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Finding the Signatures of Glass Beads: A Preliminary Investigation of Indigenous Artefacts from Australia and Papua New Guinea

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Abstract

Formal analysis and testing of glass beads in Indigenous museum objects has the potential to contribute significantly to our understanding of the global economy of trade and exchange in the colonial era. The unique chemical signatures of glass and the formal characteristics of the beads are the product of specific manufacturing processes, and, as such, can offer insights as to the possible identities of manufacturers in Europe and Asia that produced glass beads on an industrial scale for colonial markets. Where and how glass beads were used by Indigenous peoples provides another essential layer of context within which to consider the global pathways of the distribution and networks of exchange, including Indigenous trade systems, along which glass beads travelled. In this paper we discuss the results of a preliminary survey of a sample of objects drawn from the Indigenous collections at Museums Victoria in Melbourne. Using a portable X-ray fluorescent analyser (p-XRF), the chemical composition of glass beads in objects used by Australian Aboriginal groups was identified, the majority being neck chokers from the 'Top End'. A comparative set of glass beads in objects from neighbouring Papua New Guinea (PNG) was tested in order to gain a broader understanding of possible pathways along which beads and beaded objects made their way into the Pacific during the colonial and pre-colonial eras, and to consider the possibility of common origins with those found in Aboriginal objects. The relative absence of glass beaded objects from Aboriginal Australia is in marked contrast to the experience of PNG, where glass beads were actively sought in many parts and incorporated into the production of a range of objects, including high status objects where glass beads replaced the highly prized shell beads. We discuss the results of the analysis while also highlighting the limitations of the study and the readings gained from using the p-XRF.
Introduction

This paper seeks to contribute to the dialogue regarding the origins and distribution of glass beads used as global capital throughout the 19th and early 20th centuries. Glass beads, referred to variously in the literature as ‘contact’ or ‘trade’ beads, were embedded in vast global networks of exchange. They were a valuable portable commodity exchanged, gifted or traded by colonial administrators, explorers, navigators, missionaries and traders with, and consumed variously by, Indigenous peoples across the globe. For Indigenous peoples in North America, the importance of beads is evident in their application in elaborate embroidery on garments, particularly those made to reflect an individual’s high status. However, as Lidia Sciama (2001:13) suggests, the importance of beads has been somewhat trivialised; understanding beads as ‘trinkets’ reveals more about European attitudes to women’s work, as beading resides primarily within the domain of women’s craft production. Regardless, given the endless examples of Indigenous glass-beaded objects from around the world in museums today, a significantly large volume of beads sustained active colonial markets.

While the role of glass beads in the growth of a global economy of exchange fundamental to European colonial expansion and power requires further research, the mass production of beads in the colonial era provided a lucrative export product for Europe’s vibrant glass-making industry; for example, beads were a key commodity in the 17th century slave trade along the west coast of Africa and used by traders there as currency. Further, a general assumption has been that the likely origin for the manufacture of these glass beads is Venice, yet during the 17th century, glass studios and glass-bead manufacturing had expanded into many other parts of Europe.

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1 This paper is based on a presentation at Beads, Beading and Beaded: Developing Australian Indigenous Bead Research Conference at The Australian National University, 17 November 2017.

2 The term ‘trade beads’ is one used in relation to the Pacific, while ‘contact beads’ is the preferred term in the Australian literature.
such as Bohemia (now western Czech Republic), England, Spain and the Netherlands\(^3\). The identification of glass bead production sites is critical to mapping the extent and reach of these mass produced objects during centuries of colonial expansion.

Using museum collections, our interest is to consider the use of glass beads by Indigenous peoples on the colonial frontiers of Australia, and contrast it with usage in neighbouring Papua New Guinea, and investigate the possible common origins of these beads. The striking absence of glass-beaded objects from Australia\(^4\), despite thousands having been distributed across the continent as gifts or trade items in negotiations between Aboriginal peoples and settlers, explorers, traders, anthropologists, scientists, and others, sits in stark contrast with Papua New Guinea, where an active gift economy, fuelled by networks of alliance building and negotiation, saw an abundance of glass beads incorporated into objects. New materials, like glass beads, were variously rejected or adopted, replacing or complementing beads made from natural materials, particularly shell, and used to make high status objects, and, at times, to create new forms.

We present here the results of a preliminary study of glass beads in museum objects, including chemical characterisation. Manufacturing methods produce unique chemical signatures in glass, and the results of chemical analyses of beads can be used to propose possible origins of specific beads. Glass-bead production methods also dictate the physical form of the bead, and detailed analysis of the physical characteristics of the beads provides another layer of data to identify possible sites of production.

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\(^3\) Venice experienced a major downturn in bead production in the 17\(^{th}\) century due to deaths of glass-makers from plague outbreaks and difficulties sourcing raw materials (see Graham 2006).

\(^4\) This study focuses on glass-beaded objects from Aboriginal Australians, not Torres Strait Islanders; and the original study also included testing glass-beads in objects from Africa.
The beads tested in the study were drawn from objects in the Indigenous collections of Museums Victoria (Table 1). Their chemical composition was assessed using portable X-ray fluorescent analysers (p-XRF), and a common baseline of attributes was applied to establish bead types based on methods of manufacture and their structure, shape, size, diaphaneity (the capacity to transmit light) and colour of the glass, the latter being particularly important in considering where beads have originated, as specific chemicals are required in producing specific colours. Similarities and differences in bead types present in objects from Australia and Papua New Guinea are identified, the most prevalent being the ‘small drawn oblate beads’, commonly known as ‘seed beads’. Our analysis and conclusions are, however, tempered by a consideration of the limitations of the study’s sample size and of the technology used.

Importantly, we consider the physical evidence emerging from the materials-based research methodologies of conservation practice within the context of broader cultural and historical considerations, the latter drawing upon critical analytical tools underpinning contemporary museum anthropological and material culture research. The results of this study provide a strong foundation for attributing provenance and geo-cultural associations to glass-beaded objects with little or no associated documentation.
Table 1 List of objects in the study sample.

