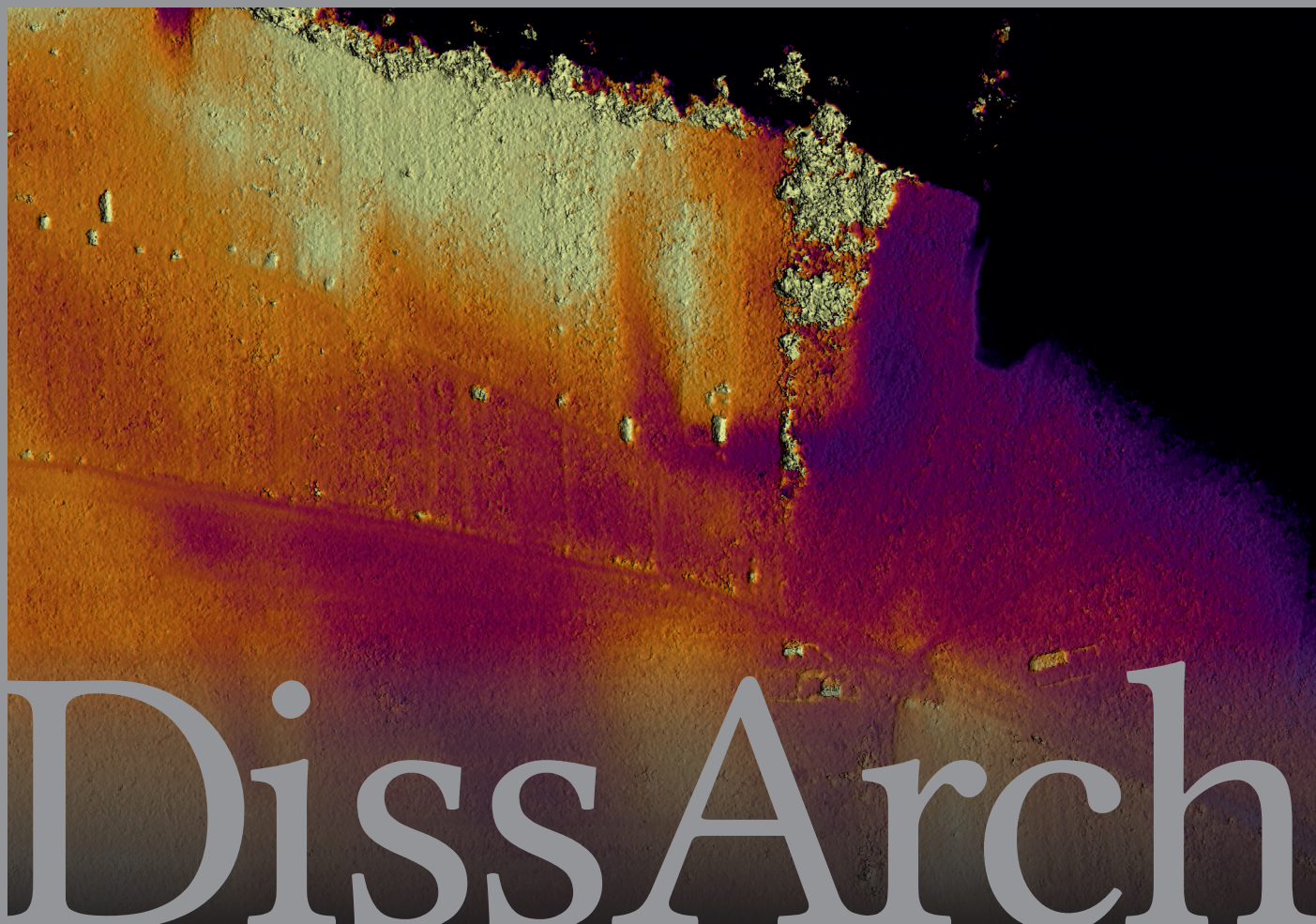
DISSERTATIONES ARCHAEOLOGICAE

ex Instituto Archaeologico
Universitatis de Rolando Eötvös nominatae



DissArch

Ser. 3. No. 11. | 2023

Dissertationes Archaeologicae
ex Instituto Archaeologico
Universitatis de Rolando Eötvös nominatae

Ser. 3. No. 11.

Aviable online at http://ojs.elte.hu/dissarch
Contact: dissarch@btk.elte.hu
Support: vaczi.gabor@btk.elte.hu

ISSN 2064-4574 (online)

Publisher
László Borhy

Budapest 2024

Contents

Articles

Field Reports

Thesis Review Articles

Dissertationes Archaeologicae 3.11 (2023) 5–32 10.17204/dissarch.2023.5

Obsidian-tipped spears from the Admiralty Islands in the Oceania Collection of the Museum of Ethnography in Budapest

Attila Péntek
Independent researcher
attila.pentek@yahoo.com

Norbert Faragó
Institute of Archaeological Science, ELTE Eötvös Loránd University, Budapest, Hungary
farago.norbert@btk.elte.hu

Received 1 February 2024 | Accepted 20 February 2024 | Published 26 March 2024

Abstract: The authors studied 36 obsidian-tipped spears in the Oceania collection of the Museum of Ethnography in Budapest. In addition to describing the objects from the Admiralty Islands collected before 1897, the paper provides a summary of the related ethnographic information, including the technological and technical details of spear point making and the characterisation of the obsidian raw material used.
The blades used for making the obsidian points presented in this study showed no sign of standardisation (an indicator of advanced blade technology) in the spear point-making process. According to 19th-century ethnographic sources, the functional part of the points was the most important, and much time and effort were invested in ensuring that the blades were effective weapons. Later, as a sign of decline, primary production of obsidian blades ceased, and manufacturers started scavenging old artefacts and utilising waste and by-products. As a result, the blades decreased in size and became more irregular, and an increasingly large number included parts of the cortex, the crust of obsidian. After 1911, the relative importance of decoration increased, and the type became more standardised.
The irregular shape of the spear points presented in the study and the thin, weak shafts with an awkward curvature raise questions about whether the spears were actual weapons. At the same time, the artistic decoration of the mounting sockets and ethnographic parallels suggest that the pieces in the collection were likely status objects instead.
Keywords: Papua New Guinea, knapped stones, lithic technology, symbolic meaning, stone tool utilisation

Introduction

The authors had an opportunity to study 36 obsidian-tipped spears from the Oceania Collection of the Museum of Ethnography in Budapest. All objects originated from the Admiralty Islands, which belonged to the German colony of German New Guinea between 1884 and 1914. Twelve of the objects were collected by Sámuel Fenichel between 1891 and 1893. The biography and collecting activity of Fenichel (Nagyenyed, Hungary, 25 August 1868 – Stephansort, Papua New Guinea, 12 March 1893) are well-known in New Guinea,[1] but there is no reference to spears from the Admi-

1 Bodrogi 1954; Bakó 1993; Vargyas 2008, with further references to Fenichel.

ralty Islands. Of the remaining spears, 21 were purchased from Fiumean (Singaporean) merchant Giovanni Bettanin in 1897, two items came from the collection of the *Naturhistorisches Hofmuseum, Wien* through an exchange for items from the collection of Count Sámuel Teleki, and one arrived from the inheritance of Ferenc Hopp in the Museum of Ethnography in Budapest.

