer Geoff Watts began to seek the location of the Will Rogers collections. Watts was a dogged and intelligent researcher, with a deep and imaginative understanding of local history and a strong commitment to the recognition and restoration of Gumbaynggirr history and culture. After months of persistent research, he located a Rogers collection at the Institute at LaTrobe University in Melbourne. He also identified other holdings of Gumbaynggirr material, possibly collected by Rogers, at the University of New England in Armidale and the Australia Museum in Sydney. Museum staff contacted the Institute and were delighted to receive a positive and encouraging response from its Executive Director, Dr Christopher Davey. In parallel, the Institute had also been trying to return the material to its rightful owners.

In May 2017, the Institute had approached the Coffs Harbour and District Local Aboriginal Land Council (the Land Council) about the repatriation of the Collection, to no avail. At the time there were changes to the leadership of the Land Council and there were other more pressing local issues, so the matter did not progress. Two years later, as a result of Watts' research, the Institute received a 'to whom it may concern' query and the repatriation negotiations restarted. The Institute provided the Museum with photographs of the 331 stone tools in its possession, all of which had Rogers' provenance identifying inscriptions: 71 came from Station Creek, 10 from Sandy Beach, 113 from Moonee Beach and 137 from Sawtell.

It was important for the Institute that the repatriation was carried out in a way that was lawful and would not give rise to legal action or complaint. As Davey stated, 'it was hoped that this would be a unifying event rather than generating disputation as sometimes happens'. Specifically, the Institute required that:-

- the objects be returned to the correct people,
- the repatriation comply with all legislative requirements,
- the objects be returned to a facility with professional curatorial processes, and that
- there be appropriate recognition of Will Rogers who had gathered and preserved the collection.

Collections and community come together

Collections are, of course, the specialisation of museums, so the time was right for Museum staff to work with the Institute and the Gumbaynggirr community to bring these collections back to country, as well as properly investigate what was in its own collection. The authors—a Museum curator and a Gumbaynggirr Elder and Aboriginal Community Planner respectively—worked together with Nat Redman, archaeologist in Council's environmental planning team, and invited members of Gumbaynggirr Elders' groups, the Land Council and Heritage NSW, to oversee the process of repatriating the Rogers Collection.

Museum staff met regularly with Gumbaynggirr Elders to deal with the items in the Museum's possession—

noting that the Museum recognised the stone tools as the property of the Gumbaynggirr community and had not accessioned them into its collection. Under the Elders' direction, Museum staff audited and documented the 218 stone artefacts in its possession; 164 had no provenance, 33 had provenance recorded in accompanying records, such as donation forms, and 21 were collected by Rogers, as they were inscribed identically to those held by the Institute. Members of the Gumbaynggirr community hold deep knowledge about these items and, over the months of consultation, Elders gave clear direction about how the collection should be managed. Firstly, Elders from specific clan groups would make decisions about the material collected from their own areas. For example, the Garby Elders would be responsible for objects found at Moonee Beach and north to Station Creek, while the Garlambirla Guuyu-girrwaa Elders would be responsible for Moonee to Coffs Harbour and Sawtell. Secondly, Museum items without provenance would need further research before final decisions could be made about their eventual home—everyone understood that provenance may never be established for the unmarked objects and therefore it may be difficult to return them to country.

As the community does not have a formal keeping place or land where they could establish one, there needed to be a safe place for immediate storage. The Elders were comfortable with the Museum remaining as caretaker, so a Deed of Deposit was prepared recognising Gumbaynggirr ownership of the objects already held by the Museum and those being repatriated from the Institute. As part of this arrangement, Elders also selected a small number of the items with provenance to display at a new museum, the Yarrila Arts and Museum (YAM) at Yarrila Place, which opened in Coffs Harbour on 16 September 2023.

Understanding and complying with legislation was another challenge. In New South Wales, the *National Parks and Wildlife Act 1974* determines that Heritage NSW and Aboriginal Land Councils are responsible for the repatriation of cultural material. Although these items were collected prior to the Act and are therefore not subject to it, all parties agreed to follow its provisions. John Duggan and Alexandra Simpson of Heritage NSW, at state and local levels respectively, provided support and expertise throughout the repatriation process. Ultimately, the formal transfer took place between the Institute and the Land Council, with documentation prepared by Heritage NSW. The Land Council and the City of Coffs Harbour signed a Deed of Deposit, prepared by Museum staff. Deeds of Deposit are increasingly favoured over formal donations in the collections sector as they are more consistent with the intent of the United Nations *Declaration on the Rights of Indigenous Peoples*, of which Australia is a signatory, with Article 31 recognising First Nations peoples' rights to 'maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions.'

While the Collection was not subject to the NSW legislation, Heritage NSW informed us that the repatriation needed to comply with Victorian legislation. They understood that the *Victorian Aboriginal Heritage Act 2006* required that the collection be registered in Victoria and a permit be granted, after the payment of a fee, before it could be removed from Victoria and repatriated to NSW. They also understood that the objects could not be returned without the approval of the Registered Aboriginal Party (RAP). The RAP for the La Trobe University area where the Institute is located is the Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation. The Gumbaynggirr Elders were somewhat indignant when they heard about the requirements as they were understood at the time. They were also concerned when informed, incorrectly as it turned out, that Victorian legislation required that the objects be collected from the Institute by the Wurundjeri Elders, who would then transport them to the Victorian-NSW border where they would be handed over to the Gumbaynggirr Elders after a smoking ceremony.

The Institute's Aboriginal collection had been checked previously by officers from Aboriginal Affairs Victoria who then advised that the Victorian Act did not regulate artefacts from inter-state. Subsequently, the *Aboriginal Heritage Amendment Act 2016* had altered the definition of *Aboriginal object*, which had related to 'the Aboriginal people of Victoria', to objects associated with 'Aboriginal people generally or of a particular community or group of Aboriginal people in Victoria' (clause 5 sub-clause 3).

The Institute contacted the Director of Heritage Services, First Peoples - State Relations, Department of Premier and Cabinet (previously Aboriginal Affairs, Victoria) to clarify the process. The Director of the branch determined that there was no relevant Victorian RAP for the area from which the objects originated so that the Secretary of the Department of Premier and Cabinet was the sole Approving Body. The fact that the matter needed to go to the Director of the branch indicated that this was not a common occurrence, and it emphasised the seriousness with which the Victorian Government treats such matters. The confusion also suggests that processes for returning ancestral and sacred material may have been conflated with cultural objects, which are potentially less sensitive. In October 2022 the Institute registered the Collection in Victoria and after paying a fee of $198.77, received a Cultural Heritage Permit in January to transfer it to New South Wales (CHP-0917).

In March 2023, the Institute's Executive Director delivered the collection in person to Coffs Harbour. A small gathering of Elders from the Garby and Garlambirla Guuyu-girrwaa groups, and staff from the Land Council, Heritage NSW and Coffs Harbour Council, including the General Manager and Mayor, was held, Figures 1 & 7. There was no media coverage on the request of the Elders. A smoking ceremony cleansed the items and welcomed

Figure 7: *Members of the Gumbaynggirr community at the repatriation event, Coffs Harbour. Left to Right: Lowanna Ferguson, Tina Powell, Aunty Deborah Dootson and granddaughter Harlo Dootson, Deakin Walker, Yvette Pacey and Nerina Ferguson. Photograph: Uncle Richard Widders, 2023.*

them back to Gumbaynggirr Country. It was a solemn and emotional event, with the joy of cultural objects being returned tempered by the enduring grief about loss of culture and land. The ambience was extraordinary as blue skies gave way to heavy black clouds and rolling thunder, widely interpreted by Elders as the presence of Uncle Mark Flanders, a champion of Gumbaynggirr culture and widely loved by the whole community, who died in June 2021. There was recognition of the Institute's support and persistence, as well as of Will Rogers' care and rigour and the role played by staff of the Council and Heritage NSW.

Conclusions

The repatriation of the Rogers collection from the Institute was a highly significant event. Will Rogers was a skilled, informed and careful collector and knew what to look for when faced with the destruction of an important cultural and archaeological site. He wanted Gumbaynggirr material culture to be preserved and understood into the future. In turn, the Institute kept his collection safe for decades and sought to return it to its traditional owners. By working with Elders, the Museum was able to bring relevant parties together to achieve the return. Heritage NSW brought together the parties with legal responsibilities and provided the required legal documentation.

It is hoped that this successful repatriation will pave the way for the establishment of a Gumbaynggirr keeping place and the return of more collections. Indeed, the process drew attention to the sheer amount of Gumbaynggirr cultural material that has been collected and distributed across personal and institutional holdings that could be returned. Resourcing of the Gumbaynggirr community so that they can manage these collections is of utmost importance. Further research about the artefacts themselves is another high priority and Will Rogers' work provides an invaluable foundation for this. The repatriation also required the Museum team to address the long-standing inattention to the items in its holdings and opened a dialogue with Gumbaynggirr Elders, resulting in a caretaking arrangement formalised through the Deed of Deposit. While the lack of provenance of some of the material in its care is an obstacle, Elders and staff recognise that there is scope for these items to be used in educational and other museum activities that will benefit the wider community. In establishing relationships of trust between the community and Museum staff, the repatriation demonstrated that collaborative partnerships bring optimum results. This important collection establishes a foundation for the realisation of the Gumbaynggirr community's aspirations for greater shared knowledge of their history and culture.

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The authors acknowledge the assistance of Alexandra Simpson, Heritage Officer, Environment and Heritage – Heritage NSW, Department of Planning and Environment, and Christopher Davey, Executive Director, Australian Institute of Archaeology in relation to the legislative procedures associated with the repatriation. We also acknowledge Yandarraa members, Nat Redman, Michelle Smith and Tina Lee who were unable to attend the repatriation ceremony.

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Appendix:

Repatriation ceremony attendees

City of Coffs Harbour

Paul Amos	Mayor
Natalia Cowley	General Manager
Uncle Richard Widders	Gumbaynggirr Elder and Aboriginal Community Planner

Coffs Harbour and District Local Aboriginal Land Council

Christopher Spencer	CEO

Environment and Heritage – Heritage NSW

Alexandra Simpson	Heritage Officer

Coffs Harbour Regional Museum & Gallery

Joanna Besley	Senior Curator
Shana Satyanand	Cultural Collections Officer
Madison Borgman	Digital Cultural Collections Officer
Debbie Campbell	Local Studies Librarian
Joan Kelly	Service Leader, Museum & Gallery

Gumbaynggirr Elders

Uncle Tony Dootson	Garby Elders Chair
Aunty Yvette Pacey	Garlambirla Elders Chair
Aunty Deborah Dootson	Garby Elder
Harlo Dootson	Garby Junior
Uncle Ian Brown	
Tina Powell	Garlambirla Elder

Smoking ceremony

Daniel Flanders
Matthew Brown
Narina Ferguson
Lowanna Ferguson
Deakin Walker

Australian Institute of Archaeology

Christopher Davey	Executive Director

Out of the Fiery Crucible: Egyptian Old Kingdom metallurgy

Christopher J. Davey and Peter C. Hayes

DOI: https://doi.org/10.62614/wmj1b145

Abstract: The evidence for Egyptian Old Kingdom metalworking is reviewed drawing upon archaeology, iconography, metallurgy, history, scientific data and process replication. The charateristics of arsenical copper are considered appropriate for making copper sheet. It is suggested that the ore was initially obtained from the southern Eastern Desert of Egypt where Pre- and Early Dynastic mines are to be found and where there may have been mining and metallurgical expertise amongst the regional nomadic people. C*haîne opératoires* are proposed for the fabrication of prestige copper vessels and for the production copper tools.

Keywords: Old Kingdom Egypt, mining and metallurgy, Pyramid Age metalworking, crucibles, arsenical copper, tomb decoration.

Introduction

The vital role that copper played in the construction of the stone pyramids of Giza and Saqqara places it at the centre of some of the most remarkable human achievements (Tallet & Lehner 2021: 68–83). It was one of several resources that were mustered and managed by a sophisticated organisation that was integral to the formation of the Egyptian state and the development of civil society (Tallet & Lehner 2021: 284–302). John Romer (2007: 169) estimated the weight of copper consumed during the construction of the Great Pyramid to have been about 290 tons. The supply of this resource and the processing of it into useful tools involved expeditions to potentially hostile non-Egyptian environments and the application of the most advanced technologies of the time.

The way Egyptians worked with copper during the Pyramid Age is depicted on the walls of at least nineteen tombs, but scholars have still not reached agreement about the processes being illustrated. Jack Ogden (2000) does not consider the images, while Andreas Hauptmann (2007: 220) suggests that they may portray smelting, although the scenes show molten metal being poured from crucibles, a smelting process that was not realised before the next millennium. Hermann Junker (1958) and Bernd Scheel (1985: 128) correctly describe the scenes to be about melting and casting, but the technological details of the process were not well understood by them.

This paper aims to explain the ancient technology and discuss its origins using archaeological evidence, iconographic images, metallurgical technology and process replication. Christopher Davey has published papers about the subject for over forty years, and with publication of Martin Odler's recent tome *Copper in Egypt* (2023), it is time to draw them together into a coherent narrative. In so doing the evidence is clarified and interpretations are revisited in the light of ongoing research, and an historical context for the development of Old Kingdom metallurgy is explored.

Figure 1: *An image of a crucible being carried by a metalworker from the Fifth Dynasty tomb of Nebemakhet at Giza, drawn by James Burton in about 1824. Note Figure 9 for a later drawing. From: J. Burton, British Library, MSS 25621 (1824-39), 87, courtesy of the British Library.*

Scholarly comment has often assumed that the metallurgical processes used during the Old Kingdom were common in other periods, but that is not necessarily

Figure 2: *The Early Dynastic crucible discovered at Elkab in 2015, field registration number E15/T3/101/1, dia. 118 mm, ht 82 mm, wt 462 g. Image: © Belgian Archaeological Mission to Elkab, used with permission.*

the case. The *chaîne opératoire* is rarely the same from one period to the next as the available resources vary, the technology develops and the political, social and economic demands and constraints alter. The evidence relied on by modern scholarship also changes. The 1824 drawing of a metalworker carrying a crucible in Figure 1, for example, was later redrawn at least twice from the tomb wall with less precision because of the deterioration of the relief itself or more casual drafting (Lepsius 1842–45: pl. 13; Hassan 1943: 140, fig. 81). Scholars relying on these later works therefore do not see the details as originally portrayed by the tomb artist.

Background

Archaeometallurgy has normally focussed on the analyses of metal artefacts and slags. However, the equipment employed in metallurgical processes, which in the ancient world was often made from ceramics that sometimes appear in the archaeological record, is also valuable evidence. Indeed, the metalworking activities depicted on the walls of Old Kingdom tombs illustrate crucibles, blowpipes, hammerstones, moulds and so on. The crucible shapes shown are especially enigmatic and are not known from more recent metalworking practice.

Complete examples of such crucibles were excavated by Lamia Al-Gailani at the Isin-Larsa Period site of Tell edh-Dhiba'i in Baghdad, where she had discovered a remarkable coppersmith's workshop (Al-Gailani 1965; Moorey 1994: 265–68). However, the visual link with metalworking practice in Old Kingdom Egypt was not made until ten years later when Davey studied the collection (1983). Al-Gailani's publication (1965) of the workshop included a report by W. Winton of the Science Museum, London, who identified the metalworking objects from photographs supplied to him. Using photographs, rather than the objects themselves, put him at a distinct disadvantage. He did not recognize one of the earliest known broken lost-wax moulds, nor the axe head pattern and core, which were the earliest evidence for sand casting, and he proposed a crucible operating system that was not possible in the Early Bronze Age. But he did identify the blowpipe nozzle and the pot-bellows, which became the subject of further studies (Davey 1979; 1988; de Jesus 1980).

The scholarly world remained sceptical about the Tell edh-Dhiba'i crucible shape being the same as those depicted in the Old Kingdom metalworking scenes. One of the few justifications for the scepticism was immediately offered by Laurence Garènne-Marot (1985), who drew attention to the chronological difference between Tell edh-Dhiba'i and Old Kingdom Egypt, and the fact that no such crucibles were known from Syria, or Egypt for that matter. Only the Mesopotamian archaeologist and Ashmolean Museum keeper, Roger Moorey, took the unique Tell edh-Dhiba'i metal workshop collection seriously, referring to it as 'by far the best identification of a workshop' (1994: 265–71).

In the spring of 2015, the Elkab excavation in Upper Egypt discovered a complete crucible, Figure 2, on the floor of a Second Dynasty building that had the shape and size of the Tell edh-Dhiba'i crucibles, and those depicted in the Old Kingdom tomb scenes (Claes et al 2019). The unearthing of such an object in a well-defined locus in a metalworking precinct of a major Old Kingdom Egyptian town may have been expected to decide the matter. However, according to Odler 'conclusive evidence is yet to be found' to confirm that metal workshops used these crucibles as depicted (2023: 276). This paper

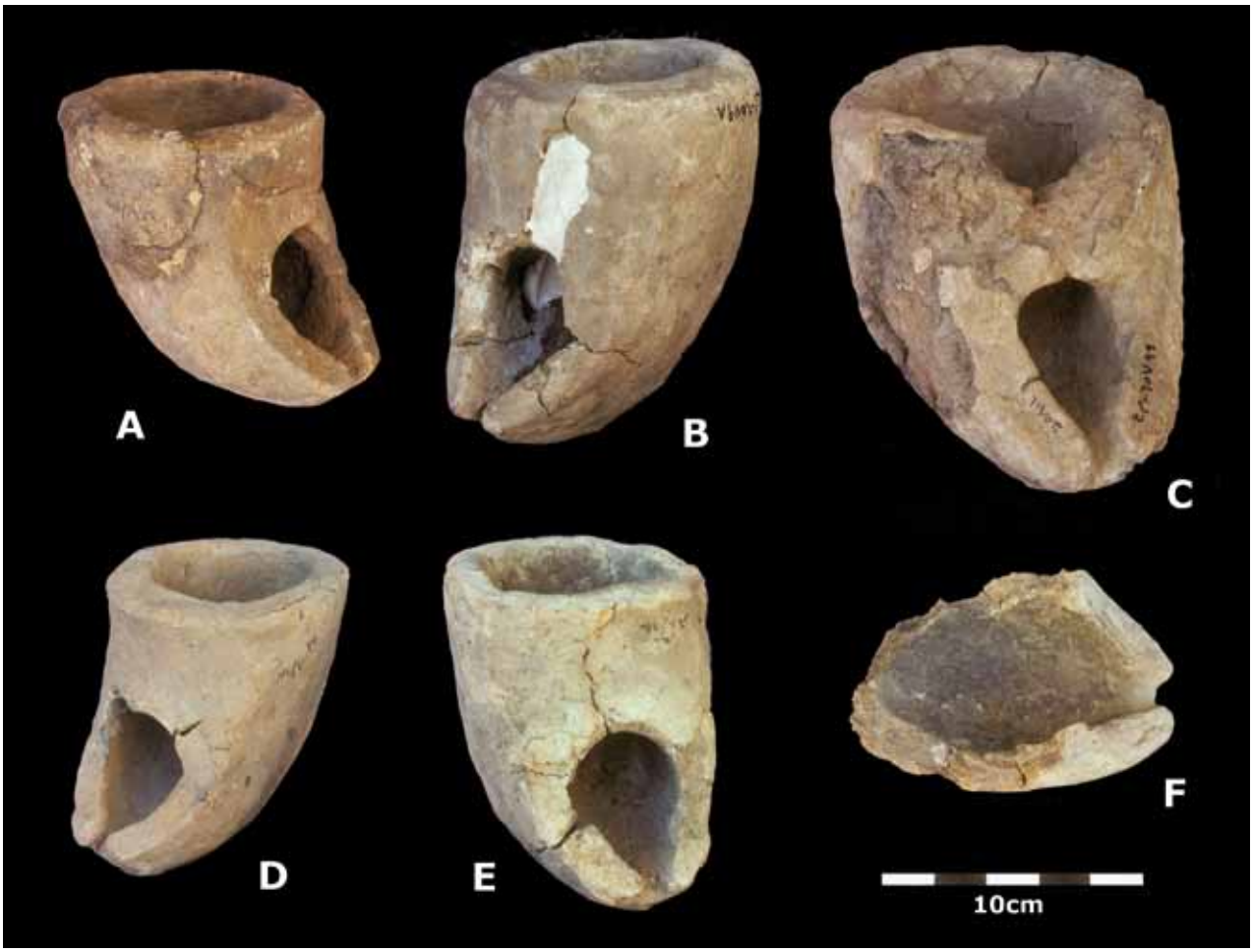

Figure 3: *The five crucibles and one crucible fragment found at Tell edh-Dhiba'i: A. 614/3 (IM65797) 100 dia. x 110 ht; B. 614/4 (IM65798) 110 dia. x 150 ht; C. 614/5 (IM65799) 130 dia. x 140 ht; D. 614/6 (IM65800) 90 dia. x 110 ht; E. 614/7 (IM65801) 100 dia. x 120 ht; F. 614/8.*

addresses the technological issues of Old Kingdom copper metalworking, while another paper will offer translations of the texts associated with the tomb metal melting scenes, to suggest that the evidence is convincing (Ockinga & Davey, In preparation). One impediment to the understanding of Old Kingdom metalworking has been the enigmatic and asymmetric shape of crucibles used at that time. A three-dimensional rendering of the Elkab crucible may be found at https://aiarch.pedestal3d.com/r/bNp8ThcV9o?studio=true.