<table>
<thead>
<tr>
<th>Australian Objects</th>
<th>Place of collection</th>
<th>Date</th>
<th>Collector/Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>X25839, Choker</td>
<td>Adelaide River, Northern Territory (NT)</td>
<td>c. 1911</td>
<td>Gerald Freer Hill</td>
</tr>
<tr>
<td>X25840, Choker</td>
<td>Adelaide River, NT</td>
<td>c. 1911</td>
<td>Gerald Freer Hill</td>
</tr>
<tr>
<td>X26908, Choker</td>
<td>Daly River, NT</td>
<td>c. 1916</td>
<td>Harcourt Boys</td>
</tr>
<tr>
<td>X29139, Choker</td>
<td>Adelaide River, NT</td>
<td>c. 1923</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X29140, Choker</td>
<td>Adelaide River, NT</td>
<td>c. 1923</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X29141, Choker</td>
<td>Adelaide River, NT</td>
<td>c. 1923</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X38662, Choker</td>
<td>Rum Jungle (now Batchelor), NT</td>
<td>c. 1930</td>
<td>D. Raymond</td>
</tr>
<tr>
<td>X71564, Choker</td>
<td>NT (attributed)</td>
<td>No date</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X71565, Choker</td>
<td>NT (attributed)</td>
<td>No date</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X71566, Choker</td>
<td>NT (attributed)</td>
<td>No date</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X71567, Choker</td>
<td>NT (attributed)</td>
<td>No date</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X75974, Choker</td>
<td>Eastern Arnhem Land, NT (attributed)</td>
<td>c. 1930</td>
<td>M.A. Carter</td>
</tr>
<tr>
<td>X92710, Choker</td>
<td>NT (attributed)</td>
<td>No date</td>
<td>Unrecorded</td>
</tr>
<tr>
<td>X25921, Biting bag</td>
<td>Oenpelli, western Arnhem Land, NT</td>
<td>1918</td>
<td>Paddy Cahill</td>
</tr>
<tr>
<td>X25934, String of glass beads</td>
<td>Oenpelli, western Arnhem Land, NT</td>
<td>1918</td>
<td>Paddy Cahill</td>
</tr>
<tr>
<td>X28711.12, String of glass beads</td>
<td>Oenpelli, western Arnhem Land, NT</td>
<td>1922</td>
<td>Paddy Cahill</td>
</tr>
<tr>
<td>X25695, Arm ornament</td>
<td>Lorangau, Manus Island, Papua New Guinea (PNG)</td>
<td>1914</td>
<td>Captain A.P. Hext</td>
</tr>
<tr>
<td>X45536, Arm ornament</td>
<td>Manus (attributed), PNG</td>
<td>Pre-1941</td>
<td>Kew Golf Club</td>
</tr>
<tr>
<td>X48140, Arm ornament</td>
<td>Manus Island, PNG</td>
<td>Pre-1940</td>
<td>W.B.P. Ashby</td>
</tr>
<tr>
<td>X48140.1, Arm ornament</td>
<td>Manus Island, PNG</td>
<td>Pre-1940</td>
<td>W.B.P. Ashby</td>
</tr>
<tr>
<td>X45542, Apron</td>
<td>Manus (attributed), PNG</td>
<td>Pre-1941</td>
<td>Kew Golf Club</td>
</tr>
<tr>
<td>X83409, Apron</td>
<td>Manus (attributed), PNG</td>
<td>No date</td>
<td>Valerie Davies</td>
</tr>
<tr>
<td>X88382, Leg ornament</td>
<td>Manus (attributed), PNG</td>
<td>No date</td>
<td>Griffin Estate</td>
</tr>
<tr>
<td>X37391, Lime container</td>
<td>New Britain, PNG</td>
<td>Pre-1930</td>
<td>A.M. Ackroyd</td>
</tr>
<tr>
<td>X80646, Arm ornament</td>
<td>Massim, PNG</td>
<td>No date</td>
<td>Mrs A.B. Paterson</td>
</tr>
<tr>
<td>X81447, Arm ornament</td>
<td>Trobriand Islands, PNG</td>
<td>c. 1968–1971</td>
<td>Ian and Leonie Page</td>
</tr>
<tr>
<td>X82753, Arm ornament</td>
<td>Trobriand Islands, PNG</td>
<td>c. 1968–1971</td>
<td>Ian and Leonie Page</td>
</tr>
<tr>
<td>X81451, Neck ornament</td>
<td>Trobriand Islands, PNG</td>
<td>c. 1968–1971</td>
<td>Ian and Leonie Page</td>
</tr>
<tr>
<td>X82763, Neck ornament</td>
<td>Trobriand Islands, PNG</td>
<td>c. 1968–1971</td>
<td>Ian and Leonie Page</td>
</tr>
</tbody>
</table>
Glass Beads in Aboriginal Australia

Throughout the 18th century Macassan fishing fleets (from Sulawesi) and Dutch and French explorers visited Australia’s shores. The origins of beads that they brought could be any of the glass-making centres of Europe or Asia. Glass beads recovered from archaeological sites in Australia have been identified as coming from southeast Asia, ‘mostly discussed as a component of a general corpus of Macassan trade goods used to assign the sites from which they were recovered to broad temporal categories’ (Wesley and Litster 2015:11). May et al. (2013:85) identify an image of a Macassan prau in rock art at Djulirri in the Wellington Ranges of western Arnhem Land as being ‘the earliest identifiable contact art...found in Australia [and] dates to before AD1664 (and possibly to sometime in the 1500s)’5. As glass beads had been part of the trade from Europe to Asia at least from the 1500s onwards (see Sher Dubin 2015), any that made their way into Australia via southeast Asia a century or more before Dutch and French navigators and explorers visited Australia’s shores (from the 18th century onwards) could have been manufactured in Europe. The earliest written account of glass beads in Australia is in 1705 when Tiwi people were reported by Dutch navigators to be ‘very greedy after linen, knives, beads and such knick-knacks’ (Forrest quoted in Litster et al. 2015:300).