In addition to describing the objects, the paper provides a summary of the related ethnographic information, including the technological and technical details of spear point making and a characterisation of the obsidian raw material used. Since the studied artefacts will be added to the online collection of the Ethnographic Museum in the future, the text refers to the individual objects by their specific inventory numbers (IN). Fig. 1 shows a schematic map of Melanesia with the location of the Admiralty Islands and the prehistoric archaeological sites with obsidian finds mentioned in the text. Fig. 2 displays an overview of the Admiralty Islands with the known geological sources of obsidian.

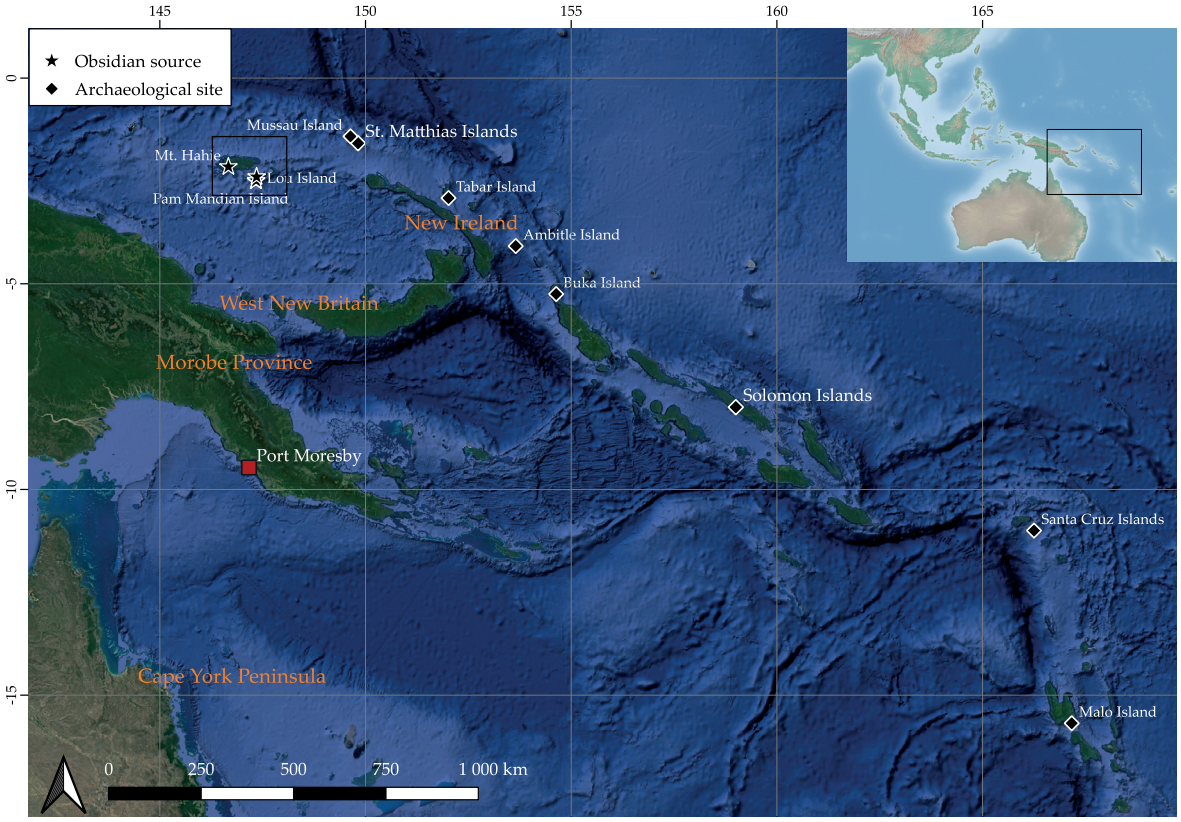


Fig. 1. Map of Melanesia with some occurrences of obsidian from the Admiralty Islands in prehistoric contexts

The Admiralty Islands

The Admiralty Islands is an archipelago of 18 islands north of New Guinea in the Bismarck Sea in the Pacific Ocean. It comprises a large island, Great Admiralty or Manus Island, and numerous coral and volcanic islets. Manus Island is about 60 miles [96 km] long and 15 miles [24 km] wide, with a total area of about 810 sq mi [2,100 km^2]. Manus' highest elevation is at 2,300 ft [700 m] a.s.l., of volcanic origin and probably emerged from the sea 8–10 million years ago, during the late Miocene; it consists of volcanic rocks and coral limestone. The Admiralty Islands belonged to the administrative area of Germany between 1884 and 1914 and Australia between 1919 and 1975. Hans Nevermann

discussed in detail the history of the discovery and exploration of the islands[2] from the beginnings of the German colonial empire and the Australian administrative mandate following World War I. Later, Alfred Bühler[3] analysed the population and indigenous culture of the islands.

Fig. 2. Map of the Admiralty Islands with known obsidian geological sources

Margaret Mead discussed in more detail the social and religious life, social relations, and exchange networks of the indigenous communities.[4] The inhabitants of Manus Island had to acquire most of their plant foods via exchange, together with all kinds of raw materials for building houses and canoes and various goods such as obsidian spears and carved beds. They fished both for direct consumption and exchanging the catch for other necessary goods, while the surplus could be exchanged indirectly for goods participating in ceremonial exchange (as fish was not used directly). The Ushians were a horticultural group occupying the inner lands of Manus Island; they cultivated taro, their most valuable crop, and yams. Besides, coconut, betel, and banana palms were planted around the villages. The importance of wild sago was second only to taro. Pigs were only farmed for ceremonial exchange and to be eaten at the feasts where these exchanges took place, but not for regular, everyday consumption.[5] The people of the small 'satellite' islands were called Matankor;

2 Nevermann 1934, 1–17; Nevermann 2013, 1–15. A Spanish explorer, Álvaro de Saavedra Cerón, discovered the island on 15 August 1528. He charted Manus Island on the map as *Urais la grande* (de Navarrete 1837, 473; Coello 1885, 309). The name Admiralty Islands is attributed to P. Carteret, the captain of the English warship *Swallow*, who visited a southern member of the archipelago in 1767 (Hawkesworth 1773, 605).