The crucibles from Tell edh-Dhiba'i

Five complete crucibles and one fragment were discovered at the Isin-Larsa period site of Tell edh-Dhiba'i, Figure 3 (Davey 1983). The collection provides a comprehensive introduction to the fabrication, operation and life cycle of this type of crucible. While the external dimensions of the crucibles vary, the internal sizes and shapes are uniform, revealing that the crucibles were made over two similar horn-shaped armatures. Crucibles A and D appear to be unused. They are made from a coarse clay fabric levigated with straw, which was burnt out when they were fired to about 700°C, producing an open and heat resistant ceramic. The thick evenly coloured ceramic section of Crucibles B and C indicates that they were made from sun-dried clay. Crucible C has 3 cm thick walls and the sloughing-off of the ceramic is a further indication that it was made from sun-dried clay. Crucible F fragment reveals that when this crucible type fails, it forms a shape that has the appearance of a broken bowl-shaped crucible.

Crucible E had been used extensively: it was very fragile and was nearing the end of its useful life. The repeated melting of copper (1080°C) had produced a friable white silica-rich ceramic around its front opening and on its internal base. If it had broken, it may well have formed the shape of Crucible F fragment. Later experiments with replicas of this type of crucible confirmed that this was the normal failure pattern (Davey & Edwards 2007).

In summary, the information derived from the Tell edh-Dhiba'i crucibles was that the:

- crucibles will not retain a liquid when upright,
- seat of the fire was inside the crucible,
- crucibles were used repeatedly until they failed,
- crucibles tended to fail by breaking horizontally across the lower section,
- crucibles were made from a refractory and insulating but weak ceramic,

Figure 4: *A map of sites referred to in the paper. Map base: from Google Earth.*

- new crucibles were fired lightly to about 700ºC or were made from a thicker sun-dried clay, and
- crucibles had a common internal size and shape, indicating that they were made over a horn-shaped armature.

The creation and operation of these crucibles required expertise and skilful manipulation, which must have been acquired from by a well-defined craft tradition. That tradition appears to be depicted in several Old Kingdom tomb reliefs. Davey's publication of the Tell edh-Dhiba'i collection (1983) drew specific attention to the metalworking scene from the Sixth Dynasty Tomb of Mereruka at Saqqara as an exemplar for the operation of this type of crucible.

Evidence from tomb images

From the Fourth to the Sixth Dynasties, a period of about 150 years, nineteen Egyptian tombs from Giza to Luxor are known to have images portraying metal working (Davey 2012). The scenes are not very common when compared to the large number of decorated tombs from that period. Some scholars have argued that the images were copied from a pattern book, and that there is no evidence that tomb scenes were a realistic record of contemporary Egyptian society (Malek 1999: 128). Yet, in this case the tomb artists drew crucibles of an enigmatic shape, then known only in Old Kingdom Egypt, on tomb walls once every decade or so. If these scenes were in a pattern book, they should be far more common.

The completeness and physical condition of the metalworking scenes vary. Five nearly complete series of scenes are shown in Figures 5, 9–12. The Sixth Dynasty Tomb of Mereruka, the vizier to king Teti, at Saqqara has a complete metalworking sequence, showing weighing, melting, casting and hammering, Figure 5. The sequence is left to right and begins with the weighing of the metal feedstock by a balance operator, and the recording of the result by the *Overseer of the Workshop*, *imy-r pr* (Hannig 2003: 96). Above the next three scenes are images of metal vessels illustrating the products that were to be made from the metal sheet being manufactured by the metalworkers; there is no ambiguity about the intention of the *chaîne opératoire*. It is significant that the Old Kingdom metalworking tomb scenes portray the making

Figure 5: *The metalworking scene on the East wall of Chamber A3, the Sixth Dynasty Tomb of Mereruka. Image: the author, see also Prentice Duell (1938: pls 29–33) and Naguib Kanawati et al. 2010 (pls 20–21, 74–75).*

Figure 6: *The Melting Scene, Tomb of Mereruka.*

Figure 7: *The Casting Scene.*

of metal sheet for the fabrication of prestige vessels, and not the casting of metal tools for tomb construction.

The melting scene, Figure 6, has six operators pointing their blowpipes at the front openings of two crucibles. The fire was inside the crucible, not under it. The crucibles have a profile similar to those found at Tell edh-Dhiba'i, and are in upright positions placed back-to-back with a lid on top of them. The lid retained heat within the crucibles and regulated the oxidising-reducing atmosphere in them. The operators had one hand by their mouths to cover the blowpipe orifice as they drew breath. Three operators exhaling in succession would have generated a fairly constant air stream. The disjointed portrayal of the operators' legs is probably meant to indicate that they were very close together, so that their blowpipes could be aimed directly into the crucible.

The casting scene, Figure 7, has a metalworker carrying the crucible at knee height with the aid of two wads of something like damp clay. A second metalworker pokes the hole in the front of the crucible and a stream of molten metal pours out. Some modern observers find this scene hard to believe, but other tomb scenes, Figures 9–12, depict the same practice. The crucible was made from an insulating fabric and the seat of the fire was inside at its base, so that the external temperature of the upper body of the crucible was probably less than 200°C, a temperature that could be managed with the aid of insulating pads. Most representations show the crucible in profile, and the hands holding it, in front view. This convention portrayed explicitly the crucible profile and the carrying technique.

All of the scenes show crucibles being used in an upright position so, to hold a liquid, they needed a barrier near the spout, Figure 8. The depiction in the Tomb of Mereruka casting scene of a metalworker poking the crucible to dislodge the barrier and to let the molten metal discharge confirms that this was how the crucibles were used. This approach was adopted in the publication of the Tell edh-Dhiba'i workshop tools (Davey: 1983), and contrasted with the earlier tipping proposal by Winton (Al-Gailani 1965). The barrier could only partially cover the hole in the front of the crucible, as there had to be space above it to aerate the fire inside. This limited the amount of copper that could be contained in the crucible to about 50 ml, an amount that was manageable by people using blowpipes and no protective equipment. Experiments have shown that the operation of the barrier was not straightforward, but it did skim off dross and charcoal floating on the metal surface, which would otherwise have spoilt the

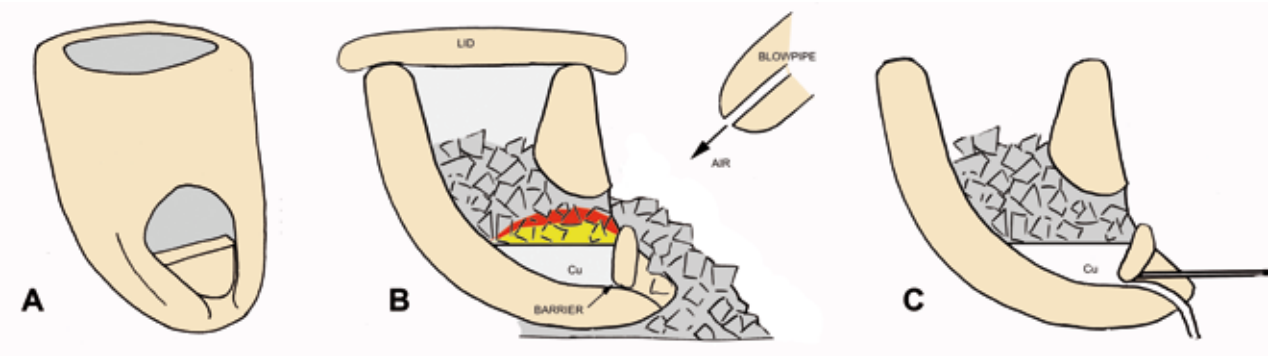

Figure 8: *A drawing of the proposed operation of an Old Kingdom crucible showing the configuration of the blowpipe, copper charge, charcoal and the barrier. A. General view, B. Melting, C. Casting.*

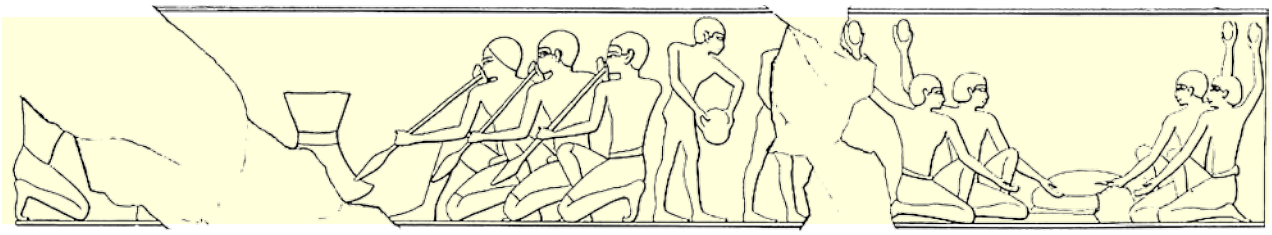

Figure 9: *The metal working scene from the Fifth Dynasty tomb of Nebemakhet at Giza, but note Figure 1. From: Lepsius (1842–45: Text 2, pl. 13).*

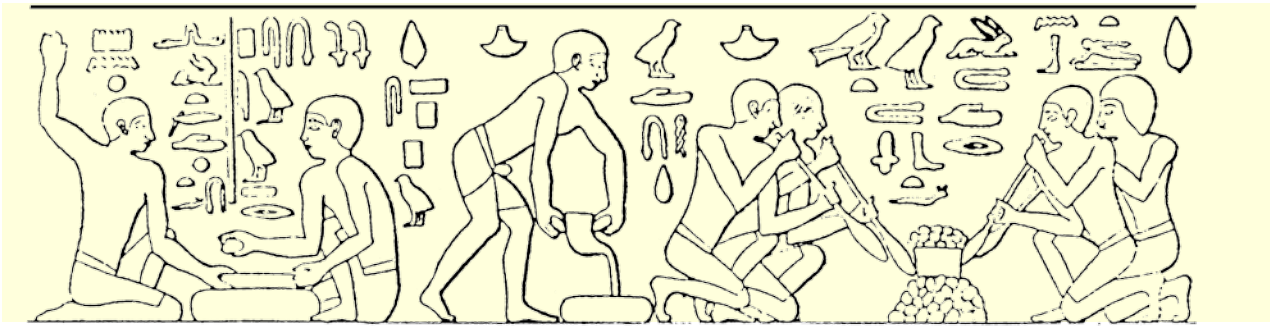

Figure 10: *The metal working scene from the Fifth Dynasty tomb of Wepemnefert at Giza. From: Hassan (1936: fig. 219).*

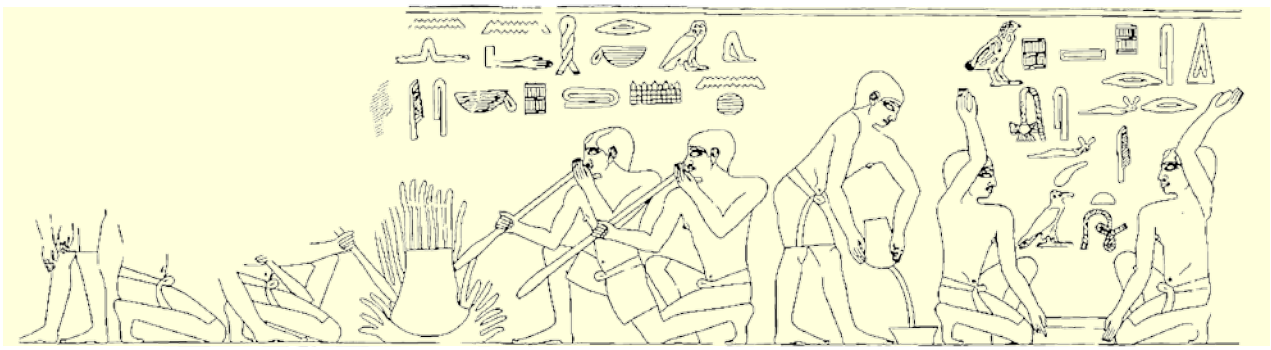

Figure 11: *The metal working scene from the Fifth Dynasty tomb of Ty at Saqqara. From: Wild (1966: fig. 173).*

Figure 12: *The metal working scene from the Sixth Dynasty tomb of Pepyankh: Heny-kem at Meir. From: Blackman and Apted (1953: pl. 16).*

casting (Davey & Edwards 2007). The crucible operating configuration at Tell edh-Dhiba'i proposed by Davey (1983: fig. 6) was devised to incorporate the pot-bellows, but subsequent research has led him to question some aspects of that reconstruction.

The tomb scenes show that the molten metal was not poured into a mould, but onto a flat surface where it flowed out and, as depicted in the fourth scene Figure 5, was hammered as it cooled to form a sheet of approximately 20 cm diameter and 1.5 mm thick. The shape of this sheet may have been the origin of the 'drop' hieroglyphic ideogram, 𓎛 X3-like, one of the two signs for copper, metalworker and crucible (Odler 2023: 78–79). The other signs were the profile of the crucible, 𓌂 N34, or double crucible, 𓌃 W13. It should be noted that the Gardiner Sign list misidentifies these signs (Junker 1958; Davey 1985; Odler 2023: 67–96).

None of the metalworking depictions are identical, however it is possible to identify consistencies and to explain most variations, Figures 9–12. All metal working scenes show that the blowpipes were directed at the front of the crucible to ventilate the seat of the fire above the metal charge inside the crucible, not under it. All scenes have two or three blowpipe operators. Some of the scenes show the crucible being carried and the molten metal being discharged from about knee height onto a flat surface, where it was hammered into a sheet.

The differences in the depictions from one tomb to another are also significant. The 'furnace' in Nebemakhet, Figure 9, is comprised of two back-to-back crucibles similar to that of Mereruka, except that the cover has a different shape, which is not dissimilar to an inverted Clayton ring (Bobrowski & Mączyńska 2020) (https://artsandculture.google.com/asset/a-desert-enigma-clayton-rings/-QGps3wj7Ps5IA). The Wepemnefert scene, Figure 10, shows the crucibles surrounded by charcoal. This depicts what an observer would have seen, and is a *Realistic* style, rather than the *Technical* or *Didactic* style found in the tombs of Mereruka and Nebemakhet, where the coals were stripped away to reveal the back-to-back crucibles that formed the furnace (Davey 2012: 95). The furnace in the tomb of Ty, Figure 11, has what appears to be flames coming from the crucibles. This is a third style of depiction, which may be called *Naturalistic* because it conveyed the atmosphere of the environment; in this case the 'flames' indicate that the crucibles were radiating heat, not that the fire was under the crucible. Many later metal working scenes adopt the Naturalistic style.

The scene in the tomb of Pepyankh, Figure 12, shows quite a different shape of crucible. It is proposed that this crucible was made from sun-dried clay and, like the sun-dried clay crucibles at Tell edh-Dhiba'i, it had an internal shape like most Mereruka-shaped crucibles, but it was bulkier. Such a design had advantages but was less portable. This is a Realistic style of depiction. The portrayal of the metal workers hammering is also notable. Both Realistic style scenes, Wepemnefert and Pepyankh, depict one person with the hammering hand-held high while the other person was about to strike the metal, showing that they were operating reciprocally, taking it in turns to strike. This is in contrast to the Technical style in the tombs of Mereruka and Nebemakhet, which show all foundrymen with their hammering hands above their heads, indicating the hammering stroke was the maximum possible extent.

To explain the rationale behind the use of a crucible that would not normally retain a liquid, it was proposed that the primary function of the crucibles was the refining of slag-rich copper concentrate that derived from the low-temperature and inefficient smelting process used at that time (Davey 2018). John Merkel (1983; 1990) explored this aspect of metallurgy in a New Kingdom context. However, the absence of slag in the crucibles from Elkab and Tell edh-Dhiba'i indicates that these crucibles were not used for slag-rich copper. Instead, it seems that the hole in the front of the crucible enabled the process to be monitored so that casting could be carried out as soon as the metal melted, thus conserving charcoal by not generating unecessary heat, and minimising the oxidation of copper and the loss of useful impurities such as arsenic.

A metalworker image and statue

A sketch from the burial chamber of the Fifth or Sixth Dynasty Tomb of Ka-em-ankh in the West Field at Giza provides more evidence, Figure 13 (Junker 1940: 72–75, pl.10: PM III/^{2}131–33; G4561). It depicts a single metalworker with a blowpipe ventilating an upright crucible that appears to have a 'Mereruka' shape (Davey 2009: 42, fig. 4; 2012: fig. 6). The blowpipe is directed toward the front of the crucible, which according to the accompanying inscription contained copper. The simple outline conveys the appearance, atmosphere and energy of the scene. The figure was drawn from a three-quarter view, which contrasts with the traditional frontal and profile views of Old Kingdom Egyptian art. This image would not have appeared in a pattern book and reveals that the tomb artists were skilful draftsmen who had the capacity to draw from the reality that they knew.

Figure 13: *An ancient sketch of a metalworker in the Fifth or Sixth Dynasty Tomb of Ka-em-ankh at Giza. From: Junker (1940: 72–75, pl. 10).*

***Figure 14**: The small servant statue of a metalworker in the University of Chicago's Institute for the Study of Ancient Cultures Museum, OIM 10631, ht 110 mm, l. 100 mm, w. 50 mm. Courtesy of the Institute for the Study of Ancient Cultures, The University of Chicago.*

The collection of late Fifth or Sixth Dynasty servant statues probably from Giza and now at the University of Chicago's Institute for the Study of Ancient Cultures contains a small statue of a metalworker (Davey 2009). The collection was acquired in 1920 and published by James H. Breasted jnr (1948). The metalworker is operating a blowpipe, which is directed at the front opening of a 'Mereruka' shape crucible, Figure 14. The small statue is painted and shows the area around the tip of the blowpipe, which is almost inside the crucible, to be bright red, indicating that it was hot, Figure 15. The statue provides a 3D representation of the 'Mereruka' shape crucible and operator.