In the 1930s, anthropologist Donald Thomson (1949) investigated the impact of Macassans on Arnhem Land people, and in his book, Economic Structure and Ceremonial Cycle in Arnhem Land, wrote about the importance of glass bottles for making scrapers, especially for spear-making, and the inclusion of beads or manimani (a word still used by Yolngu people of eastern Arnhem Land for ‘necklace’) amongst the goods Yolngu gained from Macassans (Thomson 1949:86). However, in his original handwritten field notes (see Thomson 1937, 1942), Thomson makes no mention of beads, listing tomahawks, knives,

---

5 See also Macknight (2008) for a review of current thinking regarding Macassans visiting Australia from the mid- to late 18th century; also Veth et al. (2008) and Clark and May (2013).
calico and tobacco as the ‘chief items’ (Thomson 1949:86) sought by Yolngu in return for their permission for Macassans to strike camp, build smokehouses and access sea estates primarily to harvest trepang or \textit{bèche de mer} (Thomson 1949).

Early historical accounts of encounters with European explorers, navigators and traders confirm the extensive distribution of glass beads, however the paucity of evidence surviving in museum collections appears to suggest they held little value for Aboriginal people. In 1802, the botanist on the Baudin expedition, Jean-Baptiste Leschenault de la Tour wrote of an encounter with Palawa men on Mariah Island in Tasmania\textsuperscript{6}.

One of the last of this group seemed to have some authority over the others [and] gave me the necklace he was wearing, which was made of small shells [and] asked in exchange a necklace of glass beads.
(Quoted in Plomley 1983:130)

Baudin noted the preference for buttons on a jacket given to a Palawa man in an exchange for a kangaroo skin, the jacket being discarded while ‘the buttons, which were blackened bone and not metal, had disappeared’ (Quoted in McAdam 2008:39).


It was the gift exchanges, which occurred during that last week of 1793...[in which] the exchange of European goods took place on a surprisingly large scale, as by the final days together officers, scientists and the entire crews became enthused with gift giving...These goods included the ‘conventional trinkets for the natives’, such as mirrors, glass beads, bracelets, coloured cloths and handkerchiefs.
(Mulvaney 2008:121)

D’Auribeau, on the same expedition, noted a preference for ‘axes above all else, and indeed I think that the axe is the object from which they can draw the greatest benefit’ (as quoted in Mulvaney 2008:121). The ‘tomahawk’ or hafted steel axe had universal appeal across the continent, as did other metal items like knives and nails. Particular items were highly prized by the Europeans, and the Aboriginal Protector in Tasmania, George

\textsuperscript{6} Palawa is a generic term used by Tasmanian Aboriginals to refer to themselves.
Augustus Robinson, described his difficulty at Sandy Cape in northern Tasmania in persuading Palawa people to let him have ‘a large and excellent basket [and] I put beads, buttons, knives...in the basket and came away’ (2 June 1830 as quoted in Gough 2009:12).

Perhaps the most famous (or infamous) encounter was the signing of the so-called ‘Batman Treaty’ transacted in 1835 by the Port Phillip Association, represented by John Batman, and the Ngurungaeta (headmen) of the east Kulin nation. The latter were given blankets, scissors, knives, ‘looking glasses’, ‘tomahawks’, ‘beads’ and flour in exchange for 240,000 hectares (600,000 acres) of land around Port Phillip Bay in Victoria. However there is no indication as to value placed on any of these goods by Kulin people, and glass beads have not been found in southeastern Australian objects in museum collections to date. They are absent from objects collected in the desert regions of Australia as well. However, in 1902, anthropologist Baldwin Spencer took beads to Barrow Creek in the Northern Territory, writing ‘[t]he day after our arrival we unpacked our stores of knives, tomahawks, looking glasses, bead necklets and pipes [and] in a very short time we were busily engaged, bartering our goods in exchange for native things’ (Spencer and Gillen 1912:318).

The relative absence of glass-beaded objects in museums may be due partly to collector bias. Spencer himself had little regard for objects containing introduced materials, noting, ‘[h]ow readily the blackfellow succumbs to the temptation to use some white man’s material and at once spoils his own originally simple but beautiful native work’ (Spencer 1928:848). In 1912, Spencer carried beads amongst his store of goods again, this time to Melville Island:
My trade consisted of 15 bags of flour, 25lb. of the strongest twist tobacco available, a gross of pipes, 60 yards of turkey-twill, 60 gorgeous handkerchiefs, each a yard square...24 tomahawks for special occasions, 48 knives, 20lb. of assorted coloured beads, 12 tins of black treacle, 28lbs. of lollies for the piccaninnies, with the secondary aim of gaining the goodwill and personal ornaments of their mothers.

(Spencer 1928:653)

Despite a preference for the ‘authentic’, Spencer collected a glass-beaded choker (X27541) on Melville Island, the only object with introduced materials amongst the 1200 or so objects he collected on Melville and Bathurst Islands. These chokers, worn mostly by men, are the most common Aboriginal beaded object to survive. Spencer most likely collected it from an Iwaidja man working for the buffalo hunter, Joe Cooper, at his camp on Melville Island, as there is no historical evidence of Tiwi men wearing these chokers. Iwaidja people come from the mainland opposite around the Coburg Peninsula in western Arnhem Land. Paul Foelsche photographed Iwaidja men wearing these, as well as a Larrakia (Darwin) woman, an ‘Alligator’ River woman and a seven year old Iwaidja girl. The German ethnologist, Erhard Eylmann, observed glass beads on ‘decorative objects’ belonging to Aboriginal people of ‘six or seven tribes’ when visiting their camp outside of Darwin. However, Eylmann does not identify these ‘tribes’ nor the types of objects they had, but could have likely included glass-beaded chokers (diary entry, 21 September 1897, translation by Courto 2003:155).

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7 Museums Victoria’s register entry is ‘Neckband of European beads of Malaysian influence’, but is recorded as ‘missing’ in the 1966–1967 stocktake. It may be one of four chokers found without registration numbers during that stocktake and registered as X71564, X71565, X71566 and X71567.