3 Bühler 1935.

4 Mead 1937.

5 Apart from the famous '*kula* ring' in the Trobriand Islands, described by Bronisław Malinowski (Malinowski 1922), there was at least another important ritual exchange system, the *moka*, in the wider region of Papua New Guinea (Bulmer 1961), which revolved around a highly formal exchange of pigs and played a significant role in the creation of the 'big man' concept by Marshall Sahlins (Sahlins 1963). In the 1970s, even a documentary was dedicated to the *moka* exchange ('Ongka's big Moka', 1976).

their language and culture were surprisingly heterogeneous. They combined gardening, as their small coral or volcanic islands allowed, with fishing and seagoing on canoes like the Manus islanders. Some islands, such as Lou and Baluan, were known for sweet potato cultivation of some kind. Most islands were abounding with coconut, but only the largest were somewhat independent of the main island in terms of sago and building materials. All exchanges depended on non-local trade as much as on production. All marriage-related exchanges required the accumulation of large quantities of goods, most of which were not produced directly by the local community or even by the ethnic group of the bride- and groom-to-be. The marriage-related exchange was thus part of a more complex and indirect system in which diverse producers exchanged various products. Theodore Schwartz has examined primary and secondary specialisation and the associated forms of exchange.[6]

The inhabitants of the Manus Islands could sail probably almost anywhere in Melanesia. Their sailing capabilities allowed them to cover the distance between the Admiralty Islands and the Schouten Islands of Papua New Guinea [formerly known as Misore Islands, a group of islands in the Cenderawasih Bay (Sarera Bay, formerly Geelvink Bay)] on the one hand, and the Admiralty Islands and the New Ireland island chain on the other hand. Philip Carteret described in 1767 a 15-metre-long Manus outrigger sailing canoe,[7] which he considered one of the smallest ever seen. Jacques Labillardière commented on the speed of Manus sailing canoes, writing, "We admired the celerity with which that flotilla clave the waters. Although we had a very fresh breeze and a great deal of sail set, those little vessels sailed a great deal faster than our ships."[8]

Obsidian in the Admiralty Islands

Several publications have discussed the geological sources of obsidian in the Admiralty Islands (Lou Island with several distinct outcrops at Baun, Umleang, Umrei, and Wekwok; Pam Lin Island; Pam Mandian Island; Mt. Hahie; southwest Manus and Lepong; north-west Manus) and the archaeological sites with obsidian finds in Melanesia.[9] One of the most comprehensive descriptions of the Admiralty Islands is the PhD dissertation of Clayton F. K. Fredericksen,[10] who provides an overview of available ethnographic data on the islands and describes their environmental, social, and economic structures. He discusses in great detail the occurrence of obsidian, especially on Lou Island, and the production of obsidian blades and spear points.

Weapons in the Admiralty Islands. A short cultural-historical description

From a cultural-historical point of view, it is important to note that all travellers, explorers, and ethnographers agreed that the most important weapons in Melanesia were the club (or stone axe), the spear, and the bow and arrow.[11] The spear and the bow were rarely used in the same area, but one or the other occurred practically everywhere. In the case of the Admiralty Islands, the predominance of the spear was clearly emphasized.

6 Schwartz 1963.

7 Wallis 1966, 196.

8 Labillardière 1800, 314, translated by the authors.

9 Ambrose – Johnson 1986; Fullagar – Torrence 1991; Kennedy et al. 1991; Fredericksen 1997a; Fredericksen 1997b, 379; Terrell – Welsch 1997; Hanslip 2001; Summerhayes 2003; Summerhayes 2009; Reepmeyer et al. 2011; Golitko et al. 2013; Summerhayes et al. 2014.

10 Fredericksen 1994.

11 Lewis 1932; Lewis 1951.

Henry N. Moseley wrote, "The Admiralty Islanders have no bows, slings, or throwing sticks, *ula*s (Fiji), or clubs. Their only weapons are lances of several kinds, which are thrown with the unaided hand, not even with a cord as in New Caledonia. They have no spears like the Humboldt Bay men, Fijians, etc., to be used at close quarters, and no shields."[12] Later, he slightly rephrased the above, writing, "The most remarkable fact about the Admiralty Islanders is that of their having no bows and arrows, slings, throwing sticks, or throwing cords for their spears, no *ula*s, clubs, spears for hand-to-hand fighting, and no shields."[13] According to Hugo Zöller, "*Eine Eigentümlichkeit besteht darin, daß die Obsidianpfeile der Admiralitäts-Insulaner mit Schlinge geschleudert, nicht mit Bogen geschossen werden, also eigentlich mehr Wurfspeere denn Pfeile sind, obwohl sie gewöhnlich als solche bezeichnet werden.*"[14] Sidney H. Ray wrote about the men living on Lifu Island,[15] "Every man wore on the middle finger of the right hand a small cord loop (*sep*) artistically woven. This served as a rest for the end of the spear or javelin when about to be thrown."[16]

According to Ralph Linton,[17] "The Marquesans used a throwing cord, which made the spear rotate in flight and increased its accuracy, and the Maori had a throwing whip. This was a straight stick with a long lash. The dart was set in the ground at an angle to the right of and slightly behind the thrower. The lash was wrapped about it, and it was jerked upward and forward by a quick movement of the thrower's body and arms. Sometimes two men would wrap their whips around a bundle of darts and hurl them at a single cast. The whip gave long range, but little accuracy; it was mainly used against besieged towns [...]".[18] Nevermann, referring to Zöller's study, described and illustrated a throwing cord: "Spears are thrown by hand without special equipment. Likewise, the throwing arrows with obsidian tips are often thrown by hand, although often also with the aid of a cord whose ends are knotted together. Men lay the closed end of the 27.5 cm long throwing cord around the foot section of the throwing arrow and grasp the other, knotted, end with the fingers which simultaneously hold the shaft of the throwing arrow. When throwing, they let the shaft fly but hold the cord end firmly, and give the throwing arrow greater momentum by straightening the arm with the throwing loop."[19]

Heinrich Schnee firmly stated that "*Pfeil und Bogen sind unbekannt,*" [The bow and the arrow are unknown].[20] According to Richard Parkinson, "*Bogen und Pfeile, ausschließlich für Jagdzwecke verwendet, sollen hie und da vorkommen; Keulen sind mancherorts gebräulich, jedoch immer in ganz geringer Anzahl und im Kampf von weniger Bedeutung*".[21] Some other records also mention the use of

12 Moseley 1877, 407–408; cf. Moseley 1892, 404; Mitchell 1896, 357. H. N. Moseley (1844–1891) was an English naturalist who sailed on a worldwide scientific expedition with the *H. M. S. Challenger*, a steam-powered corvette. The 'Challenger expedition,' which took place from 1872 to 1876, was a scientific venture that made many discoveries that laid the foundations for oceanography.

13 Moseley 1877, 419.

14 Zöller 1891, 168.

15 Lifu is the largest island of the Loyalty Islands, part of the New Caledonia Archipelago.

16 Ray 1917, 256, Pl. 12.3.

17 Linton 1926, 110.

18 Culin described a game called *Ke-a-pu-a,* meaning 'arrow throwing', from the island of Hawaii: "Arrows or darts, consisting of the blossom end of the sugar-cane, are thrown in the following manner: A cord is wrapped around the middle of a cane arrow, the other end being fastened to a stick about four feet long (*la-auke-a pu-a*), which is held vertically at right angles to the arrow, which rests on the ground. The latter is then hurled in the air by the stick, the wrapped cord giving it a rotary motion." (Culin 1899, 234). Culin also mentioned other Polynesian versions of the game.