It is significant that the statue portrays the crucible to be tilted backward. From the time that these crucibles were first encountered by Al-Gailani and Winton, this was deemed to be the logical way to use them. However, all depictions of the crucible, other than this statue, show the crucible being used in an upright position. It was therefore suggested that the tomb scenes show the melting of copper for the fabrication of prestige vessels, while the small statue represents the common way that Old Kingdom metalworkers melted copper and recycled copper to produce tools (Davey 2009). Hundreds of tonnes of copper were cast and recast into tools and the most efficient way to do that was to use the 'Mereruka' style crucible, which concentrated the heat, conserved charcoal, and facilitated the pouring of the molten metal. It was also suggested that this form of crucible developed into the shape that is well known from the First Intermediate Period and Middle Kingdom, where the hole in the front was retained, but the base was formed into a bowl, Figure 19 Crucibles D–F, so the crucible could retain a liquid (Davey: 2009).

***Figure 15:** Crucible detail of the small servant statue of a metalworker, OIM 10631. Courtesy of the Institute for the Study of Ancient Cultures, The University of Chicago.*

Egyptian Old Kingdom crucibles: Elkab and Elephantine

In the spring of 2015, the excavation at Elkab in Upper Egypt sponsored by the Belgian Archaeological Mission of the Royal Museums of Art and History in Brussels, discovered a complete crucible of the shape and size of the Tell edh-Dhiba'i crucibles and those depicted in the Old Kingdom tomb scenes, Figures 2 & 19 Crucible A. It was discovered upside down on the floor of a Second Dynasty building with a collection of other objects (Claes et al. 2019). The crucible had been used and was still operable when it was left where it was found nearly five thousand years later. Radiocarbon dates of associated material between 2850 and 2536 BC confirm the Second Dynasty date. It is not clear why the crucible was not retrieved from the debris of the collapsed building, as it was a valuable piece of equipment for metalworkers.

The crucible has fragments of copper on the base, indicating that it had been used in an upright position as portrayed in the tomb scenes. It has no slag or vitrified ceramic inside it.

Figure 16: *Smelter feed from Elkab. The sample consists of green malachite in a quartz host rock with a brown mineral formed from decomposed pyrite-arsenopyrite. Courtesy of the Belgian Archaeological Mission to Elkab, used with permission.*

The assemblage found with the crucible included a stone pounder (E15/T3/102), a small cup (E15/T3/100/1), a Clayton disk (E15/F-06), a fossilized aurochs axis vertebra (E15/T3/99), an oval ceramic vessel (E15/T3/97/1) and a quartz pebble, which together with the metalworking context are significant (Claes et al. 2019: 36 fig. 8). The Clayton disk may have been a lid for the crucible used to regulate the oxidising-reducing conditions in the crucible. These objects are well-known from the Western Desert and Western Sudan, where there is little or no metallurgy, so it is unlikely that there was a long-term dedicated relationship between the two object types (Riemer & Kuper 2000; Claes et al. 2019: note 27). It is interesting that a Clayton disk was also found at Elephantine (Kopp 2006: pl. 29 no. 459). The vertebra may have been used as a support for the crucible. Also found in the vicinity of the building containing the assemblage were small chunks of malachite, possibly smelter feedstock, Figure 16, and a copper-slag piece of smelter product, Figure 17. These offer potentially important analyses.

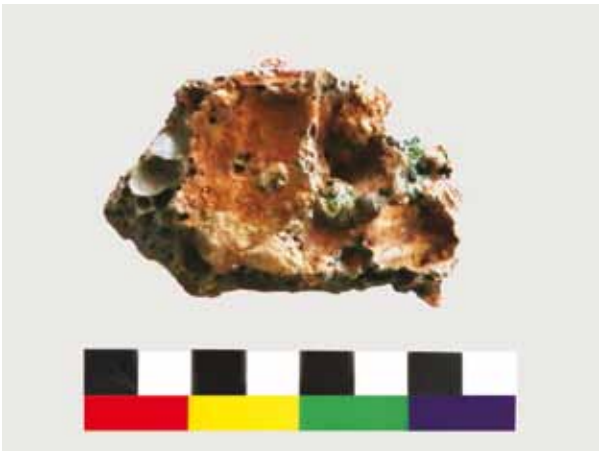

Figure 17: *Smelter product from Elkab. Prills of copper encased in slag. This would have been ground up to separate the copper from the gangue. Courtesy of the Belgian Archaeological Mission to Elkab, used with permission.*

The German Archaeological Institute excavations at Elephantine discovered a crucible fragment in a First Dynasty industrial context, Figure 18 (Kopp 2006: 32, fig. 12). Although comparatively large, it does conform to the profile of a broken 'Mereruka' crucible type, Figures 18 & 19 Crucible B. Indeed, when publishing it, Peter Kopp referenced the Mereruka metalworking scene. Odler's description of it as an open bowl crucible fragment is incorrect (2023: 269). This find is important because it reveals that the technology later depicted in Old Kingdom tombs was in the Nile Valley from the beginning of Dynastic Egypt. It also raises the possibility that metalworking may have influenced the unification of Egypt.

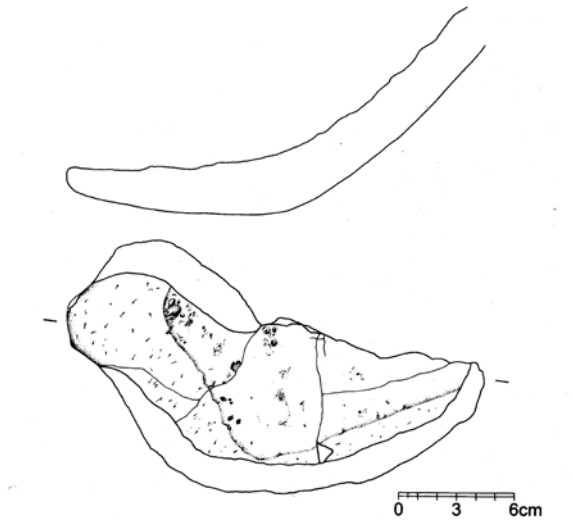

Figure 18: *The First Dynasty crucible fragment found at Elephantine. From Kopp (2006: fig. 12).*

Process replication

Two series of experiments using replicas of Mereruka style crucibles and copper were conducted, the first at the Royal Melbourne Institute of Technology and the second at the Australian Institute of Archaeology (Davey & Edwards 2007). The crucibles were made by shaping a sheet of clay over a horn-shaped pattern, Figure 20.

The first series of experiments failed to operate the crucible effectively. The barrier became welded to the body of the crucible, revealing the importance of using refractory clays that do not vitrify easily, and to conduct

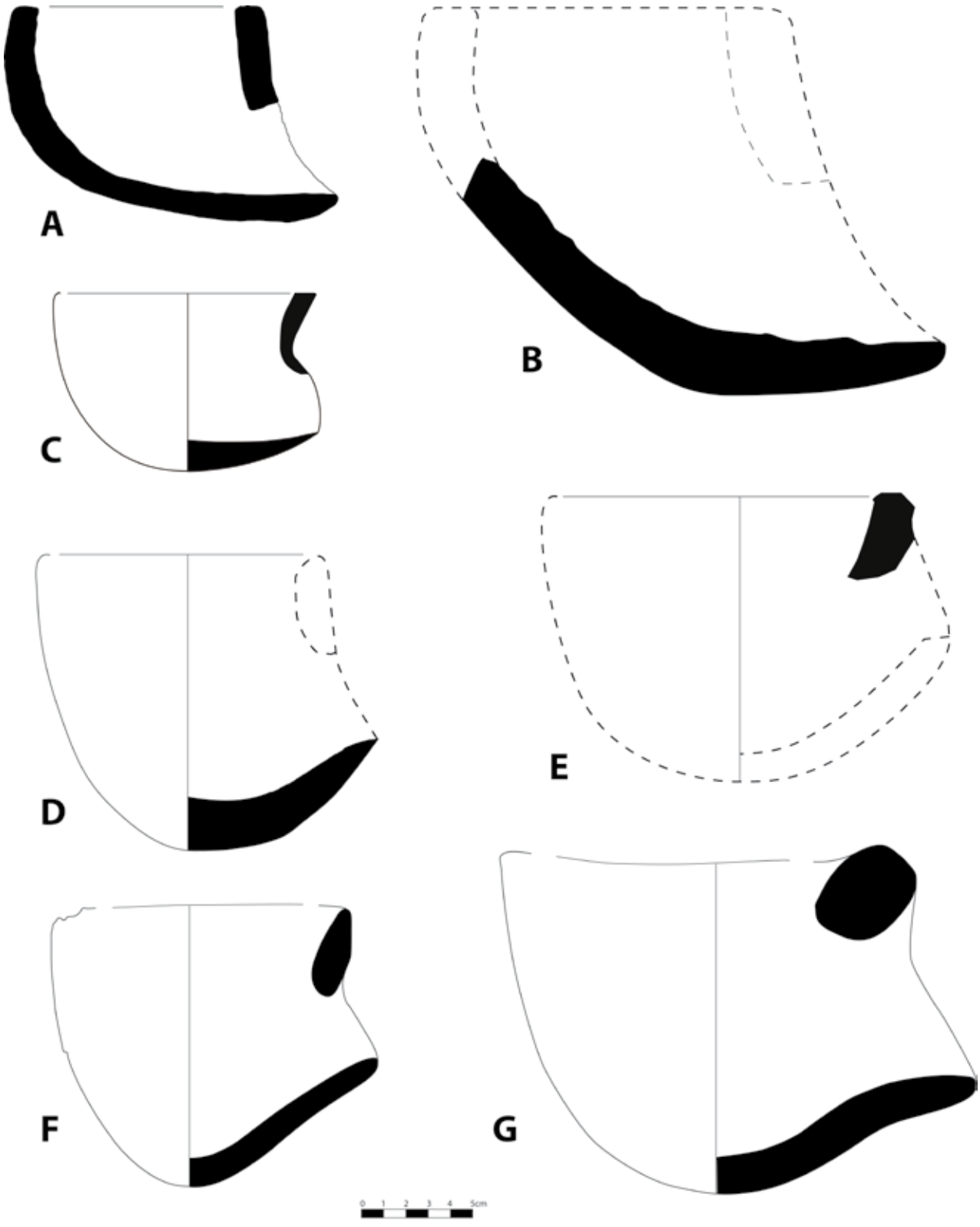

Figure 19: *A number of different crucible shapes showing the change from the Old Kingdom through to the Middle Kingdom. Crucibles A, B and C required a barrier to enable to the crucible to retain a liquid. Crucibles from the First Intermediate Period and after (D, E, F, and G) could retain a liquid without a stopper. A. Elkab E15/T3/101/1, after Claes et al (2019: Fig. 2); B. Elephantine, after Kopp (2006: fig. 12; reconstruction C.J. Davey); C. Buhen, UC 188.2, after Emery and Kirwan (1935: pl. 14.xxii); D. Buhen, UC 21748, (drawing: C.J. Davey); E. Ayn Soukhna Crucible no. 4, after Abd el-Raziq et al (2011: fig. 133); F. Badari, UC 18146, after Davey (1985b: fig. 1.5); G. Serâbîṭ el-Khâdim, Sinai, UC 8901, after Davey (1985b: fig. 1.6).*

Figure 20: *The forming of the crucible using a horn-shaped pattern. From Davey and Edwards (2007).*

the melting quickly to limit the propagation of heat throughout the crucible. Attempts to remove the barrier broke the crucible forming the shape of the Tell edh-Dhiba'i crucible fragment F, Figure 3.

The second series was conducted with a faster and more focussed jet of air and the use of cow dung to secure the barrier, Figure 21. A stream of air was supplied mechanically through a nozzle and the internal temperature was measured by a thermocouple. The copper charge was melted and poured out after the barrier was dislodged.

The time-temperature graph is significant, Figure 22. Charcoal was an excellent fuel, raising the temperature to 900°C after about eight minutes. It then drifted for twenty-two minutes, before rising to 1100°C, where it again levelled out. The crucible had been previously fired to 900°C, completing all ceramic reactions associated with that temperature range. So when it was heated up to that point it did not absorb very much heat, however, as the temperature rose above 900°C the crucible ceramic required a significant amount of heat to drive a reaction involving the dehydroxification of the clay. This is an endothermic reaction, and once completed in the ceramic adjacent to the metal charge, the temperature rose quickly again until it reached the melting point of copper (1085°C). The reaction in the ceramic is irreversible, so that when the crucible was used again, it did not need the extra heat associated the reaction in the ceramic. Ancient crucibles that had been 'broken-in', so to speak, required much less heat and were therefore reused until they disintegrated. They were valuable pieces of equipment for metalworkers, with whom they were always to be found, so that their shape became the hieroglyphic ideogram for copper, crucible and metalworker. Some of the tomb scene inscriptions state that the crucible is new in the context of the need for increased effort from the blowpipe operators.

Figure 21: *The experimental set-up showing the blowpipe nozzle directed into the crucible over the barrier with the thermocouple displaying a temperature of 1140°C. From Davey and Edwards (2007).*

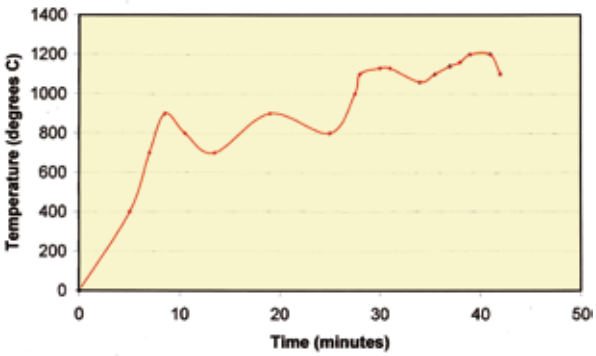

Figure 22: *The graph of the temperature in the crucible during the firing. From Davey and Edwards (2007).*

The historical context

The earliest known copper artefacts in Egypt come from the site of Maadi, located in the southern suburbs of Cairo. Quantities of malachite, copper objects and ingots were found in an archaeological context dated by radiocarbon to 3,800–3,400BC (Rizkana & Seeher 1989: 13–18; Hauptmann 2017; Odler 2023: 119, 265–67). Analyses, overseen by Hauptmann, revealed that the copper ingots at Maadi were very pure, having little arsenic, and could have come from orebodies in the Wadi Arabah at Wadi Faynan, Timna or Wadi Amram, or in south-western Sinai (Hauptmann 2017: 154). Kristina Pfeiffer (2013: 321–23) has described casting moulds from the Chalcolithic settlement of Tell Hujayrat al-Ghuzlan, near Aqaba in the Wadi Arabah, which had a shape that could have produced the ingots found at Maadi revealing a potential link between the two places. At the time there were wide ranging contacts between Egypt and the southern Levant (Klimscha 2011).

The ingot-mould link between Maadi and Tell Hujayrat al-Ghuzlan does not necessarily mean that there was a direct relationship between the sites, although that seems likely (Hartung 2013: 185), but it does show a potential link between Egypt and the technology used in the southern Levant. Pfeiffer (2013: 308) found that crucibles used at Tell Hujayrat al-Ghuzlan, Tell al-Magass, Wadi Fidan 4 and Abu Matar had a range of sizes, and consisted of flat round bowls with sockets to facilitate their manipulation with rods. No crucibles of this shape have been found in Egypt, nor is there any evidence of Mereruka shape crucibles in the southern Levant in the fourth millennium.

Ulrich Hartung (2013: 187) suggests that it was the more extensive trade connections at the start of the Early Bronze Age that facilitated the transfer of technologies, such as metal processing and the potter's wheel, to Egypt. Anfinset (2010:167) sees a dramatic change in Egyptian copper usage associated with Nubia at that time. David Wengrow's assessment that 'there is no direct evidence of metallurgical knowledge in Egypt until the later fourth millennium' (2006: 32) continues to hold true. He notes that in the southern Levant metallurgical industries restructured at the beginning of the Early Bronze Age with a separation of mining and manufacturing processes (Wengrow 2006: 39), but does not speculate on the reasons for the reorganisation, which may have been driven by increasing production, the economics of fuel and manpower, and issues of control and security. Despite this, there is no apparent metallurgical technology link between Lower Egypt and the southern Levant at the beginning of the Old Kingdom.

Egypt's involvement with metals also appears to have been restructured at this time. To envisage what happened it is necessary to review the copper working *chaîne opératoire*. During the third and fourth millennia it seems that smelting was conducted at comparatively low temperatures. Experiments have shown that at the Middle Kingdom harbour and smelting facilities of Ayn Soukhna on the Red Sea coast, smelting was probably conducted at about 900°C, using a combination of green wood and donkey dung as a fuel, and natural ventilation (Verly et al 2021), so it is unlikely that smelting was carried out at higher temperatures in the Old Kingdom and before. Smelting produced prills of copper encased in slag, as shown in Figure 17, that needed to be crushed to separate the more dense copper grains from the less dense slag with wet gravity separation. The process produced no chunks of slag and would appear to have been 'slagless' smelting, something that scholars have puzzled about (Hauptmann 2007: 149). The lack of slag for the third millennium and before has limited the study of early smelting.

The granular copper was then melted, refined and cast using a crucible in the manner illustrated in Figure 8. Any impurities floating on the surface of the molten metal would have been held back during the cast by the barrier. Crushing the ore in preparation for smelting was probably part of the mining process used at that time, but after that all activities could be conducted elsewhere. As production increased, it would have been advantageous to relocate processes requiring fuel and manpower to centres of population. The Mereruka style crucibles at Elephantine and Elkab and the evidence of smelting at Elkab, would indicate that smelting was established in the Nile Valley by the Second Dynasty.

Arsenical copper

Not only did the operating structure of metal production change, but also the metal itself. The prevalence of arsenical copper in Old Kingdom Egypt has long been recognised (Goresy et al 1995). Odler (2023: 5, 303–8) found that arsenical copper occurs at nearly all Egyptian sites, metal weapons tended to have less arsenic than vessels, while mirrors had more. The copper being used at the time must have either come from orebodies that also contained arsenic, or arsenic was added during processing. Alternatively, arsenic may have been added in the form of orpiment or realgar during melting and casting (Coghlan 1951: 79). Both pigments were known in Egypt, but their use in the Old Kingdom has not been confirmed (Lee & Quirke 2000). In ancient Near Eastern studies, an arsenic content of over 5% is deemed to indicate a deliberate addition (De Ryck et al. 2005: 266), but Odler (2023: 304) argued that the lack of arsenic in the copper orebodies he identified to have been mined by Egyptians meant that the amount was much less for Egypt. However, as this was an early stage of metallurgical development, alloying is less likely to have been practiced. Instead, it is probable that ores from different locations were selected because they were known to deliver products with desirable properties or to have had advantages in processing.

The reasons for the use of arsenical copper rather than pure copper appear to be both aesthetic and practical (Chen 2021). Arsenic gives a silver lustre to copper, which would otherwise be reddish in colour, making it a luxury fashion item in many ancient Near Eastern cultures, including Egypt. Mirrors made from polished copper-arsenic alloys typically contained over 5% arsenic. Arsenical copper also has mechanical properties superior to pure copper (Charles 1967).