8 The Phoebe Apperson Hearst Museum of Anthropology has individual glass beads from Bathurst Island that are most likely from rosaries.

9 Paul Foelsche’s photographs are held at the South Australian Museum, Museum of Anthropology and Archaeology, Cambridge University, Musée d’ethnographie de Genève, amongst others. The images of the women were taken around 1890, 1879 and 1877 respectively.
The distribution area for many glass-beaded chokers in museum collections world-wide\textsuperscript{10} is confined to a discrete part of the ‘Top End’ of the Northern Territory. It is essentially loosely bounded to the east by western Arnhem Land and adjacent islands and in the west to Adelaide River and north to Darwin and south to Daly River (see Figure 1). Museums Victoria holds the largest number of chokers, with five of the 16 coming from around Adelaide River. Three of these (X25838, X25839, X25840) were collected by Gerald Freer Hill, the naturalist and photographer on the Barclay Expedition that departed Adelaide River on its journey overland to Borroloola in 1911.

The choker form closely resembles the tightly looped string headbands or 'head filets' worn on the forehead during high order men’s ceremonies by groups around the western and central Arnhem Land region. They are similarly long thin rectangular shaped bands with ties of various materials attached to either end for securing around the head. Two chokers from Adelaide River (X25838 and X25839) have a tiny wooden message stick attached to the end of the ties, and could indicate these were worn by messengers who travelled across neighbouring territories to notify other groups to gather for funerals, ceremonies and so on (see Allen 2014).

\textsuperscript{10} Forty-five chokers were identified at Museums Victoria (16), British Museum (8), South Australian Museum (7), National Museum of Australia (5), Museum and Art Gallery of the Northern Territory (4), Musée d’ethnographie de Genève (2), Australian Museum (2) and University of Queensland Anthropology Museum (1).
The distribution of the ‘head filets’ called *galamba* overlaps on the eastern and southern boundaries with that of the glass-beaded chokers. Thomson collected at least 11 from Burarra people of Cape Stewart and neighbouring groups closely aligned with Burarra through marriage and ceremony. One of these (DT155) was obtained from a Rembarrnga man, whose territory lies inland and southwest of Burarra country, and Thomson wrote on the object tag that it is ‘not used in groups to eastwards’. Thomson noted on the tag for another of these (DT181) collected from a Burarra man at Milingimbi in 1935, that it came from Mayali people whose country is in western Arnhem Land. Thomson further noted that ‘head filets’ entered into central Arnhem Land via Indigenous trade networks from the southwest around Katherine and Daly River (Thomson 1949:63). The most south-westerly known choker is from Daly River (X26908) (Figure 2), and during consultation about this choker in 2016, Margaret Gilbert, a senior Merrepen (Daly River) woman, recounted that during her childhood one old ‘bush’ man, who baked bread for the mission, wore one, as did his wife (pers. comm. to Lindy Allen, 7 August 2016).

The next most common object with glass beads is the small string bag or ‘biting bag’ worn by Aboriginal men (see Hamby 2011). When the late Garnbaladj Nabegeyo, a Kunwinjku woman from Gunbalanya, visited Museums Victoria’s collections in 2004, she remarked these were ‘used in ceremony to make a young man’, and the beads and buttons were most likely added to ‘make pretty to sell’ (pers. comm. to Lindy Allen, 19 February 2004). No examples of the chokers were amongst the objects that Paddy Cahill, the pastoralist at Oenpelli (now Gunbalanya), collected for Museums Victoria after Spencer’s visit there in 1912. However, Spencer photographed a young Gaagudju man wearing what appears to be a glass-beaded choker and a biting bag (see Batty et al. 2005:152 and Pl.106), and other Aboriginal men and women he photographed appear to be wearing glass-beaded necklaces.
Four men in an image taken by photographer and adventurer, Ted Ryko, around 1911 are wearing chokers and biting bags (Figure 3). Based on their body painting as well, these are most likely the ‘Arnhem Land warriors’ to whom Ryko refers in his caption\textsuperscript{11}. Thomson’s observation that biting bags entered central Arnhem Land from the west via established trade networks (Thomson 1949) gives weight to the contention that biting bags are closely associated with western Arnhem Land groups. However, Museums Victoria has one choker attributed to ‘eastern Arnhem Land’ (X75974) that was found inside a \textit{bathi minydjapli}, the type of basket used by senior men of eastern Arnhem Land. While an isolated example, it may indicate that the eastern distribution of chokers may extend into the central Arnhem Land region into which both biting bags and \textit{galamba} were traded.

A few examples of glass-beaded necklaces and/or bracelets have survived from western Arnhem Land. In 1918, Cahill collected a looped string bag with its contents intact (X25934) including a long string of glass beads (discussed further below). In 1922, he collected another string bag with its contents (X28711) including a single strand of close to 500 coloured glass beads and a bracelet of beads. The latter had belonged to a woman pregnant with her first child, the contents, Cahill noted, being ‘a gift for the child’. A very small blue bead was also recovered from a tightly looped string bag collected by Cahill. Glass-beaded necklaces were also found in other parts of Australia, particularly north Queensland\textsuperscript{12}.

\textsuperscript{11} Others here are Tiwi men, wearing false beards being a customary Tiwi practice. Their body painting is also consistent with Tiwi designs.
\textsuperscript{12} The British Museum has two interlaced armbands with small glass beads stitched onto them collected by Jessie Litchfield (the source of the British Museum’s chokers). Pitt Rivers Museum has a string of eight white beads collected in Queensland; Macleay Museum, University of Sydney, has a gum nut bead necklace containing very small blue glass beads; and Museums Victoria also has a beaded biting bag from Darwin (missed in the study).
Figure 1 Locations in the ‘Top End’ of the Northern Territory mentioned in the text. Source: Vanda Fletcher.
Figure 2 A glass-beaded choker from Daly River collected in 1915–1916. Source: Museums Victoria, X26908.