19 Nevermann 1934, 313, Fig. 204.

20 Schnee 1904, 211.

21 Parkinson 1907, 356; cf. Parkinson 2010, 275.

bow and arrow. Francisco Coello quoted Álvaro de Saavedra Cerón's account from 1528, "[…] from Urais the natives, who were black and ugly, went out in some canoes, two leagues out to sea to attack them with arrows."[22] Richard Thurnwald wrote that "*Pfeil und Bogen werden nur zur Einleitung der Kämpfe gebraucht und sind rasch verschossen. Sie scheinen eine verhältnismässig junge Waffe zu sein. Man bedient sich ihrer nicht viel, sondern hauptsächlich des Speers* […]".[23] Nevermann reported on simple bows and arrows, and the illustrations clearly show that the arrows were merely pointed and without barbs.[24] Based on Georg Friederici and the Alfred Bühler Collection of the *Museum der Kulturen Basel*,[25] Nevermann noted that the bow was only used for bow fishing or as a children's toy. In his PhD dissertation, Peter Valentin discussed the bows and arrows in the collection of the *Museum für Völkerkunde Basel*,[26] catalogued until 1965. This collection of 2,858 objects comprised only one bow from the Admiralty Islands; it originated from the settlement of Loniu at the eastern end of Manus Island and was designed for bow fishing (*Fischbogen*). This bow was completely different from the one depicted by Nevermann. Sylvia Ohnemus studied a considerably larger assemblage in the collection of the *Museum der Kulturen Basel* than Valentin. Concerning the arrows, she wrote, "The fish arrows have a shaft of (bamboo) cane or palm-leaf rib. The point, which consists of hardwood, but by Bühler's time had already been partly replaced with wire, is let into the shaft. It is additionally fixed to the shaft by binding with bast, string or rattan, and can be painted red or black."[27] In summary, the bow and arrow were not used as weapons but were tools of bow fishing, and the arrows were not made with flaked tips.

Characterisation of the collection of the Museum of Ethnography in Budapest

The obsidian points

A total of 36 obsidian-tipped spears (29 with and seven without spear points) were studied. The blades[28] used for making obsidian points showed no sign of standardisation (an indicator of advanced blade technology) of the spear point-making process. One possible reason is that there was no standardised technology for blade or spear point production in a strict sense; however, examining that is beyond the scope of this study. Another possible reason is that the obsidian-tipped spears in the collection are from different areas; they may also be from different ages and represent different traditions. The Admiralty Islands is an archipelago of eighteen islands, and obsidian spear points were produced at different locations, even within the main island (Manus). All metric data (length, width, thickness)[29] of the studied obsidian spear points vary on a very wide scale; thus, the standard deviation of the series is large. Only ten spear points were intact, their lengths ranging from 76.2 to 215 mm. The picture would probably not change significantly with a larger series because these minimum and maximum values are already extreme. The width and thickness of 28 spear points could be measured. The widths vary between 25.6 and 76.6 mm, and the thicknesses between 9.4 and 22.7 mm. The profiles of the points re also pretty varied. Nearly half of them

22 "[…] *de Urais salieron, en unos páraos, los indígenas, que eran de raza negra y feos, dos leguas á la mar para atacarlos con flechas* […]" (Coello 1885, 310). Translated by the authors. *Urais la grande* = Manus Island.

23 Thurnwald 1910, 128.

24 Nevermann 2013, 311–312.

25 Friederici 1912, 123.

26 Valentin 1968, 222.

27 Ohnemus 1998, 346–347.

28 In archaeological literature on knapped stones, a 'blade' traditionally refers to detached flakes with parallel or sub-parallel edges and a length equal to or more than twice the width (Crabtree 1972, 42).

29 Metric data refer to the visible part of the spear points.

(14 pieces) are curved, while there are also pieces with twisted (four pieces), curved and twisted (two pieces), straight (three pieces), wavy (four pieces), and irregular 'S'-shaped profiles (two pieces). The cross-sections of the points are also quite varied: irregular (10 pieces), subtrapezoidal (six pieces), subtriangular (five pieces), triangular (four pieces), trapezoidal (two pieces), and trapezoidal/triangular (the proximal end is trapezoidal due to a shorter previous removal, the distal end is triangular in cross-section; two pieces). Twelve points were made on offset (*déjeté*) blades; three are bent to the left, and nine are bent to the right. As for the retouching of the edges, more than half (16 pieces) have at least partial retouching on both lateral edges. The left edge is retouched in five cases, the right one in three cases, and five points have unretouched edges.

Based on their quantitative and qualitative characteristics, the studied obsidian spear points generally contradict the tendency Torrence outlined based on a significantly larger sample.[30] She became of the opinion (see above) that originally, the functional part of the points was the most important, and much time and effort were invested in ensuring that the blades were effective weapons. This is in no way supported by our data.

The spear shaft

Most of the studied spears (24 pieces) have brown to dark brown, often irregular, curved hardwood shafts. Their lengths vary between 1,250 and 1,770 mm, with an average length of 1,583.2 mm. The shafts are generally cylindrical, 12.0–21.2 mm in diameter (16.1 mm on average) under the decorated haft binding, while the diameter of their bottom ranges from 5.7 to 13.3 mm (8.9 mm on average). Among the objects collected by Sámuel Fenichel, six specimens have a shaft with a rectangular cross-section immediately below the decorated haft binding, varying between 15.1 × 13.6 and 19 × 16 mm. The diameter of the lower part of the shafts ranges from 7.1 to 9.4 mm. Giovanni Bettanin obtained ten spears with yellowish bamboo shafts, which are almost without exception irregular and curved. Their length varies between 1,340 and 1,780 mm, with an average length of 1,601 mm. The shafts are cylindrical; their diameter under the haft binding is between 11.6 and 18.6 mm (15.9 mm on average). The diameter of the lower part of the shafts ranges from 8.4 to 14.8 mm, with an average value of 10.7 mm.

There are minimal metric differences between the wooden and the bamboo spear shafts. In their current condition, a significant part of the shafts is worn and often cracked, regardless of their material. The shaft is usually either rather irregular, crooked, or thin.

The decoration

Based primarily on the decoration of the upper part of the haft binding, the following two groups can be distinguished.

Incised bird figure

Felix von Luschan[31] discussed this motif in detail, tracking in text and images the transformation by which the realistic depiction of birds (likely frigate birds) gradually evolved into a stylised, almost unrecognisable bird motif. Due to the lack of reliable data on age, it is probably impossible to anchor this process in time. Luschan also outlined a transition from stylised bird figures to stylised human faces. Finally, he presented several spears depicting realistic human figures. Robin Torrence[32] also described and illustrated the gradual stylisation of frigate bird depictions. Of course, such processes

30 Torrence 1993, 472.

31 von Luschan 1897, 80–81, Tab. 37, Tab. 40.