Experiments have investigated the processing of copper-arsenic ores. Paul Budd (1993) described experiments by a colleague, Richard Thomas, in which malachite and weathered sulphides containing arsenic were smelted at temperatures as low as 700°C to produce arsenical copper. The experiments also showed that, with an increase in smelting temperature, arsenic diffusion into the copper increased. Smelting under 900°C produced copper with 1–2% arsenic, but when temperatures approached 1000°C, arsenic concentration in the copper could rise to over 5%. Heather Lechtmann and Sabine Klein also conducted co-smelting experiments with copper sulpharsenide ores, and showed that the process was uncomplicated and could be carried out without roasting and fluxes (Lechtman 1999). These experiments illustrate how arsenical copper objects could have been produced without alloying.

A number of comments can be made in relation to the metallurgical processes taking place during the refining and casting of the copper arsenic alloys obtained from the previously smelted ore.

Margrit Junk (2003: 21) drew attention to the copper-arsenic equilibrium phase diagram, which shows that the temperatures at which the metal is completely liquid (liquidus) depend on the bulk composition of the alloy and, for the range of compositions relevant to arsenical copper used in Old Kingdom in Egypt, decrease with increasing arsenic concentration. The solubility of arsenic in the solid copper phase also increases as the temperature decreases. As a result of these properties, the castability of the Cu-As alloy is increased relative to pure copper since the range of temperatures at which the alloy is fully liquid is extended to lower temperatures. This means the liquid metal is present at these lower temperatures and will continue to flow and spread to greater distances on casting before solidification is complete. Further, under the rapid, non-equilibrium cooling conditions encountered in this application, although the instantaneous arsenic concentration of the solid formed increases as the temperature decreases, there is insufficient time for the previously formed solid to completely equilibrate to the new conditions. In effect, less arsenic is present in the solids than predicted from the thermodynamic equilibrium. These non-equilibrium cooling conditions mean that the liquid ahead of the moving solid/liquid interface becomes progressively enriched with arsenic as solidification proceeds and the temperature for complete solidification is further lowered. In the case of copper – arsenic alloys, depending on the initial alloy composition and the cooling conditions, the liquid phase may still be present as low as the eutectic temperature at 685°C with the liquid composition of approximately 21wt% As and result in the formation of the solid Cu_3As phase in addition to the copper metal (Shishin and Jak 2018). The rejection of excess arsenic into the liquid phase will also lead to what is termed 'constitutional undercooling' and the growth of the solid metal phase in the form of cored dendritic (tree-like) structures as solidification proceeds. These microstructures are exemplified in the samples of cast Cu-As alloys produced in the studies by Junk (2003), Modlinger (2018) and Sabatini (2020).

Solidification of the alloy takes place progressively as heat is extracted from the melt and progresses in directions directly opposite to the heat flow. The first solids will form as the liquid contacts the cold solid mould surface. The bulk of the melt would at this time still be liquid and able to flow. The process depicted in the tomb images shows the molten metal is poured onto a flat mould surface. The extent to which the charge spreads over the mould surface will depend principally on the temperature of the liquid metal on casting, the bulk composition of the alloy and the horizontal momentum imparted to the fluid as it is released from the crucible. Clearly, the greater the area over which a given mass of molten metal is spread the thinner will be the cast sheet produced and the saving in the amount of the mechanical work required to prepare the metal sheet. The Egyptian metalworkers performed all tasks manually by hammering, and so even small benefits from using arsenical copper would have been most advantageous.

The combustion of charcoal provides the heat to melt the copper-arsenic alloy charge. The presence of excess charcoal in the crucible is also beneficial, since this reduces the effective oxygen activity and the concentration of oxygen dissolved in the liquid metal, thereby lowering the probability of formation of metal oxide inclusions in the material when casting. These inclusions are undesirable, since they reduce the strength of the final product and potentially influence the quality of the surface finish attainable: both factors would be important for the production of sheet materials, in particular alloy mirrors. The presence of the reducing conditions in the crucible would also reduce the production of arsenic oxide in the gas released in the process reducing the impact on the health of the metalworkers.

Old Kingdom copper sources

Knowing the sources of the Old Kingdom's copper arsenic ores may help locate the origin of the Mereruka crucible type. Finding the origin of the arsenical copper used during the Old Kingdom is, however, problematic according to Odler (2023: 151):-

> *The study of provenance suffers from the lack of data on ore bodies in Egypt and Sudan. The Sinai Peninsula is best represented, but the geologically rich Eastern Desert woefully lacks substantial data.*

Odler (2023: 106) is dismayed that the surveys of the Eastern Desert in 2006 and 2008 by a joint Egyptian-German team only collected eleven ore samples from the region, none of which contained significant arsenic (Abdel-Motelib et al. 2012). In particular, Odler concentrates on the mining area of Wadi Dara as a possible source of arsenical copper, although the ore sample taken from the area by the Egyptian-German team did not contain significant arsenic. Archaeological work in the Wadi Dara in 1989–1996 is yet to be published (Odler 2023: 109–14). Preliminary reports indicate that the mines, crushing facilities, furnaces and huts are substantial, and that there are many metalworking related artefacts dating from the Naqada III and Early Dynastic periods onward (Grimal 1993: 482–88; 1994: 423–34; 1996: 570–72). Earlier archaeological work at Wadi Dara was reported by Georges Castel et al (1993). There was also significant Old Kingdom copper mining at nearby Wadi Umm Balad and Wadi el-Urf (Castel et al. 1998; Klemm & Klemm 2013: 56–68). The areas are geographically and chronologically appropriate to be associated with Old Kingdom metalworking technology, but arsenic is not reported to be in the ores, although surveying has not been comprehensive.

Figure 23: *The Higalig mine area looking north. The arrows indicate the line of the gold-malachite-sulphide bearing quartz reef, which runs east-west and was mined from the surface. Image: Google Earth 13-9-2023.*

A recent study by Frederik Rademakers and colleagues (2018) of lead isotope data for copper artefacts from the Royal Museums of Art and History, Brussels, and dating to the period before the Sixth Dynasty, found that there was continuity of copper supply from the Sinai and Eastern Desert. However, the joint Egyptian-German team also collected many ore samples from ancient mining areas on the Sinai Peninsula and found that they were also non-arsenic bearing (Abdel-Motelib et al. 2012). Only Wadi Tar in south-eastern Sinai is known to have copper-arsenic minerals, but the region has no evidence of prehistoric mining or of an Egyptian presence, indicating that it was outside their sphere of influence (Hauptmann 2017: 154; Odler 2023: 116). Tallet has found that Egyptian exploitation of Sinai copper deposits can be firmly dated to the beginning of the Fifth Dynasty at Wadi Kharig and Bir Nasb (Tallet 2018; Tallet & Lehner 2021: 71).

Significant arsenic is not present in copper ores from deposits in the southern Levant, such as Faynan and Timna (Hauptmann 2007: 296). The Chalcolithic Nahal Mishmar hoard contained tools made from pure copper, probably mined in the southern Levant, but the ceremonial objects were made from Cu-As-Ni alloys, suggesting that metal types were selected for aesthetic reasons. Lead isotope analysis of ten mace-heads showed that seven of them were cast from copper mined at Ergani Maden in southern Turkey, while the other three were made from copper mined in Oman (Hauptmann 2007: 30, 300). While this demonstrates that long-range trade routes existed for special copper ores, it does not provide a common source of ore for Egypt's Old Kingdom copper industry.

To Egypt's south, copper orebodies in Sudan are not well characterised. A recent study of Middle Kingdom copper objects from the site of Kerma found that they contained significant arsenic and tin (Rademakers et al 2022), but the lead isotope analyses were compatible with the south-western Sinai ore deposits rather than Sudan. These studies have been hampered by the lack of lead isotope data for orebodies in Egypt and Sudan.

Sulphide mineralisation is commonly found in association with gold in the Eastern Desert, and was sometimes identified by Rosemarie and Dietrich Klemm (2013: 146) to be arsenopyrite. With the support of geological colleagues, Odler has proposed this to be the likely source of the arsenic in Old Kingdom tools (Odler et al. 2021). Klemm and Klemm identified four Pre- and Early Dynastic mining areas in the Eastern Desert, Wadi el-Urf (Wadi Dara) in the north, Abu Mureiwat east of Qena, Bokari east of Elkab and Higalig east of Kom Ombo (2013: 603, fig. 7.1).

Higalig is the oldest mining area dating to the beginning of the third millennium, Figure 23. As it was not subject to later mining, Klemm & Klemm (2013: 268–70) deemed it to be the Pre- and Early Dynastic mine type site. An east-west quartz vein contained free gold, layers of malachite, and 'brown iron hydroxide stains, which derive from decomposition of pyrite and chalcopyrite' (2013: 270). Klemm & Klemm (2013: 146) do not normally distinguish between iron pyrite and arsenopyrite as their appearance is similar, so this is probably the source of the Old Kingdom's earliest arsenical copper ore. The Bokari mining area is about 70 km north of Higalig. It also has quartz reefs containing gold, malachite and pyrites that were mined in the Early Dynastic and Old Kingdom periods (Klemm & Klemm 2013: 183–84).

The earliest mining at Higalig and Bokari was carried out by pounding the quartz and host rock with heavy stone hammers. The smelter feed from Elkab, Figure 16, shows that the ore was broken up but not pulverised by the mining method. Klemm & Klemm (2013: 5) describe the mine openings to be smooth walled, which may indicate that a groove was first mined in the country rock (i.e. rock native to the area), and then the narrow mineralised

quartz reef was broken toward it. Alternatively, they may have pulverized the ore to make a face to work to within the quartz reef. While pieces of ore would have been separated by hand-picking, finely crushed material could have been treated by wet gravity separation; the heavies, free gold, would have settled out first, thereafter the middlings, all other heavy minerals including malachite and the sulphides, would have settled next.

No dwellings were apparent near the Higalig Pre- and Early Dynastic mining area, leading Klemm & Klemm (2013: 6) to conclude that the prospecting and mining were carried out by tent-dwelling nomadic groups. The discovery of the two oldest Egyptian crucibles at Elephantine and Elkab, directly west of Bokari and Higalig, make this southernmost region of Upper Egypt a likely place for the earliest development of Egypt's copper and gold industries.

The origin of the technology is less clear. If Klemm & Klemm are correct about the presence of nomadic prospectors and miners in the Eastern Desert, they may be the origin of the expertise, although Anfinset (2010: 200) deems them to have been 'middlemen'. Miners have always been itinerant and there are traditions that ancient nomadic groups, such as the Ishmaelites, were miners. Erez Ben-Yosef argues that in a later period at Timna, nomadic people were the miners and metalworkers (Ben-Yosef et al. 2017; Ben-Yosef 2020).

These earliest Egyptian copper deposits also contained gold, and it may have been the gold that was the initial focus of mining. As free gold needs no processing other than comminution and wet separation, it is probable that gold was also melted in Mereruka style crucibles. Fifth Dynasty images on the Unas Causeway at Saqqara (Smith 1942: fig. 8) depicts Mereruka shape crucibles and the accompanying texts make it clear that it was gold being melted. The Tomb of Serfka at Sheikh Said (Davies 1901: pl. 4) also shows the melting of gold. The origin of the crucible may therefore be associated with gold rather than copper.

Not all Old Kingdom copper contained significant amounts of arsenic. The data prepared by Odler (2023: Tables 35 & 36) show that there is a similar chronological and geographical quantitative occurrence of pure copper and arsenical copper artefacts from the Naqada Period until the Second Intermediate Period. Without knowing the details of this data and the reliability of the analyses, it is not possible to comment further. It seems that Mereruka crucibles were used for all copper compositions.

The Mereruka shape crucible was used in Egypt from at least the First Dynasty (*c.* 3000 BC), as evidenced by the fragment found at Elephantine, and they are not depicted in tomb images after the Sixth Dynasty (*c*. 2250 BC). Many scholars (e.g. Odler 2023: 277) confuse these crucibles (Figure 19 A–C) with later crucibles that could retain a liquid because of their bowl-shaped bases (Figure 19 D–G). The functions of the two types seem to be different. The Mereruka shape crucible was used to cast arsenical copper into sheets for the fabrication of prestige vessels, and to melt recycled copper, and maybe gold, for casting tools. The later crucibles with bowl-shaped bases may also have been used to melt copper, but the study of one such crucible from Buhen found that it was used for high-temperature smelting (Davey et al. 2021).

While the Mereruka shape crucibles cease to be used in Egypt at the end of the Old Kingdom, they do appear in Sinai during the Middle Bronze Age, 2000–1550 BC (Beit-Arieh 1985), and of course they were used in Mesopotamia during the Isin-Larsa period, *c*. 1800 BC, for melting tin-bronze. Once archaeologists become familiar with the enigmatic shape, these crucibles may be found to have a much broader domain.

Concluding comments

The proposed *chaîne opératoire* of Pre- and Early Dynastic and Old Kingdom Egyptian metalworking differs depending on the product, whether it be prestige metal vessels or tools. For prestige metal vessels:

- mining, malachite and arsenopyrite, initially at Higalig or Bokari, then elsewhere in the Eastern Desert,
- crushing, if necessary, and hand-picking to separate gold and copper-arsenic ores,
- wet gravity separation, of the fines to produce gold and malachite-sulphide concentrate,
- smelting, copper-arsenic ore and malachite-sulphide concentrate, initially in holes in the ground and later in furnaces using wood and animal dung as fuel,
- comminution, of the smelt product and wet gravity separation to produce copper-arsenic alloy granules,
- melting, the copper-arsenic alloy granules in Mereruka shape crucibles using charcoal as fuel,
- casting, arsenical copper onto a flat surface to produce a metal sheet,
- hammering, the sheet to be 1–1.5 mm thick,
- fabricating, vessels mechanically from the sheet metal using annealing, welding on, etc.

The proposed *chaîne opératoire* for tools is the same as for producing prestige vessels, except that it was often copper, rather than arsenical copper, that was treated and:

- mining, malachite in the Eastern Desert, at sites including at Wadi Dara, and later in Sinai,
- casting, into open moulds,
- mechanical forming, sharpening, and work-hardening of tool blades.

Given the lack of reliable data, these suggested sequences are tentative until:

- Eastern Desert orebodies are characterised by mineralogical and lead isotope analyses,
- More Old Kingdom copper vessels and tools are studied using metallography and quantitative analytical methods,
- Egyptian gold technology is clarified, and
- Egyptian crucible ceramics are analysed using microscopy and SEM.

Mereruka shape crucibles were used because they allowed the melt to be observed so that casting could be carried out promptly, minimising arsenic and copper oxidation, and charcoal usage. They could also be manipulated manually with the aid of insulating pads.

Arsenical copper ores were selected for prestige vessels because the refined alloy produced objects with silver-gold colours and reflective surfaces. The alloy was also easier to process because it melted at lower temperatures and flowed more freely to form sheet metal.

The origin of the Mereruka shape crucible is unclear. Their earliest occurrence is during the First Dynasty in Upper Egypt and they do not appear in the southern Levant and Sinai until much later. Their association with Clayton disks in the Nile Valley is not replicated in the Western Desert where Clayton disks are common, but crucibles are not. Nubia remains a possible source of the Mereruka crucible technology.

The development of Egyptian metalworking in the Old and Middle Kingdoms is becoming increasingly understood from research on Ayn Soukhna, Buhen and sites in Western Sinai. This study has drawn attention to the probability that Egypt's earliest indigenous metallurgy began in Upper Egypt with local copper-arsenic resources and the application of technologies not known from the southern Levant, but maybe acquired from nomadic prospectors from Nubia with possible contacts further afield in Africa or south Asia.

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Searching for the potters behind the pots: re-examining the Tell Ahmar Neo-Assyrian ceramic assemblage

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Abstract: Ceramic studies have been crucial to the development of archaeology. This paper is concerned with a re-examination of the pottery, and the potters, of Tell Ahmar (ancient Til Barsib), Syria. It focuses on the ceramics from the Australian excavations in the Middle City (Area C), especially the more than 250,000 items from the 7th-century BCE Neo-Assyrian Stratum 2. The Stratum 2 assemblage was readily grouped into seventeen ware types. The various wares reflect different production systems: some hand-made products were manufactured locally, possibly by individual households; other wares, characterised by high rates of uniformity, were probably produced by large-scale, centralised pottery industries; another ware group exhibits considerable investment in the application of different surface treatments, indicating specific uses. The Area C assemblage provides a rare opportunity to examine a large and relatively complete well-dated corpus. Observations and explanations relating to the technology of preparing, forming, decorating, and firing these ceramic vessels casts light on the circumstances of their manufacture and, in turn, on the potters behind the pots of the Neo-Assyrian Empire.

Keywords: Tell Ahmar, Neo-Assyrian pottery, pottery technology, Syria, pots and potters

Introduction

The 2023 Petrie Oration recognised a long-serving board member of the Australian Institute of Archaeology, Professor Ian Edwards. To honour Ian's contributions in the study of ancient pottery techniques and technology, the address re-examined the Neo-Assyrian ceramic assemblage from Tell Ahmar (Figure 1), and searched for the potters behind the pots. During a visit to Tell Ahmar in 1991, Ian collected clay samples for a series of firing experiments. These experiments are discussed in consideration of the technology of preparing, forming, decorating and firing of the Neo-Asyrian pottery.

The paper draws on two key secondary sources, *Life Writing in the History of Archaeology* and *Archaeological Ceramic Analysis,* to frame the following discussion. As Claire Lewis and Gabriel Moshenska note (2023: 1): '*life-writing* is a literal translation of "biography", but in practice it represents a far broader category of texts and related forms. … memory studies … linguistics … history and philosophy of science. *Life-writing* has played a vital role in the emergence and development of archaeology, from the memoirs of early–modern antiquarian travellers to the rise of "object biography" approaches in the late 20th century'. *Archaeological Ceramic Analysis*, as described in the Oxford Handbook edited by Alice Hunt (2017: 3): 'draws together topics and methodologies essential for the socio-cultural, mineralogical, and geochemical analysis of archaeological ceramics. Ceramic is one of the most complex and ubiquitous archaeo-materials in the archaeological record. … For more than 100 years, archaeologists have used ceramic analysis to answer complex questions about economy, subsistence, technological innovation, social organisation, and dating'.

Figure 1: *A view of Tell Ahmar looking west. Image: C.J. Davey 1984.*

Pottery became an index artefact of the Neo-Assyrian imperial occupation and administration (Hunt 2015: 2, 206). Therefore, an understanding of pottery production (and the potters), is important for our understanding of the organisation of the Neo-Assyrian Empire (Duistermaat 2008).

The paper comprises four parts:

- Historical developments relevant to the analysis of the Tell Ahmar pottery
- Excavations at Tell Ahmar

- Re-examining the Neo-Assyrian Tell Ahmar ceramic assemblage
- Searching for the 'potters behind the pots'

Historical developments

Flinders Petrie

Because this is the Petrie Oration, it seems only fitting to start with Sir William Matthew Flinders Petrie (1853–1942), the father of Egyptian Archaeology and a pioneer of systematic methodology in archaeology. In his words: 'Once settle the pottery of the country, … the key is in our hands for all future explorations. A single glance at a mound of ruins ... will show as much to anyone who knows the styles of the pottery, as weeks of work may reveal to a beginner' (Petrie 1891: 40). And, in his first letter to Miss Ameilia Edwards in 1883, Petrie stated, 'the true line lies in the noting and comparison of small details' (Smith 1945: 5). Petrie was the first to use 'seriation' in Egyptology, by ordering the pottery from his excavations in Naqada, Hu and Abadiya into a chronological series. He called it 'Sequence Dating' (Drower 1985: 251–253).