Figure 3 ‘Arnhem Land Warriors’, around 1911. Photographer: Ted Ryko. Source: Museums Victoria, XP20278.
Glass Beads in Papua New Guinea

In stark contrast, glass beads are found on many 19th century objects in museum collections from Melanesia, especially Papua New Guinea (Figure 4). These, as in Australia, were introduced during the colonial, and pre-colonial periods\(^\text{13}\), but little attention has been given to the source of these beads. Red trade beads were particularly sought by people in the Port Moresby area, where makers of red/pink shell beads (\textit{Spondulus} sp.) supplied the \textit{kula} network operating in the Massim area via trade activities along the south coast\(^\text{14}\). Demand for glass beads in exchanges for hafted adzes and axes was recorded by Captain Moresby in 1873 (Davies 2012:132). In 1875, Octavius Stone brought 28 pounds of red beads to trade with Motu people, and two months later only two to three pound remained. He noted red beads constituted considerable wealth being incorporated into the making of body ornaments, such as long ear pendants worn by men and women; and necklaces made of strands of beads were considered ‘treasure’ (Octavius Stone cited in Davies 2012:132). The trader Andrew Goldie, who arrived in Port Moresby in 1876, was quickly relieved of his store of red trade beads receiving ‘a few curiosities’ in return (Davies 2012:129).

\(^{13}\) Papua New Guinea’s colonial history is complex: the northern half of the island was annexed by Germany in 1884, followed by British annexation of the southern half later in the same year, while the western half had already been claimed by the Dutch.

\(^{14}\) See Swadling and Bence (2016) for a discussion on changes in the supply chain connecting these areas in relation to boar’s tusk ornaments and \textit{kula} valuables, both of which required shell beads.
Trade goods did not have uniform appeal across all Indigenous trade networks on the south coast. By the 1880s, tobacco had replaced red beads as a favoured commodity, and elsewhere, for instance in Cloudy Bay, Goldie traded hoop iron for bird of paradise plumes. Thirty years earlier, John MacGillivray on *HMS Rattlesnake* had observed hoop iron was a prized commodity used in tools to replace stone (MacGillivray 1852 cited in Davies 2012:134). But while the people of Kerepuna were keen to acquire red beads, they maintained a preference for carving with stone tools up until the 1890s. Davies (2012) interprets these exchanges as evidence of Indigenous agency about what to accept or reject while interacting with traders and others.

**Figure 4** Papua New Guinea place names mentioned in the text. Source: Vanda Fletcher.
On the north coast a large number of trading stations were established during Richard Parkinson's (1999 [1907])\textsuperscript{15} time in the Bismarck Archipelago (in former German New Guinea)\textsuperscript{16}. His writings provide insights into the nature of trade exchanges and the impact of introduced materials on many of the islands; for example, tobacco and betel nut were considered 'luxury items', the former having been recently introduced to the Gazelle Peninsula and the rest of the archipelago by traders with tobacco possibly imported into western New Britain much earlier from mainland New Guinea (Parkinson 1999 [1907]:92). Parkinson noted that the people of New Britain, the French Islands (Witu Islands) and the Duke of York Islands used finely plaited cordage (used to make armbands) to trade for other items (Parkinson 1999 [1907]:95).

Missionaries preceded traders in New Ireland (now Latangai) and New Hanover (now Lavongai) and their offshore islands. In 1875, the Wesleyans founded mission stations on the New Ireland coast opposite the Duke of York Islands. The German administration and planters set up a coconut plantation at Nusa harbour near the Kavieng administration station where ‘trade with the natives has been going on since the beginning of the 1880s’ (Parkinson 1999 [1907]:115). However, trade with islanders was not always successful, the people of St Matthias and neighbouring islands being resistant to visitors. Parkinson noted St Matthias islanders rejected iron in trade but were ‘greedy’ for ‘red beads or red scraps of material’ (Parkinson 1999 [1907]:141).

\textsuperscript{15} Parkinson was a trader and collector who travelled extensively through the islands of German New Guinea over 30 years from 1882.

\textsuperscript{16} German New Guinea was surrendered to Australia at the commencement of WW1, incorporating from east to west, the contemporary provinces of Manus Province (formerly Admiralty Islands), East and West New Britain, New Ireland and the Autonomous Region of Bougainville (formerly German Solomon Islands).
Parkinson noted further that glass beads replaced shell beads (often referred to as shell money) in the making of aprons that he described as ‘outstanding’ in the Admiralty Islands. These aprons\textsuperscript{17}, comprising thousands of tiny shell discs, were worn for dancing on important occasions. Parkinson (1999 [1907]:162) observed the ‘not insignificant value in their homeland, so that only rich people or chiefs are able to afford such a luxury’, being worn by wealthy men or chiefs on Manus Island.

Sylvia Ohnemus (1996) references Margaret Mead and Reo Fortune’s observations in the 1930s that women wore these as part of their wedding attire (Mead 1975 [1930]:61 cited in Ohnemus 1996:105), one worn to the front and another to the back to emphasize the movement of the dancer. Parkinson observed differences in those worn by women with their soft pliable bark cloth upper surface onto which tassels of shell discs, coir and other seed kernels and feathers were sewn, and pendant shell discs with seed kernels on the end sewn onto the lower edge. He noted:

...[today] this type of apron is rarely found, if not made with imported European material, especially glass beads and bright rags—I might say adulterated and thereby significantly diminished in beauty. The natives do not seem to understand that the blending of European articles reduces the value of their original decorative items; here, too, this preference for European industrial items has arisen from the feeling that all things new are to be preferred to the old, a situation that we can often observe among civilised nations as well. (Parkinson 1999 [1907]:162)

\textsuperscript{17} Two examples in Museums Victoria’s collections (X45542 and X83409) are included in the study; also see British Museum collection—0c1908.0624.70: http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=503073&partId=1&searchText=apron&place=40892&page=1, accessed 15 July 2018.
By 1900, shell discs were rarely used in making these aprons, but continued in use as currency in customary exchanges and trade networks (Parkinson 1999 [1907]:390–1). As such, shell money remained positioned within a recognised value of exchange or regimes of value (Appadurai 1986), while trade beads, equivalent to those made of shell in terms to these aprons, were not an acceptable token of exchange for transactions in which shell money was used.