32 Torrence 1993, 453–454.

cannot be reconstructed from the few spears in the collection of the Museum of Ethnography in Budapest; however, the small assemblage includes examples of almost all phases of this transformation. No spear collected by Fenichel features a realistic bird depiction. Stylised bird representations appear on four spears; arranged according to the degree of stylisation (after Luschan or Torrence), the first is IN 7964 (Fig. 3.B), followed by IN 7966 and IN 7957 (Fig. 3.A), and finally IN 7959. Realistic bird representations appear on spears from the Bettanin collection: IN 14307 (Fig. 3.C), IN 14313, IN 14315, and IN 14322. The collection also includes stylised depictions of IN 14310, IN 14317 (Fig. 4.A), and IN 14324 (Fig. 4.B). The spears with bird depictions from the Bettanin collection in particular show a relatively simple combination of 'unpretentious' stylistic elements. The shaft-side end of the articulated, decorated haft binding of the spears is usually simple, slightly convex, 'barrel-like', about 25 mm long, featuring hourglass-shaped longitudinal incisions. Except for IN 14317 (Fig. 4.A), the slightly tapered round central part is undecorated, painted only in red; also, the pieces from the Fenichel collection have a simple painted pattern in the tip-end zone of the central part. The lower and upper edges of the central part have a black ring band of varying width, with black longitudinal connecting bands of varying width in between. The reason for such seemingly minor dissimilarities stems probably from local cultural differences.

Fig. 3. Obsidian-tipped spears in the collection of the Museum of Ethnography in Budapest. A – IN 7957 (size: 155 × 73.7 × 19.9 mm), B – IN 7964 (size: [115] × 43.8 × 14.5 mm), C – IN 14307 (size: [146.9] × 56.7 × 19.3 mm)

Fig. 4. Obsidian-tipped spears in the collection of the Museum of Ethnography in Budapest. A – IN 14317 (size: 215 × 52.2 × 21.4 mm), B – IN 14324 (size: [160] × 46.7 × 12.9 mm), C – IN 14311 (size: 120.3 × 69.9 × 18.3 mm)

Haft binding with a geometric pattern

Torrence mentions that the spears collected by the *H. M. S. Challenger* expedition were all unique,[33] akin to the studied artefacts in the collection of the Museum of Ethnography. A pattern of triangles and diamonds was created by wrapping the threads of the binding made from plant stems around the wooden socket and the obsidian point. Some parts of the pattern were painted, mostly red and black, against a white background. IN 14312 (Fig. 5.A, Fig. 6.A[34]) is an exception, as its patterns are red and dark brown. Another exception is IN 14321, which displays a pattern in four colours: grey (or off-white), light and dark brown, and black (Fig. 6.B). The flattened pattern of the haft bindings reveals that several have symmetrical structures.[35] Interesting is the pattern of IN 7965 (Fig. 6.C), where the

33 Torrence 1993, 475; cf. Moseley 1877, Pls 20–21.

34 For technical reasons, the geometric pattern designs in Figures 6 and 7 have been rotated 90° counter-clockwise.

35 See, for example: IN 7963 (Fig. 7.A), IN 7967 (Fig. 7.B), IN 14306 (Fig. 7.C), IN 14308 (Fig. 5.C, Fig. 6.F), IN 14311 (Fig. 4.C, Fig. 6.D), IN 14312 (Fig. 5.A, Fig. 6.A), IN 14314 (Fig. 5.B, Fig. 6.E), IN 14317, and IN 14321 (Fig. 6.B).

symmetry has been 'broken' as two diamonds above each other in the lower part of the right-hand column (at the top in the rotated image) have been painted red instead of black, either accidentally or deliberately. Compared to a realistic or stylised depiction of a bird figure, such geometric patterns of the binding represent a significantly more advanced stage of spear decoration because of the additional elements of the haft binding and the significantly more sophisticated decoration. This is reflected in the workmanship of both the lower and central parts of the haft binding. It is possible, and even quite likely, that the difference in decoration is linked with a difference in the function.

Fig. 5. Obsidian-tipped spears in the collection of the Museum of Ethnography in Budapest. A – IN 14312 (size: 76.2 × 41.9 × 9.4 mm), B – IN 14314 (size: 210 × 40.0 × 22.7 mm), C – IN 14308 (size: [115.3] × 40.8 × 19.3 mm)

Without going into a detailed discussion, it should be mentioned that the *pmm* patterns discussed by Donald W. Crowe and Torrence[36] also occur amongst the geometric decorations. In the notation of *pmm*, 'p' stands for 'plane' or 'periodic', referring to a two-dimensional, potential fill pattern, while the two 'm's indicate reflections in two directions. In the figures, mirror reflection axes are marked with 'M', glide reflection axes are marked with 'G', and orange diamonds mark the centres of point reflection.

36 Crowe – Torrence 1993.

The square grid pattern on the upper part of the haft binding of IN 7963 (Fig. 7.A) has a *pmm/pmm* structure with vertical mirror reflection axes passing through the vertices of all squares and a horizontal mirror reflection axis passing through the central row of squares. The intersections of the mirror reflection axes are also reflection centres of 180° rotations. The pattern of the same part of IN 79679 (Fig. 7.B) has an identical structure. The diamond grid pattern of IN 14306 (Fig. 7.C) is identical to the binding of a double-pointed spear in the collection of the Field Museum of National History, Chicago. It was presented by Crowe and Torrence:[37] vertical and horizontal reflection axes pass through the apex where the equal sides meet of the red and black triangles, while the centres and top and bottom apexes of the white diamonds are centres of point reflection. Nevermann mentions a similar pattern structure.[38]

The simple bicolour diamond grid pattern on the upper part of the haft binding of IN 14317 (Fig. 7.D) is identical to that of a spear in the collection of the Australian Museum in Sydney. This artefact was also presented by Crowe and Torrence:[39] vertical and horizontal mirror axes pass through all apexes, and their intersections are also centres of 180° rotation (not marked in the figure).

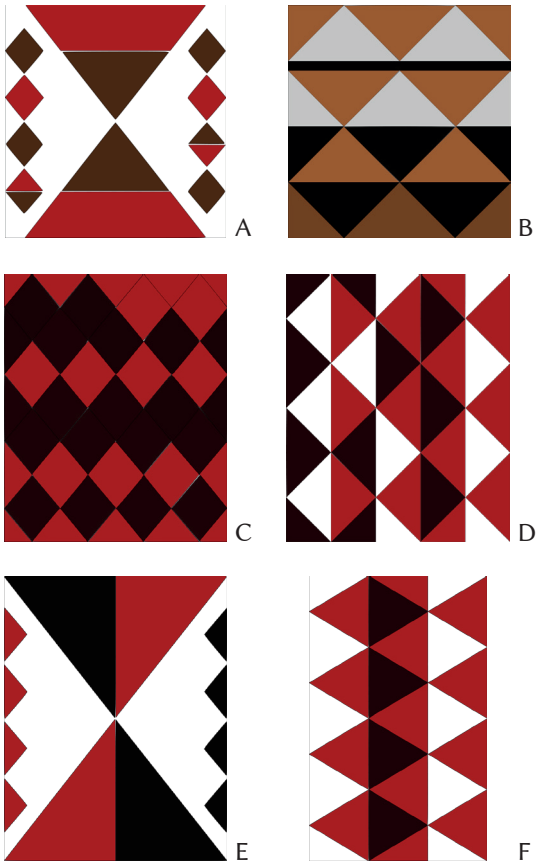


Fig. 6. Simplified drawing of the geometric decoration of the haft binding. A – IN 14312, B – IN 14321, C – IN 7965, D – IN 14311, E – IN 14314, F – IN 14308