Kathleen Kenyon

Another pioneer in Middle Eastern archaeology is Dame Kathleen Kenyon (1906–1978) (Davis 2008; Dever 1978). Kenyon made significant contributions in the field of stratigraphic excavation techniques, the so-called 'Wheeler-Kenyon' method of excavation, which she perfected at Jericho (Wagemakers 2020). She also introduced innovative approaches in ceramic methodology (*in situ* recording). Another important aspect of Kenyon's archaeological career was her role as a teacher. She helped train a generation of archaeologists, including Australians (Wagemakers 2020).

Henk Franken

Hendricks (Henk) Jacobus Franken (1917–2005) from the Netherlands participated in Kenyon's excavations at Jericho (from 1955 to 1958). In a paper on the impact of Kenyon's excavations on Dutch Archaeology in the Near East, Bart Wagemakers mentions, Franken learned from Kenyon about the importance of pottery (2020). When Franken commenced his own excavations at Tell Deir 'Alla in Jordan he applied Kenyon's excavation methods and ceramic analysis (Franken and Kalsbeek 1969). Wagemakers describes this as: 'A contextual approach to pottery, that was carried out by Franken and his students in collaboration with potter Jan Kalsbeek, defining a pottery tradition as a set of recurring traits in pottery production' (2020: 87). This method, now known as the 'Leiden School/Approach', is still practiced in the Near East by former students of Franken. In her obituary on Franken, Eviline van der Steen noted: 'Franken looked for the potter behind the pots, and on his digs, there was always a professional potter present, to analyse and interpret the production process' (2005: 14).[2] Franken is also remembered for establishing the Department of Pottery Technology in Leiden, and the Leiden *Journal of Pottery Studies*.[3]

Basil Hennessy

In the context of Middle Eastern archaeology, John Basil Hennessy (1925–2013) represents an important Australian connection (Hennessy 2013). At the end of 1951, Hennessy joined the first season of renewed excavations at Jericho under the direction of Kathleen Kenyon where he too was exposed to the Wheeler-Kenyon excavation technique that he would employ and modify in his own excavations, notably at Pella (Walmsley 2012: 13). Kenyon described Hennessy as 'one of the most promising' students she had met (Barker 2014: 11). In remembering Hennessy, Alan Walmsley recalls: 'Pella quickly grew into Australia's premier archaeological project in Jordan', and notes, 'It took a large team to tackle the myriad of research topics Pella presented' (2012: 14).

Ian Edwards

William Ian Edwards (Figure 2) was one of many to work with Hennessy at Pella. Ian's PhD, titled 'A Potter's View of Bronze Age Pella (Jordan): A Study of Ceramic Technology', investigated the residual evidence of the technology and techniques used in the production of the Bronze Age pottery from Pella (Edwards 1993). Trained as a professional potter, Ian lectured in studio pottery at Burwood Teachers College (now Deakin University) for many years. It was this practical experience that Ian brought to the study of Pella pottery. Ian established the Archaeology Research Unit at Deakin and formed close connections with Henk Franken in Leiden. Through these associations, he promoted the role of ceramicists in Australian archaeological projects working in the Middle East (Edwards 1983). Of importance to this paper is Ian's visit to Tell Ahmar, Syria in 1991.

Figure 2: *Ian Edwards with Andrew Jamieson, on his left, and Christopher Davey, at the 2023 Petrie Oration. Ian was awarded a Fellowship of the Australian Institute of Archaeology at the lecture. Image: courtesy Mohamed Alsamsam.*

Excavations at Tell Ahmar[4]

The Australian excavations at Tell Ahmar in Syria, by a team from the University of Melbourne, were directed by Belgian archaeologist, Guy Bunnens, a student of Assyriologist Georges Dossin.[5] This connection would not have escaped the attention of the Directorate General of Antiquities and Museums in Damascus when it came to the allocation of excavation permits. Other connections of note: Greg Wightman joined the Tell Ahmar project for one season in 1988, and Ian Edwards in 1991; they brought experience that they had acquired with working with Hennessy at Pella (Bourke and Descoeudres 1995).

Before the Australian excavations at Tell Ahmar, a French team had worked at the site between 1929 to 1931 under the auspices of the Louvre (Thureau-Dangin 1929). It was directed by Françiose Thureau-Dangin, with the assistance of Maurice Dunand, Lucian Cavro and Georges Dossin.[6]

Location

Tell Ahmar is situated on the east bank of the Euphrates River (Figure 3), approximately 20 km below Carchemish (Bunnens 2022: 2–3). It commanded a position of prime importance in the middle and upper Euphrates River valley of northern Syria (Bunnens 2022: 3–5).

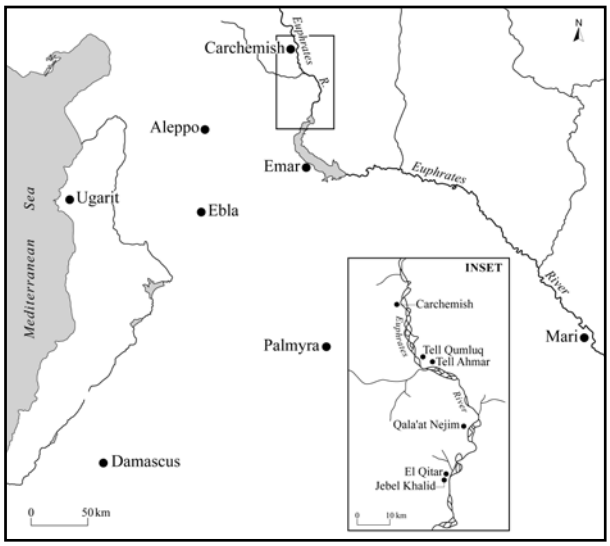

Figure 3: *Map of Syria. Courtesy Chandra Jayasuriya.*

The names of Tell Ahmar

Throughout history, Tell Ahmar has been known by several different names (Bunnens 2022: 1–2):

- Hittite (Luwian) name: Masuwari
- Aramean name: Til Barsip / Til Barib (or Tabursiba)
- Neo-Assyrian name: Kar Shalmaneser (Shalmaneser's gate/port)
- Modern Arabic name: Tell Ahmar ('red mound')

Tishreen Dam flood zone

Owing to the construction of the Tishreen Hydroelectric Dam, Tell Ahmar was one of twenty or so sites

Figure 4: *A map of the Tishreen flood zone. Image: courtesy Guy Bunnens.*

threatened with destruction (Figure 4).[7] In responding to an international call for assistance from the Syrian Directorate General of Antiquities and Museums, the University of Melbourne commenced salvage excavations at the site in 1988 (Bunnens 2022: 6–10).

Tell Ahmar was inhabited as early as the Neolithic period, but it is the remains of the Iron Age city that is generally considered the most important settlement at the site. On the site's history, Bunnens reports the city was largely Neo-Hittite up to its conquest by the Neo-Assyrian Empire in 856 BCE. At the time, Til Barsib was in the area of the Aramean-speaking Syro-Hittite state of Bit Adini. When it was captured by the Assyrians the city was renamed Kar Shalmaneser, after the Assyrian king Shalmaneser III. Following the Assyrian conquest, Tell Ahmar became a prominent provincial centre for the Empire's administration of the region due to its strategic location (Bunnens 2022: 2).

The site comprises three main parts (Figure 5). The first is the main tell or Acropolis, which rises above the surrounding region on the edge of a terrace overlooking the flood plain. The original height of the mound was 25 m, with approximate dimensions of 250 m by 150 m. The second component is the Middle City, which extends over several hundred metres (350 m) westwards from the Acropolis. The third part comprises the semi-circular Lower City, about 1200 m in diameter extending to the north of the Acropolis. Of this tripartite configuration it is important to note that the Middle City and Lower City at Tell Ahmar were built-up during the Neo-Assyrian period (Bunnens 2022: 115–134).

French excavations

As stated above, the French were first to excavate Tell Ahmar (Thureau-Dangin & Dunand 1936). On top of the tell they found a palace made of mud bricks. It was the residence of the king's representative: a provincial governor. The throne room, and other areas, were decorated with wall paintings in black, red and blue

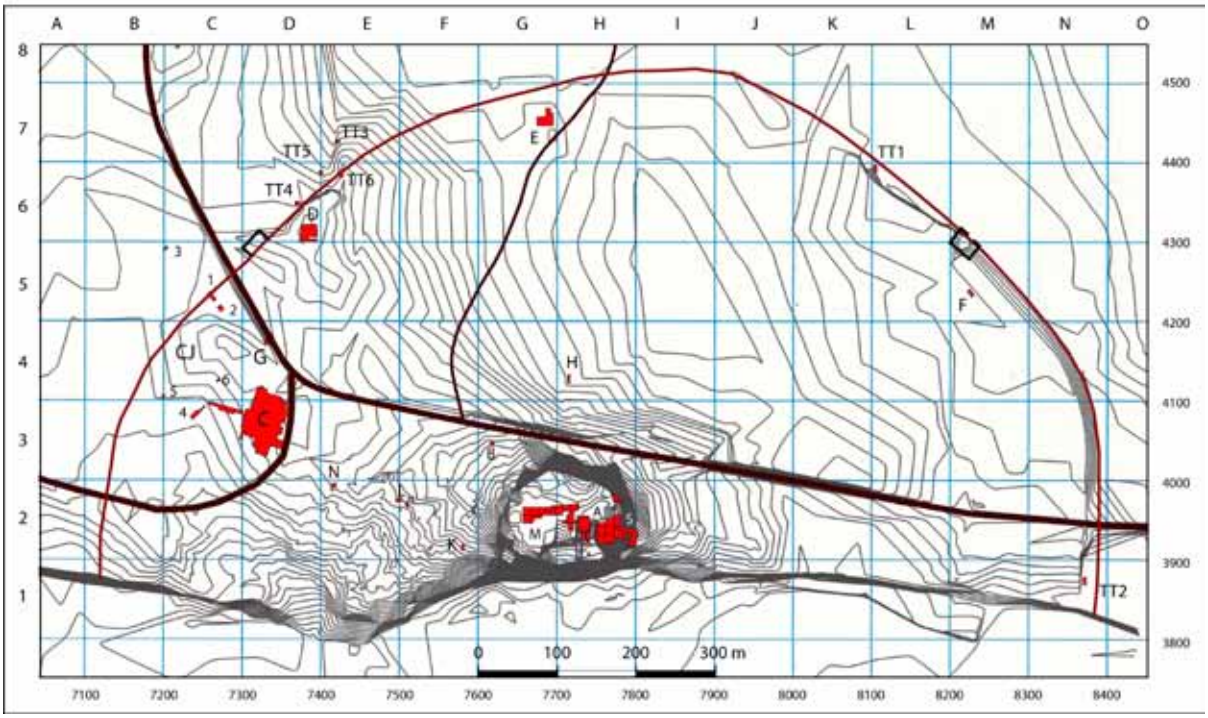

Figure 5: *Plan of Tell Ahmar 2010. Courtesy Guy Bunnens*

(Bunnens 2022: 118–125). The subjects glorify the king and served to magnify royal power. The paintings played the same role as carved reliefs of the palaces of Assyria, but at lower cost. They are some of the only surviving examples of Assyrian painting in existence (Thureau-Dangin 1930; Roobaert 1990). The French also explored the Lower City, in the vicinity of the city gate where two basalt lions marked the entrance to the town. A cuneiform inscription on one lion mentions the name of the site, Kar Shalmaneser (Thureau-Dangin 1930; Roobaert 1990; Bunnens 2022: 6–10).

Australian excavations

Because the French had concentrated their efforts on the main tell, the Australians decided to focus their attention on the Middle City and Lower City areas (Bunnens 2022: 6–10). Of particular significance are the excavations in Area C that covered an area approximately 3300 sq m (Bunnens 2022, 135–148). Just below the surface in the Middle City, a series of well-preserved buildings were found. Several mud brick buildings, with walls up to two metres in height, were identified in Area C. All structures were constructed around open courtyards, and in at least one instance (Building C2) Bunnens notes the architectural layout conforms to known Neo-Assyrian conventions (2022: 156). Although traces of industrial activities were found in Building C2, the function of the building as a residence is clearly indicated by features such as room 6 which are typical of Neo-Assyrian reception rooms. The courtyard of Building C2 featured a black and white chequerboard pattern pebble mosaic (Bunnens 2016; 2022: 144–45). Near the houses in Area C was found a burial vault made of baked bricks (Bunnens 2022: 145–48). Other than a terracotta bathtub sarcophagus, the tomb was completely empty. A hole in the roof was possibly made by tomb robbers. Above the tomb were found fragments of a life-size basalt male statue with clasped hands; only the feet were missing (Roobaert 1996: 79–87; Bunnens 2022: 128–33). The beardless figure suggests a eunuch (texts record eunuchs often served as governors in Assyria (Inurta-bel-usur)). The figure was deliberately damaged in antiquity; the face had been erased and the chest punctured, indicating a ritual killing. The proximity to the tomb may therefore not be accidental.

Twenty cuneiform tablets were found in Building C1a (Dalley 1997; Bunnens 2022: 171–72). Most date to the second half of the reign of Ashurbanipal (based on the eponyms). One name, Hanni, appears several times in the tablets. It may be assumed Hanni is the owner of the house/s (and the archive) in Area C. The contents of the tablets reveal Hanni was a businessman: lending silver and buying slaves. Other tablets contain ration lists of various commodities (Bunnens 2022: 135–36, 171–72).

Twenty carved ivories were also found in Area C (Bunnens 1997: 435–50; 2022: 165–67). During the Assyrian period, ivory was used as decorative inlay in wooden furniture. The largest ivory is a plaque 32 cm long, which depicts a procession of figures carrying provisions – grapes, pomegranates, small birds and fish – for a banquet. The figures are led by a musician playing a flute. This ivory reflects Egyptian and Syro-Hittite stylistic features (Bunnens 1997; 2022: 165).

Neo-Assyrian Ceramic Assemblage

The greatest quantity of material to be found in Area C was pottery (Jamieson 1999a; 2000; 2012; 2013). The

No./Ware	Code	Man.	Fir.	Surface Treatment	% of Total
1. Common Ware	CW	W/M	OX	Plain & self-slipped	85.0
2. Coarse Ware	COW	H/M	PIT	Plain, wet-smoothed & incised	1.00
3. Cooking Pot Ware	CPW	H/M	PIT	Plain & wet-smoothed	2.50
4. Red Slip Ware	RSW	W/M	OX	Slipped & burnished	5.50
5. Palace Ware	PW	W/M	OX	Self-slipped & smoothed	1.00
6. Fine Ware	FW	W/M	OX	Self-slipped & smoothed	2.00
7. Grey Ware	GW	W/M	RED	Self-slipped & burnished	0.50
8. Tall Jar Ware	TJW	W/M	RED	Self-slipped	1.00
9. Glazed Ware	GLZW	W/M	OX	Glazed	0.05
10. Painted Ware	PATW	W/M	OX	Self-slipped & painted	0.15
11. Incised Ware	INCW	W/M	OX	Self-slipped & incised	0.15
12. Stamped Ware	STPW	W/M	OX	Self-slipped & stamped	0.15
13. Cypriot Ware	CYPW	W/M	OX	Slipped, smoothed & painted	0.15
14. Bi-Chrome Ware	BCW	W/M	OX	Self-slipped & painted	0.05
15. Phoenician Ware	PHOW	W/M	OX	Self-slipped & painted	0.05
16. Sheik Hamad Ware	TSHW	W/M	OX	Self-slipped & incised	0.05
17. Plain Crisp Ware	PCW	W/M	OX	Self-slipped	0.05

Table 1: *Tell Ahmar Neo-Assyrian Area C Stratum 2 Ware Types.*

excavations in Area C yielded close to 400,000 sherds (393,325). The pottery from the Neo-Assyrian Stratum 2 comprised over 250,000 individual items (255,825). Diagnostic features enable the Area C Stratum 2 pottery to be well dated to the 7th century BCE – and more specifically to the second half of the 7th century. The dating of the Area C pottery is corroborated by textual evidence and other finds. The Neo-Assyrian pottery can be readily grouped into 17 ware types (Table 1). In all instances the ware types that were identified at Tell Ahmar relate to known Neo-Assyrian fabrics documented at other Neo-Assyrian sites. They exhibit distinct features in terms of their 1) fabric and colour, 2) texture and inclusions, 3) fracture and firing, 4) manufacture technique, and 5) surface treatment. The assemblage was enriched by ceramic imports from Anatolia, Cyprus, Phoenicia, the Levant and northern Mesopotamia. The presence of some of these imports at Tell Ahmar probably relates to content of the vessels (Jamieson 2000).

It is apparent that the different technical attributes of Area C pottery reflect different systems of production. For example, Coarse Ware (COW) and Cooking Pot Ware (CPW) are both characterised by low firing temperatures, soft hardness and hand-made methods of construction. Other wares, Common Ware (CW), Tall Jar Ware (TJW), Stamped Ware (STMW), Tell Sheik Hamad Ware (TSHW) and Plain Crisp Ware (PCW) are: characterised by wheel-made fabrics, have high rates of uniformity, appear to be highly utilitarian and were probably produced by large-scale pottery industries. A third group of wares, Red Slip Ware (RSW), Palace Ware (PW), Fine Ware (FW), Grey Ware (GW), Painted Ware (PATW), Incised Ware (INCW), Glazed Ware (GLZW), Cypriot Ware (CYPW) and Phoenician Ware (PHOW), although appearing relatively infrequently, are characterised by wheel-made, high fired products that exhibit considerable investment in the application of different surface treatments. Some of these wares appear to have had specific functional uses (Jamieson 2000; 2012).

Similar smaller samples of Iron Age pottery were recovered from several other areas in the Lower City at Tell Ahmar: D, E, F, & H (Jamieson 2000; 2012). Whilst the pottery from these different areas may not be identical to that of Area C, it does appear to conform broadly to the Neo-Assyrian period, indicating that the site reached its maximum extent during the 7th century BCE (Jamieson 2020).

The greatest and closest parallels of the Area C Tell Ahmar pottery are with the ceramics from the Assyrian heartland: Assur, Nineveh, Nimrud and Khorsabad (Anastasio 2010; Jamieson 2013). The pottery from Nimrud, one of the capital cities of Assyria, is possibly of greatest significance. The grit tempered Common Ware, Cooking Pot Ware, Red Slip Ware, Palace Ware, Fine Ware, Grey Ware, Glazed Ware, Stamped Ware and Painted Ware are all represented in the Neo-Assyrian assemblage at Nimrud (Lines 1954, Oates 1959). Within these wares many of the individual types find exact parallels with the pottery from Area C Tell Ahmar. The high number of similar wares and types, particularly within the Common Ware that display classic Assyrian forms, suggests that Tell Ahmar and the Neo-Assyrian heartland were closely connected at that time (Jamieson 2012; 2020).

Most of the vessels from Area C were made of Common Ware. These vessels display highly standardised fabric and

technological features, a consequence of mass production in state-organised manufactories, where potters were part of the Assyrian administrative system. Peter Pfälzner proposed that Assyrian imperial administration brought with it a specific ceramic tradition and its mode of production to the provinces (2007: 250). He named this type of pottery Middle Assyrian Administrative Pottery. According to Janoscha Kreppner, a characteristic feature of Assyrian Administrative Pottery is its manufacture in the so-called Middle Assyrian Standard Ware, displaying highly standardised fabric and technological features (2015: 222).

Searching for the Potters Behind the Pots

In searching for the potters behind the pots, there is a range of evidence to consider: epigraphic, archaeological, ethnographic, experimental and scientific.