During field work in the Aitape area in the West Sepik between 1987 and 1992, Maria Wronska-Friend (2015) came across ceramic replicas of shell objects being used and worn by people but they couldn’t account for their origins. She discovered these were likely made by A. Sachse & Co. in the Austro-Hungarian Empire. This company mass produced glass beads as well as replicas of bone and shell objects for the colonial trade and distribution throughout the German colonies.

In 1895 [Sachse] opened a branch in Venice and became the main producer of glass pearls in the world...[and] for at least three decades Albert Sachse was one of the main European producers of glass and ceramic goods, with many of his products destined for distant ‘exotic’ markets.
(Wronska-Friend 2015:52)

Subsequently branches were opened in Germany, London, Moscow, Paris and west Africa, but the outbreak of World War 1 saw the global collapse of this market and Sachse & Co. ceased operations in 1920 (Wronska-Friend 2015:52). Wronska-Friend points out they were one of many companies that marketed beads and replicas to supply an ever-expanding network of late 19th century markets in Africa, India and North America, as well as the Pacific. However, she notes that ‘little is known of the mechanisms of exporting these goods from Gablonz [now in the Czech Republic] to the Pacific or to other parts of the globe’ (Wronska-Friend 2015:54), and, as such, highlights the importance of identifying the chemical composition of beads known to have been manufactured by Sachse & Co. and other companies.
The Sample

The sample of glass-beaded objects tested for the study (see Table 1) comprises 16 objects from Australia, including 13 glass-beaded chokers, a biting bag and two strings of glass beads from the Northern Territory. The 13 Papua New Guinea examples include arm and neck ornaments, aprons and a lime container and are from Manus Island and the Massim region (the eastern tip of the New Guinea mainland and neighbouring offshore islands). Selection was made on the basis of a visual match in type and colour between the beads found in objects from both regions, specifically red, blue and white beads. Similarity was important given the in-situ p-XRF analysis requires a sufficient sized grouping of the same colour bead for isolated testing. All but four of the objects were collected or registered into the museum collections in the late 19th and early 20th centuries, and most have little accompanying documentation beyond the donor or collector's name and a place or country of origin. Those without provenance information have been attributed to a region or place based on their stylistic similarity to other objects.

The Analysis

A systematic methodology for characterising and categorising beads was applied to the sample, with attributes of material, manufacturing technique, structure, shape, size, colour and diaphaneity (the capacity to transmit light) according to Wood's (2011:68) typology. Individual areas of glass bead colours were

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18 A selection of necklaces and waistbands with glass beads from South Africa underwent XRF analysis but are not included in this study.
19 Ian and Leonie Page, teachers in the Trobriand Island 1968–71, noted X81451 has 'very old glass beads'.
20 Bead diameter (the maximum width of a specimen, perpendicular to the perforation) was taken using digital callipers and a size range recorded for each item and classed as very small (under 2 mm), small (2–4 mm), medium (4–6 mm), large (6–10 mm) and very large (over 10 mm) as per Karklins (1985, 2012). Wesley and Litster (2015) use Wood (2011) in their analysis of glass beads from the Wellington Range archaeological sites.
tested using the Bruker Tracer III-V+ portable XRF unit with an X-Ray tube source with a Rhodium (Rh) target and a Peltier cooled Silicon-PIN diode detector. The instrument was fitted with a Ti (Blue) filter to reduce the spectral contribution from the Rh target and with a vacuum to allow greater sensitivity at lower energies. Operating conditions were 15 kV and 34 µA with vacuum for 300 sec. Under these conditions the instrument detects elements from atomic weight 13 (aluminium) to 30 (zinc). The XRF unit was placed in the vertical desktop stand with the safety shield accessory in place. Items were placed on the safety sample table above the XRF test aperture for testing. Care was taken to ensure the test aperture covered individual colour areas of the beaded material.

Examination revealed all the beads on the Australian and Papua New Guinea examples to be undecorated rounded monochrome beads, oblate in shape (commonly known as ‘seed beads’) and small in size (2–4 mm). The exception was very small (1–2 mm) beads on the biting bag (X25911). All beads are of simple construction or single layered, and of the drawn type, a manufacturing method whereby beads are made by pulling molten glass into a hollow tube, cutting them to size and reheating until smooth and round (Wood 2011: 68).

Opaque (op.), translucent (tsl.) and transparent (tsp.) beads were identified across the sample, with opaque beads appearing in greater quantities overall. Across the sample range, only one choker (X71564) was made entirely of beads with the same diaphaneity, in this case opaque, suggesting colour was of greater importance to the design than opacity. Beads were assigned a colour name and Munsell notation of colour (Munsell Bead Colour 2012 Revision) to examine individual beads. Forty-one individual colours are present with the most frequently used being red, white, and blue, and, to a lesser extent, purple in the Papua New Guinea objects. Nineteen colours appeared only once and in small quantities of less than 20 beads, while the four colours that featured in large quantities across the Australian examples and repeatedly in the Papua New Guinea ornaments

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21 Drawn beads were produced in Europe in the 19th century and exported in large quantities from Europe to Asia and elsewhere. This bead type (some close in colour) was recovered from Wellington Range archaeological sites (Wesley and Litster 2015).
were Bright White (op.), Poppy Red (op. and tsp.), Cerulean Blue (tsl.) and Orchid Mist (op.), indicating either preference for these or they were the dominant colours available22.

The chokers, the largest object type in the sample, consist of small sized (2–4 mm) round beads that exhibit significant colour variation: thirty-three individual colours were identified, the most prominent being Orchid Mist 2.5 RP 7/4 (op.), Bright White N 9.5 (op.), Daffodil 5.0Y 8/10 (op., tsl., and tsp.) and Cerulean Blue 7.5B 5/10 (tsl.). The beads are strung on machine-made thread and are inclined at 45 degrees in a herringbone-like pattern to form narrow rectangular-shaped beadwork23. The connections through the beads appear to be made using warp and weft threads in a technique documented by Hector (1995:15).