Discussion

Obsidian utilisation in the prehistory of the Melanesian region

According to Wallace R. Ambrose,[40] the Manus exchange system received large quantities of obsidian from mines on Lou Island. The obsidian was used to make spears and daggers on Lou Island, which were transported to all parts of the Admiralty Islands. Contrary to recent, local use, the prehistoric distribution of Lou Island obsidian was extensive, reaching as far southeast as the New Hebrides through the island chains of the Solomon Islands and New Ireland, as well as the mainland of New Guinea. Ambrose gave a brief overview of the distribution of the Lou Island obsidian in prehistory. Maurice F. Leask mentioned obsidian flakes from Lou Island in northeastern New Guinea, near the settlement of Wewak, at a bird fly distance of about 400 km from Cape Wom in Manus Island,[41] while Ambrose mentioned obsidian flakes from Lou Island on the Moem

37 "Pattern type *pmm/pmg*. Double-bladed spear. Black-red on a white background. FM 134342 (1911–19)." "In Figure 5, the denominator *pmg* indicates that for the black portion of the pattern, there are reflections ('m') in one direction, but in the perpendicular direction, only glide reflections ('g')." (Crowe – Torrence 1993, 392, Fig. 5).

38 Nevermann 1934, 299, Fig. 192.2.

39 "Pattern type *cmm/pmm*. Red and white. AM E848. (1876–1910)" (Crowe – Torrence 1993, 394, Fig. 7).

40 Ambrose 1978.

41 Leask 1947, 300.

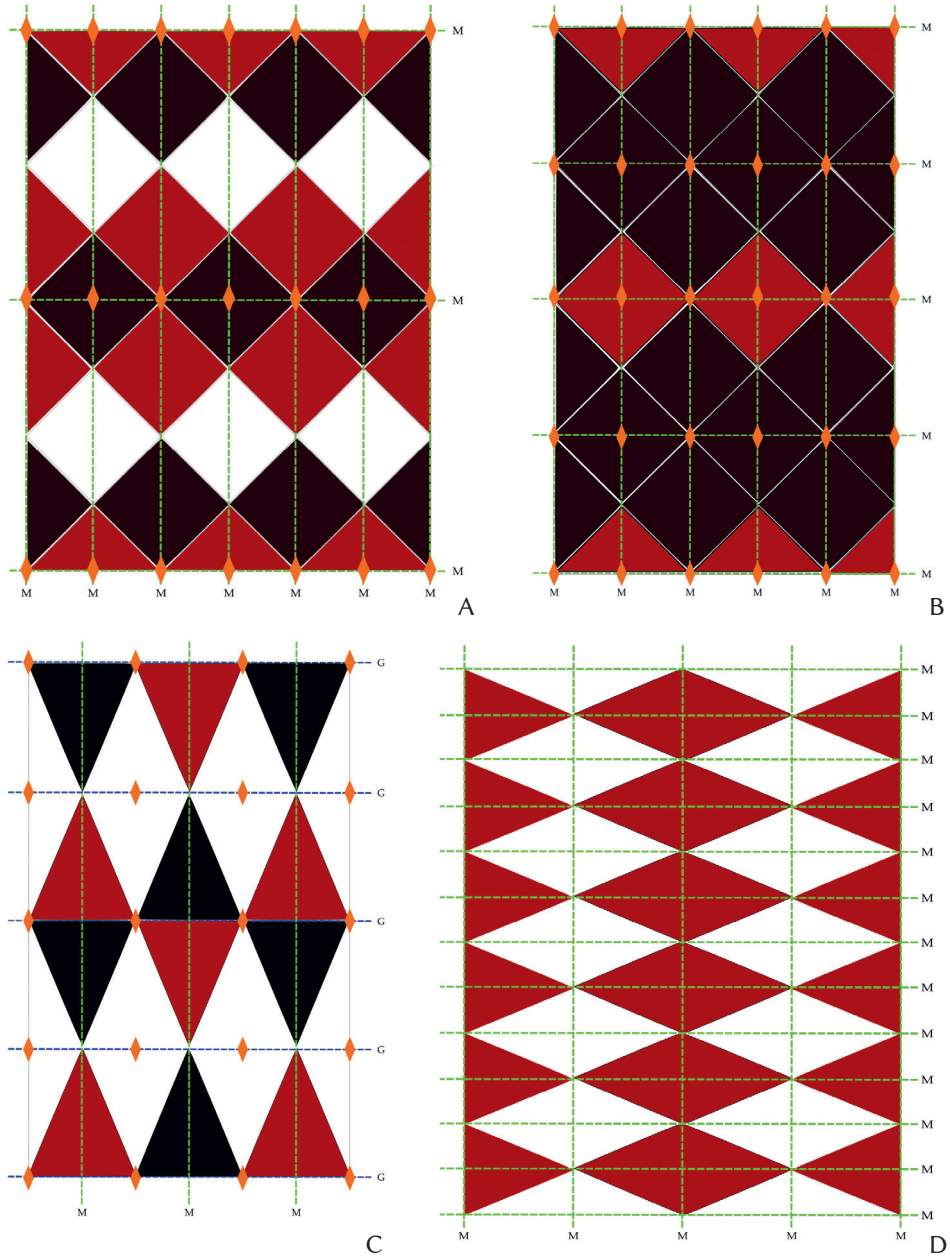


Fig. 7. Simplified drawing of the geometric decoration of the haft binding. A – IN 7963, B – IN 7967, C – IN 14306, D – IN 14317

Peninsula.[42] Brian J. Egloff found hundreds of obsidian flakes on Eloaue Island in the St. Matthias Archipelago (also known as Mussau Islands).[43] Of the 165 specimens examined, 125 came from Lou Island, some 250 km away. Obsidian from Lou Island has been found in several archaeological sites and surface find scatters throughout New Ireland, including the upper cultural layer of Balof Cave near the settlement of Medina[44] on the northeast coast of the island, about 450 km from Lou Island, and an excavation at the Lesu site opposite Tabar Island.[45] Lou Island obsidian has also been found on the Muliama site on the southeast coast, opposite Ambitle Island, in surface collections from the

42 Ambrose 1976, 359.

43 Egloff 1975, 19.

44 White et al. 1978.

45 White – Downie 1980, 203.

nearby Tabar, Lihir, and Tanga island groups, and a site on Ambitle Island. Based on dated analogies of decorated pottery, the Ambitle Island site was occupied around 500 BC or before.[46] Jim Specht[47] mentions obsidian flakes from Lou Island found in excavations on Buka Island in the Solomon Archipelago at a 900 km bird fly distance from the source, but the material also appears in the Santa Cruz Islands over 2,300 km away.[48] Currently, its most remote known occurrence is Malo Island in the New Hebrides, at a distance of some 2,700 km.[49]

The record of some of these sites also contained obsidian from the Talasea Peninsula in the northern part of the West New Britain province of Papua New Guinea.[50] Of course, several new results have been obtained since Ambrose published his article in 1978[51] as a result of intensive archaeological research in Melanesia applying more advanced methods of obsidian analysis.