Epigraphic: Neo-Assyrian Specialists – Praḫhāru ('potter')

Epigraphic sources record that Mesopotamian craftsmen in all periods were organized into guilds or workshops. The Neo-Assyrian Text Corpus Project published *The Prosopography of the Neo-Assyrian Empire*, Volume 4, part 1, dealing with 'Neo-Assyrian Specialists: crafts, offices, and other professional designations' (Baker 2017: 80). Under the entry for potters, *praḫḫāru*, the texts mention: a potter, possibly a deportee; and a potter, the son of a potter, as well as potters from the Assyrian capitals: Nineveh, Assur, and Nimrud (Kalhu). From the names mentioned, we learn that potters are male, they are located at Assyrian centres, and in some instances their profession is hereditary. However, this does not exclude the involvement of women and children in daily work. Texts show that craft production could be organised in various ways. Some craftsmen worked in the service of the temple or the palace. Others received raw materials to produce certain fixed amounts of objects, while they probably could spend the rest of their time on private work.

Archaeological: Khirbet Qasrij, Iraq – pottery kiln

The archaeological evidence found at Khirbet Qasrij included a pottery kiln. Khirbet Qasrij, a modest regional site in norther Iraq, situated in the Mosul Dam flood zone, on the Tigris River, was excavated by John Curtis from the British Museum (Curtis 1989: 21; fig. 20a–d). The kiln was roughly oval in shape, with vitrified lining. The fire pit was largely subterranean. Sufficient remains of the kiln chamber survived to show it belonged to the type known as a double chamber updraught kiln. Scattered throughout the deposit in the fire pit were potsherds, pottery wasters, and some collapsed jars (Curtis 1989: 23–25). Combined, this evidence indicates the Common Ware (typical of Assyrian Administrative Pottery) was made and fired in the kiln. The Khirbet Qasrij pottery finds close parallels with the Late Assyrian (7th century BCE) pottery at Nimrud; however, Curtis notes some types indicate the corpus may date to the post-Assyrian period (1989: 51–54).

Archaeological: Tell Sabi Abyad, Syria – pottery workshop

A pottery workshop was found at Tell Sabi Abyad, Syria, which yielded several finds related to pottery production: kilns, unfired sherds, wheels, wasters, and two work areas. Kim Duistermaat states, the organisation of the pottery production at Sabi Abyad was a professional operation, with one or two potters and several assistants (2008). They used efficient shaping techniques and professional tools and kilns, and were most probably involved full-time in pottery production. It is likely that the local administration paid them for their work in rations.

Ethnographic: pottery manufacture

The Australian investigations at Tell Ahmar were backed by a study of the modern community living at the site. According to Bunnens, this aimed to be an ethnoarchaeological study, noting, 'we need to study the traditional technologies to better understand the archaeological remains' (1990: 144). Kent Fowler in his chapter on 'Ethnography' in the *Oxford Handbook of Archaeological Ceramic Analysis* describes: 'The ethnographic present and the archaeological record are incommensurate, but compatible domains. … In this case, both share potter's work as a medium through which we can understand societies' (2017: 470).

At Tell Ahmar it was possible to observe several local village potters (Jamieson 1999b). The village women produced a limited quantity of handmade pottery, mostly cooking pots and storage jars. The clay was collected from nearby sources. River sand and chaff were added as tempering agents. Pottery manufacture was by hand, tools were not used. After the pots were sun dried, they were bon fired in simple open pits using animal dung as fuel. The firing lasted several hours and the firing temperature was estimated to be around 500 to 550°C. In some cases, making pottery was a communal and intergenerational activity. The pots produced were for use within their immediate households.

By contrast, a different mode of production was observed in workshops located on the outskirts of Aleppo (Syria's second largest city) (Jamieson 1999b, 2004). Here the potters were male. Each workshop comprised several family members: fathers and their sons, sometimes brothers and cousins. The older men were responsible for manufacturing most vessels, while the younger members of the enterprise served as assistants and actively involved in the tasks of clay preparation and firing. The use of kick and electric wheels were observed. Clay was mechanically crushed and refined using sedimentation tanks. Wood, oil or gas fired downdraught brick kilns. Pots were mass produced in a select range of utilitarian shapes, including shallow bowls, jugs, and jars for sale at markets operated by middlemen.

Figure 6: *Ian Edwards sieving clay samples to remove extraneous material.*

Experimental: firing experiments of local Tell Ahmar clays

When Ian Edwards visited Tell Ahmar in 1991, it provided an opportunity to collect and fire local clay samples. The aim of these experiments was to evaluate the suitability of these clays for ceramic manufacture. All the samples collected and tested came from sources situated directly along the Euphrates River or from ancient riverbed deposits near Tell Ahmar (Jamieson 2002). Ten clay samples were collected for testing. A range of different coloured deposits could be visually distinguished in the mostly calcareous clays that contained varying proportions of iron compounds, calcium carbonates, quartz sand, organic material and alkalies. The dry samples were prepared by firstly grinding the samples into a powdery state. A sieve was used to remove extraneous material and large inclusions, Figure 6.

The ground clay was then mixed with water to produce a suitable condition that would allow for shaping into a series of flat test bars (briquettes), Figure 7. The amount of water varied with the different coloured clays. The bars were incised with a 10 cm scale to record shrinkage. Once dry, the samples were fired in a small kiln. Three firings were carried out to 650, 750 and 850°C. Most of the clays were suitable for pottery production; some samples disintegrated at higher temperatures. Those clays fired to 750 and 850°C most closely resembled the ancient pottery in colour and texture. The experiments confirmed the availability of clay suitable for manufacture at Tell Ahmar. On the subject of 'Investigating ceramic manufacture', Daszkiewicz and Maritan discuss the merits of 'Experimental Firing', noting that: 'Firing experiments attempt to reproduce ancient firing technologies, in order to evaluate the influence that each parameter involved in the firing process has on the compositional, physical-mechanical and chemical properties of the fired products' (Daszkiewicz & Maritan 2017: 488).

Scientific: PIXE analysis

As part of the program in the study of pottery from Tell Ahmar, ceramic samples were analysed with particle induced X-ray emission (PIXE) to identify the characteristic composition of selected sherds (Kieft et al 2002). On the use of PIXE and its application for ceramic analysis, Rizzutto and Tabacinks mention: 'PIXE is widely used to determine the elemental composition of archaeological objects' (Rizzutto and Tabacinks 2017: 382).

In addition to the PIXE analysis of the Tell Ahmar pottery, pieces from other nearby sites (Jebel Khalid, Tell el-Banat, Tell Aber) were also analysed. The samples were irradiated with a scanned 3 MeV proton beam using the University of Melbourne nuclear microprobe. The samples from Tell Ahmar included Common Ware and Palace Ware, as well as Grey Ware, Red Slip Ware and Fine Ware. The composition of all sherds measured by this method was similar. However, cluster analysis of the twelve most abundant elements revealed that the samples known to be from Tell Ahmar could be distinguished from those known to be from elsewhere. The natural variation in the samples was too large to discriminate the samples based on the concentration of one element. But a cluster analysis of all detected elements revealed that samples from Tell Ahmar could be discriminated from the samples found elsewhere to a high probability. Discrimination of the samples was mainly based on Manganese (Mn), Gallium (Ga), Strontium (Sr), Niobium (Nb) and Zirconium (Zr). The samples from Tell Ahmar contained a higher concentration of these elements than the samples known to originate from other places. The

Figure 7: *Test bars of the different clay samples.*

Site name	Glazed Fabrics	'Palace Ware'	Ivories	Reliefs/ Sculpture	Palace/ Residence	Temple/s	NA Texts
Central Assyria							
Ashur	X	Xd	X	(X)	X	X	X
Nimrud	X	Xd	X	X	X	X	X
Khorsabad	X	Xd	(X)	X	X	X	X
Nineveh	(X)	Xd	(X)	X	X	X	X
Balawat		Xd			X	X	
Ibrahim Bayis		Xd				X?	
Kar-Tukulti-Ninurta		Xd					X
Kh. Khatuniyeh	X	Xd					
Kh. Qasrij	X	Xd					
Kh. Shireena		Xd					
N-Jazira No. 113		Xd					
Rownak		X					
Tell Abu Dhahir		Xd					
Tell Baqaq2					X		X
Tell ed-Dem		Xd					
Tell el-Hawa		X				X?	X
Tell Rimah		Xd		X		X	X
Tell Shelgiyya		Xd					
Tell Taya	X	Xd					
Khabur Valley							
Girnavaz		X					X
Tell el-Hamidiya	X		X		(X)		
Tell Abu Hafur E		X					
Tell Rad Shaqrah		Xd					
Tell Fakhariyah		Xd		X			X
Tell Halaf	(X)	Xd					
Tell Boueid		Xd			X		
Tell Ajaja		(X)		X	X		
Tell Sheikh Hamad	X	Xd	X	X	(X)		X
Upper Euphrates							
Sultantepe	X	(X)			(X)		X
Tille Höyük	X	Xd			(X)		
Tell Ahmar	X	Xd	X	X	X	X	X
Tell Shiukh Fawqani	X	X					X
Middle Euphrates							
Yimniyeh		(X)			(X)		
Bijan		(X)					
Ju'ana		(X)					

X = recorded (X) = reported d = dimpled ? = questionable

Table 2: *Features of the Material Culture of the Assyrian Elite (from Hausleiter 2008: 222).*

petrographic findings support the identification of a Tell Ahmar ceramic region or tradition (Kieft et al 2002).

Archaeological: basalt tournette – part of potter's wheel

Finally, a basalt tournette that was found on the surface of the site at Tell Ahmar is thought to be part of a potter's wheel (Trokay 1990: 123–85). Few potter's wheels have been preserved from the Late Assyrian period, which Roger Moorey believed indicated a technological transition from stone and ceramic to organic or wooden wheels (1994: 146). If the basalt tournette was part of the bearings of a potters' wheel, it would support local pottery production at Tell Ahmar.

Material culture of the Assyrian elite

In a study on features of the material culture of the Assyrian elite, Arnulf Hausleiter identifies seven categories: glazed fabrics, palace ware, ivories, reliefs/sculptures, palaces/residences, temples and Neo-Assyrian texts, Table 2 **(**2008: 222). All these categories are represented at Tell Ahmar (Bunnens 2022). Significantly, Tell Ahmar is the only site with all seven categories outside the Assyrian heartland. As noted previously, at Tell Ahmar Glazed Ware and Palace Ware are rare and highly specialised products, Figure 8.

The 'Palace Ware Problem'

Palace Ware is found throughout the Assyrian Empire (Hunt 2014; 2015; 2016; 2017). Bradley Parker claims that the term Palace Ware is misleading for several reasons. According to Parker, the analysis of the distribution of this type of ceramics in the Cizre region, and in the upper Tigris area, has shown that Palace Ware vessels do not occur only at the larger sites where it may be likely to encounter a palace or other institutions of centralised administration. Parker claims that Palace Ware vessels are evenly distributed in large central sites as well as smaller villages (Parker 2001).

Palace Ware is used to make small goblets and sharply carinated bowls. Both the eggshell thin ceramic bowls and goblets are thought to imitate metal prototypes (Ohtsu 1991: 131–53). The size and shape make them ideal drinking vessels. It has been suggested that the sharp shoulder carination of the bowls would have trapped any sediment or residue often found in wine (Stronach 1996: 175–95).

Ceramically, Palace Ware is characterised by the following attributes:

- delicate eggshell thin walls
- fine-grained, highly levigated fabric
- wheel thrown and pinched rather than cut from the hump
- thrown to its current thinness
- dimpled to facilitate handling while wet from the wheel
- high fired in an oxidising kiln

Figure 8: *Palace Ware goblet from Area C. Image: courtesy Guy Bunnens.*

- made of clay with a low iron content
- highly specialised and difficult to manufacture

Dimples are the frequent, distinctive and identifiable decorative element on Palace Ware goblets. No other Neo-Assyrian ceramic ware is decorated with dimples, making them unique to the Palace Ware corpus.

In 1927, Petrie uncovered a cache of thin-walled pots during excavations in Palestine which reminded him of metal vessels from Assyria. Petrie believed the presence of these ceramics at Tel Jemmeh resulted from the occupation and administration of the city by the Neo-Assyrians during the 8th–7th centuries BCE (Petrie 1928; Ben-Shlomo 2016; Engstrom 2004; Na'aman & Thareani-Sussely 2006).

The term 'Palace Ware' was first used by Rawson in 1954 to refer to all the ceramics from the North-west palace at Nimrud (Rawson 1954). Archaeologists began to associate it with cultural constructs, particularly Neo-Assyrian power and prestige, reinforcing Petrie's earlier belief that the presence of Palace Ware outside the Assyrian core was indicative of Neo-Assyrian imperial occupation or administration (Rawson 1954).

The 'Palace Ware problem' is a term coined by Alice Hunt, noting Palace Ware has been equated with imperial identity (Hunt 2015: 2). According to Hunt, archaeologists use Palace Ware as an 'index artefact' of Neo-Assyrian imperial occupation and administration. However, as Hunt points out, this connection has yet to be concretely established, noting, 'The Palace Ware problem is compounded by limitations inherent in the material itself and the materials available for study and analysis, most of which were excavated 60–100 years ago and for which limited archaeological information is available' (2015: 2).

Mode of production	Location	Frequency and income	The potters	Labour division	Technology	Variability	Scale	Distribution
Household production	Private household	Occasional or seasonal, no extra income	Mostly women	No	Simple, no wheel or kiln	Possibly high	Small quantities	Private household
Household industry	Private household	More regular or seasonal, small income through sale	Mostly women	No	Simple	Possibly high	Small surplus	Private household and others within the community
Individual workshop industry	Workshop with inner spatial divisions, isolated	Part time or full time, major family income	Mostly men	Yes	Wheels, kilns	Standardized or serial production, and special shapes	Medium to large	Markets and peddling, local and regional
Nucleated workshop industry	Several workshops in one location, workshops with inner spatial divisions	Full time, major income	Mostly men	Yes	Wheels, kilns, high technological investment	Standardized or serial production, and special shapes	Medium to large	Markets and middlemen, local and regional
Manufactory	Specialized manufactory, large scale	Full time, profit oriented	Large number of workers under a supervisor	Yes	Complex, often specialized in one product	Standardized production, high worker specialization	Mass production	Very wide distribution, supra-regional
Estate production	On the estate premises	Full time or part time, not for profit	Mostly men	Most probably yes	Wheels, kilns	Standardized and functional?	Medium to large	Estate
Military or official production	On military or state premises	When possible part time, not for profit	Mostly men	Yes	Efficient use of technology	Standardized and functional?	Medium to large	Military organization or state institution

Table 3: *Modes of Production (from Duistermaat 2008: 341).*

Hunt argues Palace Ware was not a traded or transported commodity (2015; 2016; 2017). Rather, she suggests it was given as honour-gifts by the king to members of the imperial administration and its allies in a material signifying their rank and role within the empire. Although Palace Ware bowls may have been reserved for the lower ranking members of the Empire, Hunt asserts that the conspicuous consumption of the form identified the consumer as a person of importance, power and prestige, and a loyal participant in the Neo-Assyrian imperial system. As a symbol, Palace Ware bowls represented loyalty to the Assyrian king and State. Hunt explains, Palace Ware goblets and cups were used in the Neo-Assyrian imperial practice of the conspicuous consumption of grape wine (Hunt 2015; Stronach 1996: 175–95). Therefore, the value and meaning of these vessels are derivative of the value and meaning of grape wine; a luxury good, reserved for the elect and elite.

In a relief from the palace at Nineveh depicting Assurbanipal feasting, or at least drinking, with his queen-consort Aššur-šarrat below grape vines, the queen is holding a vessel with a similar shape to Palace Ware carinated bowls designed for consumption of grape wine.[8] As symbols, Palace Ware goblets and bowls represented wealth, privilege and access, and the consumption and possession of the vessels themselves indicated the relative status or individual power of the consumer. According to Hunt, despite its association with the Late Assyrian period in general and the Neo-Assyrian imperial administration specifically, it is important to note that Palace Ware was always a local phenomenon (2015). Hunt asserts that: 'Although it is likely that Palace Ware from the Central Polity were transported across the imperial landscape as vessels, due to their social function as honour-gifts, Palace Ware in general was not a traded commodity' (2015: 206). Based on extensive petrographic analysis, Hunt has concluded that these vessels were manufactured locally, possibly by 'Central Polity', or by 'Central Polity' trained, potters in the annexed provinces for local consumers.

Modes of Production

In a consideration of different modes of production (Table 3), Palace Ware falls into what is described as a 'manufactory mode of production', characterised by fulltime, complex, specialised mass production and very wide distribution. If we apply the criteria presented in Table 3 to other Neo-Assyrian ware types, it is possible to see that multiple modes of production are represented: household, household industry, workshop, manufactory, estate, etc. This suggets that there were multiple production modes involved in manufacture of the Tell Ahmar Neo-Assyrian pottery assemblage.

Conclusion

This search for the 'potters behind the pots' at Tell Ahmar, has revealed the following:

- There were different potters producing different pots during the Neo-Assyria period.
- Some were male, others were most likely female.
- Some were full time specialists, other's part time.
- Some used relatively simple methods of manufacture and firing, others used more complex technologies and processes.
- Some produced highly standardised mass-produced wares, others less so.
- Some modes of production were local, others were centralised or foreign.

According to Nicholas Postgate, pottery is an integral component of the package of Assyrian occupation: remarking, 'the development of standardized ceramic assemblages was not an intentional imposition of a centralized state administration but rather as a response by the potters to the growing demand for certain functional types often with specific volumetric requirements' (2010: 27).

This re-examination of the Tell Ahmar Neo-Assyrian pottery assemblage is aligned with movements in imperial studies to replace global, top-down materialist models with theories of contingency, local agency, and bottom-

up processes (Düring & Stek 2018; Parker 2018). Such approaches bring to the foreground the reality that the development and lifecycles of empires in general, and the Neo-Assyrian Empire in particular, of which Tell Ahmar certainly played a key role, cannot be completely explained by the activities of the core.

Tell Ahmar lost its status as a regional centre with the fall of the Assyrian Empire at the end of the 7th century BCE. The completion of the Tishreen Dam in July 1999 caused the flooding of part of the village, while most of the modern houses that had not been flooded were abandoned. The villagers carried away everything they could, in particular doors, window frames and rood beams. During the civil war, troops fought for control of the area. The Acropolis was bulldozed and became a military installation. On these developments Bunnens remarked: 'The geographical advantages that had made the prosperity of ancient Tell Ahmar caused the ruin of the modern village' (Bunnens 2022: 192).

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Endnotes

1 This is a revised version of the Petrie Oration presented by the author at the Australian Institute of Archaeology on 26 October 2023. The author would like to express his appreciation to Dr Christopher Davey, Director of the Australian Institute of Archaeology (AIA) for the invitation to give the 2023 Petrie Oration. Chris is a very generous colleague and has done a brilliant job running the AIA. The 2023 Petrie Oration was dedicated to Professor Ian Edwards, a long-time member of the AIA board. In fact, it was Ian's idea to establish the Petrie Oration.

2 On Franken, see also Vilders 2005; van As 2005; van As and Steiner 2005.

3 The first volume was published in 1983. The series ran for 26 years until its last volume was issued in 2010. Abraham van As succeeded Franken as the journal's editor. https://ancientworldonline.blogspot.com/2019/10/newly-open-access-journal-leiden.html

4 The following account on the excavations at Tell Ahmar draws heavily on the work of Guy Bunnens, Director of the renewed excavations at the site. The author would like to thank Profs. Guy Bunnens and Arlette Roobaert-Bunnens, for generously supporting and encouraging all aspects of the Tell Ahmar pottery analysis.