Litster et al. (2018) contend that while the chokers they examined appeared at first to be made using a loom, the patterning cannot be achieved on a loom as it ‘creates angled bead orientation [and] does not create warp threads’ (Litster et al. 2018:307). They concluded that it is ‘an undocumented technique... provisionally named the non-weft looming technique’ (Litster et al. 2018:308).

Ties of plaited or twisted fibre appear to be made from the gathered warp threads, and a range of ties made of 2 ply vegetable fibre string, wool and/or cloth are attached at either end. A string of almost 500 beads (X28711) has translucent and transparent light blue, pink and yellow beads, and, as with the chokers, are small in size. They are strung on a single thread of undyed hand spun fibre forming a large bead group measuring 1426 mm in length. X25934 is a smaller assemblage made from similar sized transparent yellow and green coloured and clear beads threaded and joined on undyed hand spun fibre. The third example (X25921) has very small-sized (1–2 mm) orange and blue opaque beads with an average diameter of 1 mm that are

22 Consistent light sources and settings were used. Opaque colours were examined under UV-filtered day-light approximating fluorescent CLE lamp (240 VOLT /50 HZ 5) and translucent and transparent colours by transmitted light using a MES Medical Equipment light box.
23 Median length of 217 mm, width of 29.8 mm wide and density of 24 per cm².
threaded onto machine-made undyed fibre and affixed to the exterior of the bag with an overlaid stitch technique of black thread. Detailed analysis of the threads was undertaken in this study, but the results are not included here.

The Papua New Guinea sample includes two arm ornaments (X80646 and X81447) and two neck ornaments (X82763 and X81451) decorated with individual lengths of red opaque and translucent blue beads in the small size range. Each has beads threaded as a single colour on vegetable fibre secured to a support made from shell or pigs tusk. The lime container (X37391) has two separate lengths of threaded beads strung on vegetable fibre. These consist of eight translucent green beads in different hues and the more commonly used opaque red, white and black beads. The two armlets (X25695 and X88382) and two large aprons (X45542 and X83409) are constructed where the beads themselves in combination with the vegetable fibre thread form the ground. In these examples, red, blue, white and purple beads of the opaque, translucent and transparent type are threaded to form bold geometric designs dominated by triangles and crosses.

Initial examination of the construction method shows the use of both warp and weft threads in a variety of configurations, possibly reflective of regional difference. The final group of arm ornaments (X45536, X48140 and X48140.1) are decorated with the same red, blue and white beads, threaded on vegetable fibre and sewn to a bark ring. Pink beads were not present in any of the Papua New Guinea objects.

The core glass chemical composition of all glass beads are present in similar levels, including sodium (Na) (assumed), aluminium (Al), silicon (S) and iron (Fe) and additive elements potassium (K), calcium (Ca), arsenic (As) and lead (Pb)\textsuperscript{24}. Arsenic and lead are typical of the production techniques used in European and southeast Asian glass-bead production from the late 19\textsuperscript{th} century to the early 20\textsuperscript{th} century (see Fusco and Speakman 2010; Robertshaw et al. 2010). As discussed already,

\textsuperscript{24} The majority of glass beads are identified as soda-lime-silica glass, including Islamic and Indian glasses (Robertshaw et al. 2010) and European glass from the 19\textsuperscript{th} and 20\textsuperscript{th} centuries. Soda-lime glass beads found in America and Africa can be sourced to European or Asian manufacturing sources in the late 19\textsuperscript{th} and early 20\textsuperscript{th} centuries (Fusco and Speakman 2010). Lead glasses have been identified in American (Hancock et al. 1997) and African beads (Fusco and Speakman 2010).
we know some trade beads from Papua New Guinea were sourced to Sachse & Co. (Wronska-Friend 2015). We were unable to confirm the sodium content, so it has been assumed to be present for the purposes of this preliminary study. Studies of glass beads of European and Indian origin in both ancient and present day glass manufacture have been identified as soda-alumina based glass (Dussubieux 2001; Hancock et al. 1997; Kock and Sode 1995).

Heavier atomic weight elements present in glass beads are usually indicative of the components used to create colours—iron, tin, lead, copper and cobalt being common colouring agents. Chemical elements used as colouring agents can be used for dating bead manufacture (as particular additives were used at different times). However, the sample size here is too small for source identification, but may be used for an indication of raw materials available at a particular time, a specific maker or specific source locations. Small variations in the chemical elements used for colour have been found and it is hoped that further analysis using a larger set of glass beads may lead to or be indicative of source location.

Under the test conditions, and without appropriate matrix matched glass standards, the concentrations cannot be calculated, and so only qualitative data is reported. The results are reported in raw counts where the ratio of raw counts is proportional to the ratio of the metals/elements concentrations in the following comparisons. White opaque beads and pink opaque beads have been used for preliminary comparisons, as they are the most frequently used colours in the Australian objects tested, while white is used on most Papua New Guinea objects. Overall the composition of base elements Al$_2$O$_3$, SiO$_2$, K$_2$O, CaO and Fe$_2$O$_3$ (i.e., aluminium, silicon, calcium and iron) is very similar, and the count levels for arsenic and lead show little variation across the items from the two regions. Potassium has a

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25 The main components of glass, excluding oxides used in the creation of colours and modifying agents, have been identified in previous studies as Na$_2$O, MgO, Al$_2$O$_3$, SiO$_2$, K$_2$O, CaO and Fe$_2$O$_3$ (Robertshaw et al. 2010). The p-XRF technique under vacuum applied here is able to detect Al$_2$O$_3$, SiO$_2$, K$_2$O, CaO and Fe$_2$O$_3$.
26 This was also true for the African objects tested.
broad range of counts recorded where Australian beads generally have higher counts than the Papua New Guinea beads with some overlap.