Patrick V. Kirch[52] wrote that recent and ongoing archaeological work on the Bismarck Islands has contributed greatly to a better understanding of the complex relations of exchange between Lapita communities.[53] Of the nineteen sites recently investigated by the Lapita Homeland Project, a programme realised in collaboration with several institutions,[54] all contain obsidian from both the Admiralty Islands and sources in western New Britain.

Obsidian spear points

Technological remarks

Between 1978 and 1985, Ambrose excavated five archaeological sites on Lou Island. In his doctoral dissertation, Fredericksen processed obsidian finds from four prehistoric sites, Emsin, Sasi, Umleang, and Pisik School.[55] The first two were lithic workshops, where various operations of retouched blade production were carried out.[56] The Pisik School site, seemingly not a workshop, yielded obsidian (mainly small flakes) in smaller quantities than the other three. Emsin and Pisik School were radiocarbon dated to about 1,650 BP and Sasi to 2,100 BP.[57] Fredericksen described and illustrated the general process of blade-making, including the generalised reduction sequence,[58] and compared the stages of the process as appearing on each site.[59] "Four basic reduction stages are shown. In the first, an obsidian block undergoes initial shaping. This results in large primary flakes and large pieces of shatter, the latter discarded due to accidental block breakage or material inconsistency [...]. The second stage of reduction involves shaping the incipient core to be ready

46 White – Specht 1971, 92.

47 Specht 1972, 310.

48 Green 1976, 245; Green 1987; Sheppard 1993, 123; Sheppard 2010, 23.

49 Hedrick 1971, also mentioned by Ambrose 1978, 31 after him.

50 Specht 1981.

51 Ambrose 1978.

52 Kirch 1991, 147.

53 See, for example, Allen – Gosden 1991.

54 Gosden et al. 1989. The Lapita culture is the name for a Neolithic Austronesian people who settled by sea migration on the islands of Melanesia, most of Polynesia, and parts of Micronesia between 1,600 and 500 BC.

55 Fredericksen 1994.

56 Fredericksen 1994, Pl. 9, see, also Ambrose 1988; Ambrose 1991; Antcliff 1988; Fullagar – Torrence 1991.

57 Ambrose 1988, 484; Ambrose 1991, 107.

58 Fredericksen 1994, 142. Lithic reduction is the process of fashioning stones or rocks from their natural state into tools or weapons by removing some parts.

59 Fredericksen 1994, 142; Fredericksen 2000.

for blade detachment. By-products from this include secondary flakes. The third reduction stage sees blade removal and subsequent core reshaping to prepare the piece for further removal. Aside from blades, material resulting from this activity would include smaller tertiary flakes, small or malformed blades, and spent or heavily reduced cores […]. In the fourth and final stage of the reduction sequence, blades are shaped by controlled percussion flaking. By-products of this activity comprise comparatively small retouch flakes with dorsal scars and incomplete, broken point segments."[60]

Concerning the stone tool manufacturing process, Fredericksen's statements can be summarized as follows: "None of the larger core pieces possess any indication of a highly systematic technique of blade removal. […] On most pieces, blade scars are not parallel, demonstrating that knappers rotated the cores during blade detachment […]. Platform preparation is present on a few pieces (<5%). Generally, blade segments exhibit an extremely variable geometry […]. Occasionally, pieces display a regularity of form approaching that of, for example, blades in the prepared core industries of Mesoamerica.[61] […] The conclusions drawn from these observations are that at all localities, blade removal was governed mainly by the variable geometry of minimally prepared cores and that little attempt was made to maximise the number of blades removed from each core. Blade scars on many core pieces are too narrow to have been left by blades subsequently shaped into points. […] an examination of point morphology revealed significant inter-site differences in the extent of morphological standardisation."[62]

As for blade making, it is worth referring to the articles by Australian archaeologists on crafting large *leilira* blades used as knives and spear points.[63] In their article on ballistically anomalous Australian stone points (projectile points),[64] the authors, Kim Newman and Mark W. Moore, briefly discuss the large blades of the Admiralty Islands. "Stoneworkers in the Admiralty Islands, northeast of Sahul, also made obsidian macroblades using a hard-hammer percussion technique into the historic period […]. Macroblades were traditionally made and exchanged by specialists who controlled the stone sources. Local recipients in the exchange chose to haft the macro blades as either spear points or knives […]. By ca. 1907, traditional blade production had mostly ceased […], and the focus of trade began shifting towards Europeans […]. The TCSA values of Admiralty Island macroblades dating prior to 1876 […] do not differ significantly from the TCSA values of macroblade points and knives of the Australian Aborigines […]. We also calculated TCSP values for these Admiralty Island macroblades and found that they did not differ significantly from Aboriginal macroblade points […]. The similarity in morphology between Australian and Admiralty Island macroblades is probably a result of the design constraints inherent in using hammerstones to strike long, pointed blades from cores."[65]

The hafting of the spear points

Moseley was the first to describe in detail the obsidian spear points, the hafting technique and the decoration of the mounting socket on the Admiralty Islands.[66] "The principal weapon is a lance formed of a small, usually [sic! usually] flexible shaft of tough wood, a natural stem often, with the bark trimmed off, to the thicker end of which is attached a heavy head of obsidian, which, in size,

60 The core is struck directly or indirectly with a hard (stone) or soft (wood, bone) percussion instrument (Crabtree 1972, 80; Inizan et al. 1999, 148–149).

61 Crabtree 1968; Parry 1994; Parry 2002.

62 Fredericksen 1994, 158–164.s

63 Akerman 1976; Akerman 2007; Moore 2003a; Moore 2003b.

64 Newman – Moore 2013, 2617.

65 TCSA: tip cross-sectional area, TCSP: tip cross-sectional perimeter (Sisk – Shea 2011).

66 Moseley 1877, 407–409.

appears out of proportion with the light shaft. The obsidian lance-head is usually of this conical form, but some have a knife-edge in front, and some are irregular [...] They are shaped by bold, wide flaking. The points and edges are often slightly rechipped in order to sharpen them, but the original faces and angles are never worked up for the sake of symmetry or balance, but remain rough. Many lances have their edges and points sharp and perfect, though formed entirely by the original flaking. The hinder borders of the lance-heads are simply rounded. They are secured in a socket of wood attached to the end of the shaft by means of a cement, and by being bound round with fine twine. The socket is hollowed out in a separate piece of wood, and in order to facilitate the scooping-out process, two slots are usually cut in the faces of the socket. [...] The shaft of the lance is spliced into a V-shaped slot in the lower part of the socket piece. A rounded strengthening piece is retained in the socket piece, between the actual socket and the narrowed part of it, in which the slot for the shaft is cut. A very hard and solid gum is used to bed the lance-head in its socket, and the shaft in its slot, and to mass together the turns of fine twine which secure the whole. In some lances the entire socket piece and the turns of binding twine are concealed by an even thick layer of the gum [...], whilst in others the gum is used more sparingly, and the turns of twine and wood of the socket piece are exposed to view. In the former class of lances, ornamentation is affected by patterns being incised in the layer of gum, and these have no *coix lachryma*[67] seeds attached to them. In the latter class, the upper turns of twine are arranged diagonally, separating the ornamental colours, and the actual wood of the socket pieces is carved and coloured."[68] Arthur Mitchell,[69] without knowing Moseley's above description, described the hafting of spears practically the same way.