5 On Tell Ahmar, see most recently Bunnens 2022; for selected bibliography on the field work at Tell Ahmar, see 197–198.

6 Thureau-Dangin and Dunand 1936. Thureau-Dangin and Dossin founded the *Rencontres Assyriologique Internationale* (https://iaassyriology.com/rencontre/).

7 On sites in the flood zone, see Del Olmo Lete and Montero Fenollos 1999. Roobaert and Bunnens 1999, 163–178.

8 Stronach 1996, 190–192. https://www.britishmuseum.org/collection/object/W_1856-0909-53

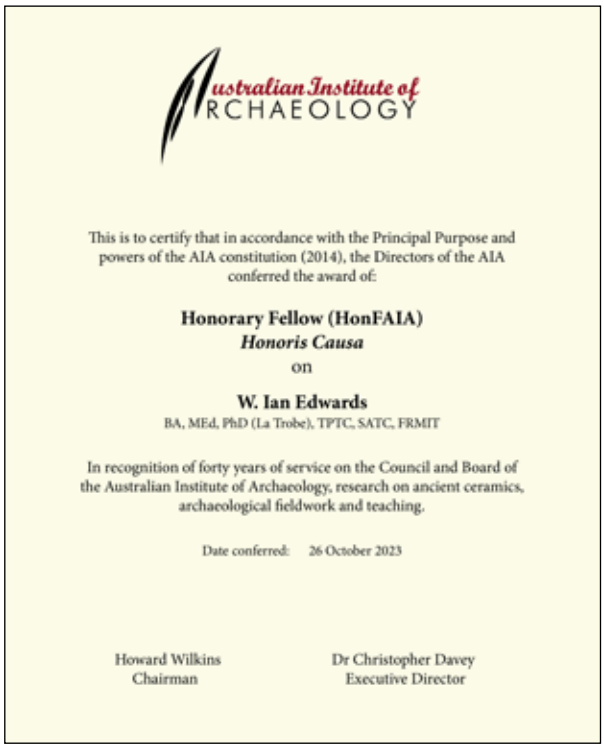
Addendum: The award of Honorary Fellow of the Australian Institute of Archaeology to Ian Edwards

Ian Edwards joined the Council of the Australian Institute of Archaeology in 1983. He has remained on what is now the Board of the Institute until now, and served as the President for a period. He instigated the Petrie Oration and has always promoted practical archaeological policies.

Ian took up archaeology when Deakin University (previously Burwood Teachers College) awarded him a scholarship to apply his knowledge of ceramics to archaeological pottery. With ongoing support, Ian continued to dig annually with the University of Sydney at Telielat Ghassul and Pella for nearly twenty years. Other excavations that he worked on during this time included at Dakhla Oasis and Tell Ahmar.

Ian worked with Professor Henk Franken of Leiden University, embracing his approach to the technology of ancient ceramics and, completed a PhD in 1993 at La Trobe University entitled *A potter's view of bronze age Pella {Jordan): a study of ceramic technology*. At Deakin University he developed an archaeological materials research unit and fostered the research of several scholars. He contributed significantly to the establishment of the Egyptological Society of Victoria. Ian has encouraged many scholars, one such being Associate Professor Andrew Jamieson who enrolled in archaeology at the University of Melbourne after hearing Ian speak at the Royal Melbourne Institute of Technology.

Figure: 9 *Ian Edwards and Stephen Bourke at Pella 1985 repairing a hot water service. Image: courtesy Stephen Bourke.*



Australian Institute of ARCHAEOLOGY

This is to certify that in accordance with the Principal Purpose and powers of the AIA constitution (2014), the Directors of the AIA conferred the award of:

Honorary Fellow (HonFAIA)
Honoris Causa
on

W. Ian Edwards
BA, MEd, PhD (La Trobe), TPTC, SATC, FRMIT

In recognition of forty years of service on the Council and Board of the Australian Institute of Archaeology, research on ancient ceramics, archaeological fieldwork and teaching.

Date conferred: 26 October 2023

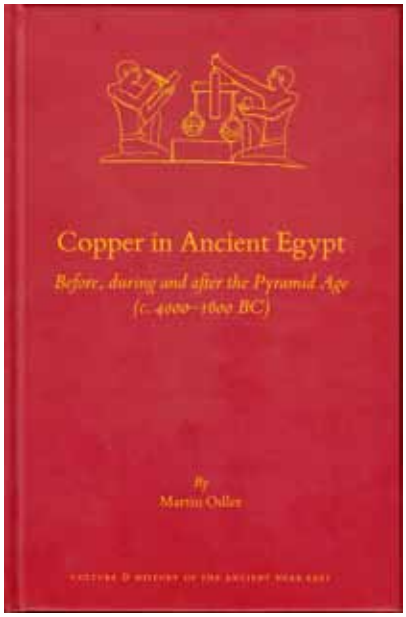
Howard Wilkins
Chairman

Dr Christopher Davey
Executive Director

While preparing the 2023 Petrie Oration, the current director of the Pella project, Dr Stephen Bourke, sent Andrew the following recollections of Ian at Pella:

> *Ian is affectionately remembered at Pella as 'the great repairman'. Nothing that broke could resist his touch. Our cranky generator, hot water systems and kitchen cookers, among many other things, were kept going well past their use-life by Ian's magic [Figure 9]. His serious side was as ceramic technician, and he brought a small electric kiln to Pella in 1981, wherein he delighted in showing us the effects of reducing and oxidising firing, often joining grey and red sherds together to make his 'showmanship' point. He was employed in later seasons in the 90s as a draftsman, and a very fine one too. His knack for repair was on display one year (you will guess which) when a fragmentary but complete to profile large Chocolate on White jug was drawn complete and successfully, when Ian created an internal cardboard hive-like support for the bulbous exploded pot, allowing him to hold it one-handed and secure, while he drew it onto paper. The cardboard creation was quickly christened the 'Death Star'. Ian was always a jolly, positive and very practical team member, whether assisting in the field, or working in the house. Every time I have to replace a broken item, I rue the fact Ian isn't there, as I know he'd have fixed the offending item quick-smart.*

Reviews



Martin Odler, 2023, *Copper in Ancient Egypt: Before, During and After the Pyramid Age (c. 4000–1600 BC),* Culture and History of the Ancient Near East, Book 132, Leiden: Brill, ISBN: 9789004524088, pp. 810, + xlviii, figs 310, A$395.

by Christopher J. Davey

The first English scholarly book on ancient Egyptian metallurgy was published in 1927. It was written by Major Herbert Garland and Charles Bannister, Professor of Metallurgy, University of Liverpool and ran to 214 pages. The book under review illustrates the growth of the field, it focuses on copper only prior to the New Kingdom, but still has 810 pages including 140 pages of bibliography, 40 pages of indexes and 310 figures, plus 48 pages of front matter, and there are an additional 40 tables online at https://doi.org/10.6084/m9.figshare.22293871. An online version of the book is also available.

The author studied at Charles University, Prague, and has been involved in fieldwork with the Czech Institute of Egyptology, Faculty of Arts, Charles University at Abusir and at Sabaloqa in the Sudan, and with joint Polish-Slovak mission at Tell el-Retaba. Dr Martin Odler is currently the Marie Sklodowska Curie Fellow, Newcastle University; School of History, Classics and Archaeology. His earlier published research (Odler 2016) contains much detailed analysis and is the kernel for this book.

In the Preface Odler explains that the 'objective of the monograph is to present a narrative, a synchronic and diachronic reconstruction of the development and changes of the *chaîne opératoire* of copper and copper alloy artefacts based on the preserved evidence' (p. xiv). The evidence considered includes texts, iconography and metal artefacts and their scientific analyses. He observes that 'copper was always "foreign" to the Egyptians' (p. xvi) because it was not sourced from the Nile valley, but he does not speculate on the implications that this may have had for technological innovation in ancient Egypt. While the book should be of interest to Egyptologists and everyone interested in Archaeometallurgy, he acknowledges that the 'design and cost' of it will largely limit it to academic and professional libraries (p. xviii).

The subject is defined and outlined in the Introduction. It considers copper and its alloys from when they first appear in Egypt during the Badarian period in the fourth millennium BC until the end of the Second Intermediate Period. The discussion brushes past issues of archaeological theory and concludes that 'the main research question of the monograph must be expressed in a different manner, as a practical one: we know that ancient Egyptians used copper, but how?' (p. 23). This is refreshingly blunt.

The adoption of such a practical approach leads to a chapter discussing *chaîne opératoire,* a methodology that seeks to identify the stages or processes of production. More specifically, 'these steps involve everything from the procurement of the ore to the use and reuse of objects made of that ore' (p. 24). The activities involved may relate to non-copper-based materials and artefacts, although I do not agree that metalworking ceramics were no different to other ceramic vessels (n. 8 p. 28); the application of heat by potters and metalworkers was fundamentally different in character and intent. The discussion about the origin and nature of *chaîne opératoire* is useful as it acknowledges that modern categorisations will be very different from those practised in antiquity.

The monograph is based on two large databases, one containing archaeological and archaeometallurgical data and the other, textual and iconographic material. Their nature and background are discussed, but little detail is given. There is a brief introduction to archaeometallurgical methods, non-invasive and invasive. The British Museum is mentioned a couple of times to have contributed the most significant number of analyses, an indication that the study of ancient Egyptian artefacts focusses on material held outside the country. Chapter Two concludes with ethno- and experimental archaeology. Experiments by Stocks on a New Kingdom smelting furnace and those by Verly and Rademakers on Middle Kingdom installations at Ayn Soukhna are mentioned, but John Merkal's replication and operation of a New Kingdom smelter at Timna and the reviewer's pioneering experiments with crucibles depicted in numerous Old Kingdom tombs are not, although the paper publishing that latter work is listed in the bibliography.

Ancient Egyptian words for metals and metalworkers are examined in Chapter Three. An introduction to copper-arsenic alloys used during the Old Kingdom prompts the suggestion that there may have been different names for

copper with impurities, copper with low concentrations of arsenic, and copper with high concentrations of arsenic (p. 68). Two hieroglyphic signs for metal are identified to be the 'drop', similar to X3, and N34, a crucible. This section may have been more useful if it had summarised the history of the interpretation of hieroglyphic ideograms relating to metal, referencing Maspero (1902), Erman (1919) and Junker (1958), amongst others, before presenting further arguments. Contrary to note 71, p. 89, when in 1985 I suggested that N34 was a crucible I was not 'following' anyone. Gardiner's sign list and identification of N34 as an ingot were universally accepted in England at the time, and my suggestion was based on the identical shape of the ideogram, the profiles of the crucibles depicted in tomb scenes and those found at Tell edh-Dhiba'i that I had published. When Professor Boyo Ockinga (2005) listed Gardiner's sign N34 as an ingot U30A, he was following Junker (pers. comm.). The words *bḏ3.t* and *bḏ3.ty* for crucible and metalworker are discussed with illustrations of signs as they occur.

Under the heading *Expeditions*, the prospecting for, and mining and initial processing of copper is addressed. The logistics of mineral procurement expeditions are briefly reviewed from the Egyptian perspective, with the suggestion that such ventures were undertaken from the late fourth millennium, when the evidence indicates that they occurred less than once a decade to any one region. There is little recognition of local prospecting, mining and processing of minerals in these areas until the Middle Kingdom. The chapter considers regions radially, Eastern Dessert, Nubia, Sinai etc, for each period in turn, Predynastic and Early Dynastic, Old Kingdom, Middle Kingdom and Second Intermediate. This is a little confusing as the earliest metalwork in Egypt is found at the site of Maadi and was probably the result of trade with the more distant Wadi Arabah, so it appears at the end of the Predynastic section, well out of chronological order.

The summaries of evidence for each region do provide useful overviews clarifying the current knowledge. There is, for example, no evidence connecting the Wadi Faynan, Jordan, with Old Kingdom Egypt (p. 131). Those wanting a definitive explanation for the pyrometallurgical operations at Ayn Soukhna will be disappointed. It is still not clear why smelting took place there when there were contemporary smelters in Sinai. Chapter Four ends with an acknowledgement that lead isotope data is limited, especially for ore deposits, and ore samples from datable archaeological contexts, so that many conclusions are only tentative. This is considered to be the 'gravest' problem in current Egyptian archaeometallurgical research (p. 153).

Chapter Five on the administration of copper resources by the Egyptian state gives rise to much conjecture, because of the limited evidence available and because the distinctive characteristics of metalworking, which set it apart from Nile valley rural production, are not considered. Copper was not then a commodity because its value depended upon work of a small number of skilled artisans and the application of other resources, such as charcoal.

The role of the Treasury and the officials in charge are discussed in relation to titles, weights and measures, and 'sealing'. The two known units of weight are not well understood during the Old Kingdom, but can be better quantified in later periods. There are numerous weighing scenes in tomb images and most of them show the weighing of the fabricated metal objects, not the raw material. The reason for this is not clear, but is consistent with Odler's observation that the weight of Old Kingdom metal vessels appears to have been standardised. The central administration of metals is important for Odler because he believes that the distribution of metalwork in Egypt during this period was only amongst elites, who depended upon royal patronage. The chapter concludes with a comment on tomb looting, which included the removal of copper objects. Over time, this may have changed the distribution of copper in ancient Egyptian society.

Chapter Six turns to 'the professionals working with … metals, their social standing, and institutional connections' (p. 213). It is deemed that there are sufficient mentions of Sokar to designate him to be 'the deity of the metalworkers and a metalworker of the ancient Egyptian "pantheon", thus an early precursor to the Greek god of crafts, metalworking in particular, Hephaistos' (p. 215). Metalworkers' social status and standing are investigated through title and tomb. There is little Predynastic evidence, but many metalworker titles appear during the Old Kingdom and there are some metalworkers' tombs. It is hard to assess the significance of the data and there is no attempt to do so. The titles generally relate to overseers who may not have had metalworking skills. Grave 4964 at Badari is described (p. 238), it was uninscribed and contained a man buried with a crucible, but the fact that the crucible had been used many times until it was unusable is not mentioned. The practical implications of the metalworking craft seem to be generally overlooked. In this case it is significant that the person was not buried in a tomb bearing his title, but with his tools of trade, two hammerstones and a dilapidated crucible, revealing who he was and what he had accomplished. The available data, an awareness of the structure of Old Kingdom society and an appreciation of the risks and intricacies of the metalworkers' craft, could provide the basis for a coherent account of the metalworkers' status.

Chapter Seven on workshops includes images or drawings of most of the metal workshops portrayed on the tomb walls of the period. The categories of text are mentioned, as are the possible types of building that the workshops may have been in, but the processes depicted pass without comment. One reason for this may be the issue of interpretation. It is acknowledged that some scholars believe the images to be 'works of art based on "pattern" books with only a loose connection to reality' (p. 258),

while this reviewer is cited to be one who believes them to be 'realistic'. The paper that is referenced here, Davey (2012), presents an approach that is not so simplistic. Even the casual observer can see that no two scenes are exactly alike. I identified the essential technical details that are consistently depicted in the scenes and offered explanations for the variations. Those who advocate a pattern book origin need to do likewise and then explain why the pattern book images had no relationship to reality. Odler makes a valid point that the tomb artists 'lived amongst other craft specialists and were inevitably familiar with the processes involved in the production of pigments, metal tools and other objects' (p. 259). He attributes some of the many misinterpretations to the two-dimensional nature of the scenes. With some justification he refers to the servant statue of a metalworker using a blowpipe and a crucible, which I published (2009), as a reliable illustration of the melting process. Later in the chapter, he also includes drawings and photographs of the crucible type depicted in the Old Kingdom tombs. The recently discovered crucible found on a Second Dynasty floor at Elkab is mentioned with a photograph and drawing (pp. 270, 278). Bitter experience has taught me to never speak about these crucibles without a replica to hand, as people normally cannot appreciate the three-dimensional nature of this asymmetric object from two-dimensional drawings.

Archaeological evidence for workshops, including furnaces, crucibles and ingots, from Maadi, Elephantine, Elkab, Heit el-Ghurab, Buhen, Balat, Kahun, Tell el-Daba and Ayn Soukhna, are described. A discussion about copper with impurities and copper alloys claims that arsenical copper has 'been seldom studied' (p. 303). That may be true for ancient Egypt, but work on Andean cultures (Lechtman 1999), European cultures (Budd 1993) and ancient Near Eastern metallurgy, has produced a large body of work on copper and arsenic. Indeed, Hauptmann suggests that 'the spread of arsenical copper marks the beginning of extractive metallurgy' (2007: 30). Odler favours the view that the alloys were the result of the intentional addition of arsenic to copper, but the form of arsenic added and the process used 'remains to be answered satisfactorily' (p. 305). Tin bronze is common from Dynasty 12, and arsenic contents diminish thereafter. There is a brief description of metal working techniques focussing on the hammering processes, but not on pyrometallurgy. The Reisner Papyri found in Tomb 408, Naga ed-Deir, and partially published by William Simpson are described. They account for metal tools being used at a ship building facility, and provide information that may illustrate tool dimensions and the organisation of their manufacture and repair.

There are three chapters reflecting on the products of the metalworking industry. This has been Odler's principal research for several years, and so it draws on his own publications and his large database. The first chapter deals with artisan's tools, the second studies tools for display, including weapons and objects associated with personal adornment, such as mirrors, and the third chapter, covers ritual objects. The analysis identifies tool kits for specific crafts or procedures and investigates the metrological properties of the objects to establish whether they were the result of state-controlled production. The sample size under consideration is 2,700 archaeological contexts. Tomb images of activities involving the application of metal implements are referenced and distribution maps are also included. These chapters are well illustrated and form a reliable introduction for anyone studying pre-New Kingdom Egyptian metal artefacts.

Tool kits for carpenters, and the textile and leather trades, are well represented in the archaeological record, while stone workers and quarrying tools are less so. The numbers of weapons of each type also differ. It is suggested that variations may arise from the popularity of an object type, or for some other reason, such as the recycling of metal. Many objects are unprovenanced, and even more have not been scientifically analysed. In the cosmetic tool kit for example, mirrors are well distributed from Kerma in the Sudan to the Delta, and are the most frequently analysed, whereas razors are more concentrated around Memphis and only fifteen have been analysed.

Although the distinction is not made in this volume, most of the copper vessels depicted in the Old Kingdom melting and casting scenes fall into the chapter on *Ritual Tools*. Metal components of furniture and boats, statuary and musical instruments are also included in this chapter. No consistent metallurgical picture emerges for these objects, and comprehensive compositional analyses and metallographic information is generally lacking.

The penultimate chapter attempts to put Egyptian copper metallurgy into an Eastern Mediterranean context. The origin of the technology is considered without any clear picture forming. The social status of metalworkers is discussed without any reference to itinerant people inhabiting remote regions where metal resources and the technology to process them were to be found. Parallels in weights and measures are also discussed. The comparison of metal artefacts provides a potentially more fruitful field of study, especially when examining different approaches to challenges, such as the hafting of axes and adzes. While there is regular representation of non-Egyptian weapons in Egypt, Odler found that the reverse was not true. As with so many issues, it is concluded that more archaeometallurgical analyses are required before connections can be identified (p. 583).

The conclusions are formed around two tables: one listing for each period the contemporary ore deposits, smelting sites, melting and production sites, artefact locations, use, textual and iconographic evidence, and changes and locations; the second lists technological choices made by ancient Egyptians compared to those made elsewhere in the Eastern Mediterranean. The text offers a lucid summary of the findings. The tentative character of the

evidence is acknowledged; 'this monograph could pose many questions, but answer only a few' (p. 595).