A more detailed analysis of the beads is required to confirm if this is related to production sites. However, the analysis of glass beads in the chokers presented particular challenges as they are tightly woven and individual beads are difficult to isolate for testing. It did reveal though the presence of a high level of potassium, indicative of plant ash used in the manufacturing process: X92710 has very high counts for potassium represented by the three points on the right hand side of Figure 5, while the pink beads showed a significant variation in potassium concentration with a distinct break in the groups, Figure 6, and X71564, X71565 and X71566 have higher levels of potassium.

Discussion

Beads exhibit specific morphological features that distinguish them and their possible origins, however the mass production of the small oblate or ‘seed’ beads, the common type found in the sample, renders identification of the morphological features alone as insufficient. What we do know is it is necessary to classify beads according to measurable, consistent and standard parameters, and bead classification needs to be used in conjunction with high sensitivity elemental and structural analytical methods to determine possible production sources. The significant commonality in beads from Australia and Papua New Guinea suggests a likely common source or sources, as all exhibit a similar core glass blend. However, more sensitive analysis of trace elements is required to identify any significant differences.

Colour and the diaphaneity (transparent or opaque quality) of the glass are major discerning features in identifying the signature of a particular maker or manufacturing process. Small variations in the elements used for colour have been found, but the sample size is too small to indicate if this can be used for source identification and may only indicate the raw materials available at a particular time or production site.
Figure 5 Plot of calcium vs potassium counts for white beads.
**Figure 6** Plot of calcium vs potassium counts for pink beads (note no pink beads were present in PNG objects).
The four dominant colours in the Australian examples: Bright White (op.), Poppy Red (op. and tsp.) and Cerulean Blue (tsl.) and Orchid Mist (op.), also appear repeatedly in the Papua New Guinea ornaments. It could be that these colours were more readily available or preferred. However, the most frequently used colours in the Papua New Guinea objects are red, white and blue, and, to a lesser extent, purple. As pointed out earlier, the selection of objects for the study was made on the basis of a visual match with Australian objects, in particular those with red, white and blue beads.

The limitations of sample size and the p-XRF readings has meant the findings are indicative rather than conclusive. Further, it is also worth noting that dirt, salts and forms of degradation on the surface of glass can impede accurate identification of bead colour and diaphaneity (Karklins 1985), while XRF spectrometry (a surface technique) can be impacted as degradation processes cause migration of the alkali ions to the surface of the beads affecting the concentration detected. However, the element results for the beads for Australia and Papua New Guinea are very similar, most based on a sodium glass matrix with arsenic and lead additions typical of late 19th and early 20th century glass bead-making techniques found in European and southeast Asian production centres. Importantly, the results reveal a closer alignment with those from the southern Indian region, another major centre for the mass production of beads, and provide little evidence for being Venetian in origin. While Wronska-Friend (2015:51) highlights the extent of the production of one company, Sachse & Co. in Gablonz in the Jizera Mountains that ‘reached the peak of its prosperity in the late nineteenth century and early twentieth century when it became the global centre of glass and ceramic jewellery production, with dozens of manufacturers settled in and around the town’, she points out the need for research to identify many similar companies producing glass beads on an industrial scale for colonial markets. Further, it is worth considering that while manufacturers like Sachse & Co. were based in Venice at times, this does not preclude them from securing beads from elsewhere in Europe or Asia.
Conclusions

Our study reveals the potential of a multilayered approach to the consideration of the global distribution of glass beads, from at least the 18th century through to the early 20th century, by giving attention to the nature of the bead itself and its chemical characterisation as well as how beads were embedded in colonial and Indigenous networks of exchange. While more research is needed to identify the manufacturers and distributors of glass beads, our study revealed how a cross-disciplinary research approach can contribute to greater understandings of the nature of these global networks and how glass beads were distributed across the globe and inserted into Indigenous societies in Australia and the broader Pacific region.

The study also demonstrated that the presence of glass-beads and beaded objects in Australia is most strongly associated with Aboriginal people living in a discrete corridor of the ‘Top End’ of Australia, an area that coincides with archaeological sites in the Wellington Ranges where beads have been recovered (see Wesley and Litster 2015; Litster et al. 2018). The dominant glass bead type present in those sites as well as the Australian objects in our study is the ‘seed bead’. The most prominent colour in beads present in the chokers is Orchid Mist, a colour of bead that appears in virtually all of the archaeological sites (Wesley and Litster [2015] refer to the colour as ‘red-purple’). A further study would benefit from examining and comparing beads from the ‘Top End’ together with those recovered from the Wellington Ranges sites using equipment that allows for more sensitive analysis of trace elements present in the beads. Such an approach could provide more definitive answers as to the possible origins of the beads, and provide further context for the results of our preliminary study.
Any future extended study would benefit from testing the chokers in other museum collections and glass-beaded objects from the Torres Strait and from other places in the Pacific. This paper demonstrates the value in looking beyond Australia in order to understand the bigger picture of the pathways and networks of exchange along which glass beads travelled globally. In Papua New Guinea, where gift economies were particularly active, beads gained specific value in more localised contexts, for example, as discussed here, replacing shell beads on aprons from Manus Island. New items and materials were drawn into networks of alliance building and negotiation between Indigenous people and outsiders, and further investigation of glass-beaded objects from this region, and elsewhere, may be useful in exploring the processes of interaction, engagement and Indigenous agency.

Even given the limitations of the small sample and the p-XRF, this paper demonstrates the value of research on glass beads and glass-beaded objects. It provides an important template for cross-disciplinary research and has great potential as a tool for provenancing, identifying and/or attributing regional associations for objects in museums that have little or no existing information. A more ambitious project might extend testing of glass beads to those found on manufacturers sample cards, e.g., the ones in Gablonz from Sachse & Co., or those in museums such as the Victoria and Albert Museum and British Museum in London that have trade samples from Venice, or hanks of ‘trade beads’ like those from W.J. Macleays 'Chevert' expedition to Papua in 1875 in the Macleay Museum in Sydney.
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