The book often misinterprets my work on Egyptian crucibles. On page 280 note 99, there is an unusual statement that 'C.J. Davey' has an 'opinion' that open crucibles were not used in Egypt. Why, one wonders, should anyone care. It is certainly odd, as I have published several ancient Egyptian open bowl crucibles (1985). The paper quoted to support this assertion, Davey & Edwards (2007), expresses no such opinion. What that paper does do, amongst other things, is draw attention to the fact that crucibles of the shape depicted in the Old Kingdom tombs have a failure pattern that leaves a fragment that is shaped like a broken open bowl crucible. In fact, the shape is exactly like the crucible fragment from Elephantine depicted in Figure 101 (p. 554), so rather than being an open bowl crucible, it would appear to be a fragment of the earliest known typical Old Kingdom crucible. The way the Elephantine crucible was published implies that the excavators thought it to be typical of those represented in Old Kingdom tombs. Archaeometallurgists have generally failed to engage with these common Early Bronze Age crucibles, meaning that they are seldom recognised. An exception was Israeli archaeologist Itzhaq Beit-Arieh (1985) who identified such objects in the Sinai. While moulds and bellows from this collection are mentioned by Odler (pp. 288–91), the crucible fragments are not.

It is understandable that, in a field of study of this magnitude and the preparation of a volume of this scope and size, that some material may be overlooked and some things will slip through. Remarkably, little has, but the indexes for example are of variable accuracy.

We are indebted to Odler for presenting an outstanding collection of data, which has brought to light much hitherto unnoticed material, and for formulating that data into chronological, geographical and process relationships. He addresses many rarely considered topics associated with the organisation of ancient metallurgy, and highlights the need for more evidence. No serious investigation of Egyptian metalworking henceforth can neglect this book. While it has identified words associated ancient Egyptian copper metallurgy, it has not considered the texts associated with the Old Kingdom tomb metalworking scenes, nor the technological details of the scenes themselves. These questions, amongst many others, are open for further attention, which will benefit from this monograph.

The book does encourage those responsible for museum collections, such as myself, to have ancient Egyptian metalwork analysed. The initiative would be significantly promoted by the availability of the author's database, because it would offer some guidance and incentive. Indeed, the publication of research increasingly requires that all associated data be made openly available, according to the FAIR principles (Findable, Accessible, Interoperable, Reusable). As this book demonstrates, until there is more accessible data and reliable analyses, the history of copper in Egypt will be assailed by many uncertainties.

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Australian Institute of Archaeology

DOI: https://doi.org/10.62614/herzrx39

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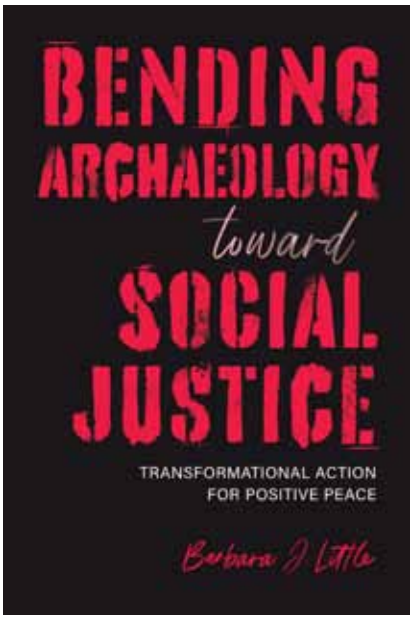

Barbara J. Little, 2023 *Bending Archaeology toward Social Justice: Transformational Action for Positive Peace,* Tuscaloosa AL: The University of Alabama Press in cooperation with the Society for Historical Archaeology, pp. 172+xvii; illus; A$61 (ppk).

Reviewed by Michael Lever.

I had keenly anticipated the arrival of this work. Although short (123 pages) its title resonates significantly with my personal vision of ethics as a primary motivation to engage in archaeology, in order to address wrongs of the past as they are manifest in current power structures. Barbara Little has worked widely in cultural resource management. hoped that her work would bring perspectives and insights into commercial archaeology, the field in which I am currently employed, particularly in a manner relevant to Australian practice.

Little does not fit comfortably into archaeological career trope definitions – at least not from her LinkedIn profile. With an undergraduate degree from Penn State University, and a Masters and PhD from SUNY University At Buffalo completed in 1987, her primary workplace has not been in academe, but a term of nearly 32 years at National Parks, up to 2012 as an archaeologist and subsequently as a Program Manager, Cultural Resources Office of Interpretation and Education. The University of Maryland Department of Anthropology lists Little as an Adjunct Professor, noting that she had taught there from 1989 to 1992. Despite not being entrenched in the academic sphere, she has published extensively in full book format with at least five works on the topic of heritage, heritage assessment and evaluation. Little is then well placed to comment on the coalface of archaeology as it interacts with development and the ethical quandaries that arise from this, as well as being active in research and publishing spheres.

The current work is presented as the first in a series *Archaeologies of Restorative Justice* jointly published by the University of Alabama and the Society of Historical Archaeology (SHA). The series is driven by the efforts of the SHA to reform itself through recognition and address of inequities including racial and gender bias. The term Restorative Justice refers to processes in which not only are past wrongs identified, but ways are sought to heal and offer recompense for such wrongs – as contrasted with the more common notion of retributive justice. I would put it more broadly that the purpose of all archaeological theory and practice is ethics. That is, if the purpose of these endeavours is to assist in approaching truths of the past, and truth is an ethical value.

Archaeology has from outset been embedded in ethical debate whether overt or not. It has regularly engaged in practices likely unethical by standards of the time, and often certainly unethical by the later standards of societies that are left with the burden of repatriating or compensating for past archaeological activities. Balzoni, Elgin, Layard, Mellaart, Mulvaney, and so many more. The tags on unrepatriated archaeological objects in collections around the world bear the names of those who gathered them in the sake of varying values including empire, wealth and science, the worldviews of which without question overruled the rights of local and descendant communities to determine the fate of their own material heritage.

This sense of entitlement of archaeologists to the material record is not a historical concern but is a current issue. In New South Wales (NSW) where I am based, the material record of Aboriginal people is subject to the NSW *Parks and Wildlife Act* (1974), an almost 50-year-old and unrevised piece of legislation in which the legal definitions of Aboriginal heritage were reached without consultation with Aboriginal people. NSW, one of Australia's larger states with a substantial Aboriginal population, is the only state to still operate without standalone Aboriginal Heritage Legislation – let alone legislation that empowers Aboriginal people to define and determine the fate of their material heritage. The move beyond recognition of First Nations rights, to reach decolonisation of archaeological research methodologies and the activities that implement them, is a field gaining increasing traction among First Nation academics and allies e.g. Tuhiwai Smith (2022).

The issue of ethics in archaeological practice in Australia is highlighted by the following: In Australia, many professions require practitioners to hold membership in governing professional bodies. These bodies both authorise the individual to practice, and also police ethical practice among members. Examples include the Medical Board of Australia, the Victorian Institute of Teaching, and Engineers Australia. There is no such mandatory requirement regarding archaeology in Australia. Some states such as Victoria issue lists of approved Heritage Consultants (Heritage Victoria, 2023).

These lists are based on formal qualifications rather than ongoing evaluation of ethical conduct. The only hurdle-based professional organisation for archaeologists in Australia is the Australian Association of Consulting Archaeologists Inc. (AACAI). of which I am a member. AACAI membership is very low as a proportion of all consulting archaeologists in Australia. There is an explicit AACAI code of ethics, however there is no capacity to regulate the conduct of non-members, and little to no oversight or capacity to regulate the conduct of members. Anecdotally, in the approximately ten years of my tertiary archaeology education in Australia (allowing for part-time candidature), I received no education on archaeological ethics other than the standard administrative 'ethics' approvals required for post-graduate research. In stark contrast, my education degree contained constant overt and implicit consideration of ethics. Given all the above, a work that purports to bend archaeology towards the ethical concerns of social justice should be of inherent interest to those working in archaeology. Whether Little's brief work succeeds in this grand aim is questionable. As I will illustrate in some greater length below, the brevity of the work means that it transitions rapidly from highly compressed and dense theoretical considerations to generally scant case models with little room to flesh out in depth the interrelationships between theory and practice, let alone express theory in a digestible manner.

Despite the extent to which they may be overpowered in this brief book by dense discussions of theory and brief case studies, the notion of Restorative Justice and the understandings of human relations that underpin it are deeply core to the personal values from which Little writes. She appeals to the potential of 'archaeology's role in recognising and lifting up the sacredness of humans' (p. xvii). The sacred nature of humanity is not a notion I have often encountered in archaeological texts. Further, it is hardly usual to have love appealed to as a core value for archaeological action, yet this is precisely Little's proposition, 'At its core this book is about love… This book asks archaeologists to cultivate that love and bring it to the power of archaeology to join the struggles for healing, justice, and a thriving world' (p. 2). The concept of love referred to here is not expanded upon, and for all the centrality that Little places on it, the word itself is only mentioned a handful of times throughout the book. Love apparently has a self-evident meaning for Little.

Little demands a social justice based on love and appreciation of the sacred nature of humanity. However, her definition of the meaning and origin of the notions of social justice appears to be wholly based on the works and thinking of economic and rationalist philosophers, rather than on this undefined notion of love identified above. She cites Herbert Spencer, Karl Marx, John Rands, Charles Mills and Martha Nussbaum in drawing the origins and current understanding of Social Justice as a concept based on rationality, fairness and reciprocity. This is tied to a brief sketch of past archaeological approaches to matters of ethics among archaeological authors in the USA. These attempts have primarily consisted of academic efforts to decolonise the discipline. Little places her work within the framework of the 17 United Nations Sustainable Development Goals (SDG) (2015), a set of ambitious aims intended to be reached by 2030, epitomized by the first goal: 'End poverty in all its forms everywhere'.

The book is arranged with an introduction and six chapters: Introduction: Archaeology and Social Justice; 1 Violence, Peace and Social Justice as Positive Peace; 2 Cultural Domain of Power; 3 Direct Interpersonal Domain of Power; 4 Structural and Disciplinary Domain of Power; 5 Climate Justice; 6 Reality, Hope, Imagination.

Chapter One opens with a theory laden exploration of types and modes of violence that exist on structural, cultural and individual levels. and a deeper exploration of key literature that Little draws on when outlining her definition of social justice. The chapter is reminiscent of the highpoint of post-processual theoretical explication of the late 1980's, replete with sequential quotes from authors invoked as authoritative and who are likely to be unfamiliar to the average archaeological reader. It includes chunky block diagrams and a detailed flow chart. This section reads more like a shorthand literature review than it does an invitation to the reader to engage.

In this chapter Little introduces her key conceptual innovation, the unwieldly named 'Diachronic Transformational Action' which consists of three parts (p. 33). The first part, 'Diachronic', is named such as it analyses the relationship between webs of power in the past and present, particularly through Walther Benjamin's notion of now-time, in which the past is pulled into and disrupts the present (p. 37). The second part, 'Transformational', reflects the aim to disrupt all three domains of established power, namely cultural/hegemonic, direct/interpersonal, structural/interdisciplinary. Lastly, the field of 'Action' is an overarching demand for cooperative effort in the demolition of the above-mentioned structures of power.

The chapter closes with a rapid jump to a potential example of community-based and structure-challenging archaeology, that of the African Burial Ground Project in Manhattan. Unfortunately, this depiction is too brief for those not already well familiar with the project to gain an understanding of just how it may have reflected and embodied the aims that Little seeks to demonstrate. There is however a concept that emerges from description of the African Burial Ground Project that is surely essential to commercial archaeology, and most pertinently in our case, the practice of Aboriginal archaeological heritage management. This is the explicit recognition that the archaeologist has two clients – the 'business client' who has engaged the archaeologist, and the 'ethical client' – the descendant or residential community to whom the archaeologist has an obligation beyond the strictures of legislation (I would add a second ethical client – the heritage and archaeology itself). Little mentions commencing efforts in USA commercial practice to involve descendant communities in archaeological work

through training and employment. Interestingly this has current parallels in Australia where at least two companies (Comber and Associates and Artefact Heritage and Environmental Services) have employed and are training Aboriginal staff to take on roles in heritage management to the extent permitted by current legislation for individuals without tertiary qualifications.

Chapter Two is highly USA-centric, basing notions of social justice in documents such as the USA Declaration of Independence and Constitution, yet several points made by Little apply well to other colonised countries including Australia. Little observes the way history as taught in the USA has long focused on heroic narratives of conquest within and without its territories, resulting in an ahistoric public consciousness of the detailed domestic past among many of its citizens. These gaps have been used by disempowered groups such as women and Black Americans to forge for themselves histories and historical contexts. Similarities may be observed in Australian history and archaeology.

More broadly, and highly applicable to Australian history, is Little's cogent observation that 'nothing in the history of the United States makes sense except in the context of whiteness' (p. 46). This of course is not a statement concerning race rather she cites Lea & Sims (2008: 11–12), that whiteness is a 'complex hegemonic and dynamic set of mainstream socioeconomic processes, and ways of thinking, feeling, believing, and acting (cultural scripts) that function to obscure the power, privilege, and practices of the dominant social elite'. Little proposes it is the social justice responsibility of archaeology to investigate and expose the historical roots of this white privilege in archaeology, the roots of which almost invariably have their source in overt racism, and to reform current archaeology accordingly.

Little proposes that it is not sufficient to identify racism in others and in the discipline of archaeology generally in order to achieve such reforms. Drawing on Henze and Green (2020), she identifies two alternative phases of reflection on racial identity, one phase that does not tend to result in meaningful change, and the second that is likely to reach such change. In the first phase, racism is noted by the individual as immoral but is generally identified as a practice engaged in by others. The second phase or mode of reform is characterised by a personal introspection which the individual identifies and examines their own racist tendencies and the entitlements on which they are based, leading to an acceptance of the need for change at the personal and disciplinary levels (p. 62).

This second phase may provide a bridge of sorts between Little's rational definition of social justice, and her call for love as the driver towards this. The second phase calls for personal introspection and what in religious terms could be described as meaningful penitence through the process of Restorative Justice. I assume that Little envisages that such introspection coupled with a love of humanity results in a desire to ensure that rationally defined social justice is available to all. Again, this chapter closes with brief (two pages) examples of pertinent case studies around the archaeology of Black Americans.

Chapter Three returns to Benjamin's notion of now-time and the concept that communities with painful pasts experience this pain in the present. In the face of mainstream attempts to portray the past and its pain as passed, such communities maintain and produce alternative histories that accompany their intergenerational trauma. The existence of all three of these factors – past pain, alternative histories, and intergenerational trauma – are generally denied by the white beneficiaries of historical and current social injustice, who often perceive accounts of past suffering as fictional, exaggerated or no longer relevant.

A somewhat lengthier case study section provides better insight to Little's theoretical points in this chapter. She provides case studies on sexual violence by Spanish colonists in California, statistics on lynchings in the southern states of the US between 1877–1950, the impact of First Nations child removal and boarding schools, and the important achievement in the passing of the 1990 *Native American Graves Protection and Repatriation Act,* which somewhat redressed perceptions that First Nation Americans owned nothing – not even their ancestral remains.

Chapter Four commences with case studies of archaeology confronting structures of power and potentially meeting some aims of the SDG. This is accompanied by examples of manners in which unionist and socialist activism in the USA has succeeded in protecting the rights of workers. The complexity of studying and identifying processes of poverty and ethnic relations in the archaeological record are explored, noting the difficulty in accurately identifying manners in which past persons and society may have identified themselves as poor compared to the manner in which current archaeologists might perceive them. There is much said here about identifying poverty and processes leading to it in the past, but very little on how this knowledge may translate into eradicating poverty in the future, which is the aim of the SDG on which Little has focused here. Little's main proposal towards this here is the hope that current and future policy makers will be informed by archaeological insights to past poverty and will implement economic changes accordingly. To my mind this is at best an over optimistic and inflated view of the perception of archaeology by policy makers, who I believe are more likely to rely on qualified economic advisors and political agendas than they are on archaeologists in developing government policies.

Chapter Five depicts archaeology as uniquely positioned to demonstrate the relationship between humans and nature, and to transcend the nature-culture divide through understanding of the deep time interactions between humans and the environment. Little proposes that archaeology can provide insight to the effects of climate change on humanity through demonstrating the

demands for adaptation placed on past societies due to past environmental shifts.

Little returns to the concept of love as a prime mover. 'Archaeologists – indeed all people who love their home planet – must ask themselves how to repair their relationship with the Earth and with each other' (p. 122). I am cynical as to how many people would honestly profess a love for the planet rather than a pragmatic acceptance for the need to maintain and upkeep it.

Chapter Six provides a summary of the work's main points as provided here, returning again to the duality between violence as the obstacle to social justice, and love as the solution for it: 'Violence is the glue of an unjust society and that love is the glue in a just one. An archaeology of social justice finds that love and brings the power of the discipline to justice, healing and a thriving world' (p. 123). In brief, Little defines requisites of archaeology in the service of social justice in four points, that it must:

- Be just and fair
- Be based in humanity
- Be collaborative
- Be based in inquiry and imagination

To summarise, Little sets out an ambitious, but to my mind, insufficiently detailed vision for an archaeology that can drive social justice. There is a comparatively large amount of text given to theoretical background and the technical model of Diachronic Transformational Action. Yet only a very small amount of text is spent on defining the quality of love, which Little proposes as the essential driver of this change. From this lack of definition, I am left to assume that this love is to be taken as an all-encompassing and self-evident emotive desire for good. A problematic outcome of this is that love itself is highly culturally and situationally specific. With reference to examples provided above, we have long seen the impact that love of empire, money and conflicting religious convictions has had on the condition of humanity and the world. Although it certainly provides much food for thought, it is hard to conclude that this work meets the aims and objectives that it set for itself.

Critical evaluation aside however, Little's work brings to mind a pair of apocryphal images from anti-Vietnam War marches in the late 1960's. In one a young man places a carnation in the barrel of a USA Marine's gun pointed at him, in the other a young woman faces the guns of USA Marines, while holding a flower out before her. These were defining moments of Flower Power, and an expression if ever there was one, of the desire to share generalised undefined love, by a generation that hoped for a world that operated on love. As beautiful as these images are, and as much as I ache to thank these then-young people for their actions, the sad reality is that they changed nothing on the grander scale. The engines of war, the industries of wealth and death through arms supply, the power-mongers of the social elites, all continued their domination, to the deaths and suffering of millions of people. I deeply wish that love could reform archaeology and in particular commercial archaeology. But so long as commercial archaeology remains a competitive profit-driven industry that gains business through demonstrating efficient provision of service to developers, so long as those who seek it out as a career are overwhelmingly career-driven rather than values driven – then I suspect far more participants in the industry will be reading handbooks on efficient leadership, profit maximization techniques, and faddish wellness schemes than they will be pondering how to use love in order to diminish their profitability for the sake of social justice.

Academic archaeology in Australia has effectively become a private industry too, in which researchers need to generate funding through claims of maximum returns and elevated potential research impact. It is a hardscrabble world of direct competition between academics in which there is frequently even less funding scope for involvement of descendant communities than is the case in commercial archaeology, where such involvement is almost invariably legislated.

In conclusion, I hope that Little's book is simply the first in a series, a first blossoming, although barely bloomed, that will be followed by further works that will better demonstrate just how social justice can be served and enacted through archaeology. For the meantime, although I am not convinced, she has elucidated her vision in this work, and I suspend judgement to the practicality of her aims, I must congratulate her for holding out the first flower.

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