Luschan described a hafting method know to him: "*Die grosse, flache, an der Wurzel meist sehr breite und dünne Obsidianspitze verlangt nähmlich schon wegen ihrer Sprödigkeit und Schwere eine besondere Sorgfalt bei ihrer Befestigung an den dünnen drehrunden Schaft. Dabei wird meist *) so vorgegangen, dass zunächst Schaft und Spitze aneinandergelegt und mit Streifen von weichem und elastischem Baummark sehr fest geschient werden. Genau, wie wir bei einem Knochenbruche Schienen anlegen, so werden hier Markstreifen um die Enden der zu verbindenden Stücke gelegt und dann mit gedrehten Rinderzeug oder anderen Fäden festgebunden. Dieser Verband wird aussen ganz dick mit einer harzigen, zu grosser Härte erstarrenden Masse so bestrichen, dass eine absolut feste und sichere Verbindung erzielt wird, eine Art Kelch, in dem einerseits die Obsidianspitze wie die Eichel in ihrem Becher festsitzt, und der andererseits so aussieht, als ob er mit dem Schafte aus einem Stücke geschnitzt wäre. Diese Art der Befestigung, die sich nur mit einem Schienen- und Gipsverband vergleichen lässt, erfüllt nicht nur ihren Zweck in einer ganz grossartigen Weise, sondern sie ist auch eine durchaus originelle, soviel ich weiss, ohn jede Analogie* [...].
**) Eine andere Art der Befestigung, die schon von Moseley (On the inhabitants of the Admiralty Islands,* Journal of the Anthropologischen Institutes, *1877) erkannt wurde, besteht in der Anwendung eines besonderen aus Holz geschnitzten Mittelstückes, das unten den Schaft und oben die Spitze aufnimmt und mit Harz und durch Umschnürung zusammenhält."*[70]

Heinrich Schnee wrote the following about the weapons of the Admiralty Islands: "*Die Hauptwaffe ist der Speer, welcher in vielen verschiedenen Arten gefertigt wird. Besonders beliebt ist der Obsidianspeer. Der Obsidian wird an drei Plätzen gewonnen, in Lou, Balual und Pom. Die Speerschäfte werden aus Bambus oder Holz gefertigt und dann auf eine der drei genannten Inseln gebracht, deren Bewohner gegen Bezahlung die Obsidianspitze pitilou daran befestigen. Zur Befestigung dient eine rote Masse*

67 *Coix lacryma-jobi*, Job's tears, also known as Adlay or Adlay millet, is a tall grain-bearing perennial tropical plant of *Poaceae* (grass family).

68 Moseley 1892, 404–405.

69 Mitchell 1896, 362–363.

70 von Luschan 1897, 80.

panavi, welche angeblich aus dem Sagobaum gewonnen wird. Die Verbindung wird mit Verzierungen versehen und ist bisweilen als menschliche Figur geformt. Neben Speeren mit einfacher Spitze finden sich auch ganz selten solche mit zwei und selbst mit drei Spitzen. Die Speere haben je nach der Art der Anfertigung, speziell nach der Art zum Schaft verwandten Holzes verschiedene Namen, z. B. bunjau, patambue, kuku, ie, patompei."[71] As regards the terms used by Schnee, Josef Meier noted that "[…] *Bei Bambus hat man zwei Hauptarten zu unterscheiden. Die kleine Art Bambus, die z. B. zur Verfertigung von Panflöten und von Lanzenschaften verwendet wird, heißt: mbúnjou* […]. *Dr. Schnee hat mit seinem Wort für: Bambus punjóu die erste Art im Auge* […] *Bunjau = Name eine Speerart* […] *eine Speerart heißt bei ihm patámbue. Es ist diese Speerart nun keine andee als jene, deren Schaft verfertigt is aus dem Stamme der Betelpalme = patámbuë.*"[72] Nevermann translated *ekuku, gugu,* and *kuku* as some kind(s) of hardwood.[73]

Parkinson wrote about the spears, "In the ethnographic museums the products and implements of the natives are well represented, and the most striking among them are the spears with the razor-sharp obsidian tips. […] The latter come in all sizes up to a length of 25 centimetres. The tips, which like both edges are produced by knocking off small splinters, have the sharpness of an excellent steel blade. The broad end of the blade is set into a wooden shaft, partly by wrapping round, and partly by puttying with crushed nuts. The shaft is occasionally carved and otherwise decorated; the carving frequently has the human figure as a motif, or that of a crocodile, which we find universally represented in various forms in native carvings."[74] Parkinson also described the process of obsidian spearhead making on Poam (Pam) Islands: "The blade-maker on Poam gave us a demonstration of his art. After a small block of obsidian had been carefully selected, he gripped it in his left hand and knocked small slivers off one side with a stone weighing about half a pound in his right hand. Then he closed his hand firmly round the block so that the side rested against his palm while his fingers gripped both ends. He gave a sudden, gentle tap with the stone against the outside of the block, and immediately a long sliver sprang off the opposite, free side. With gentle taps, this sliver was fashioned completely into a spear tip. Obsidian has a definite fracture plane which the manufacturer knows how to find and to exploit in his work."[75]

In his synthesis about the Admiralty Islands, Nevermann[76] also discussed in detail the issues of obsidian-tipped spears. Referring to an article by Meier on the shafting of such weapons, he wrote, "The obsidian points are connected to the spear shaft with or without an intermediate piece. If they do not use an intermediate piece, they abut shaft and tip, and lay splints from the thick, rib-end of the sago palm leaf over both of them."[77] Nevermann noted that this way of fastening was only employed for hardwood spear shafts. "With reed shafts and bamboo shafts, but often also with hardwood shafts, they introduce an intermediate section of softwood or a coconut palm rib between the blade and the shaft, which is joined to the tip in the same manner. With reed shafts and bamboo shafts, the lower end of the intermediate piece is inserted directly into the shaft, while with hardwood shafts they are joined by splinting."[78]

The most significant result in the research of obsidian-tipped spears and daggers was certainly yielded by the research started by Robin Torrence from the Australian Museum Research Institute

71 Schnee 1904, 210.

72 Meier 1906, 479.

73 Nevermann 1934, 34, 296.

74 Parkinson 2010, 274.

75 Parkinson 2010, 165.

76 Nevermann 1934, 297–302, Figs 192–194.

77 Meier 1906.

78 Nevermann 1934, 297.

in the 1980s.[79] Her case study, published in 1993, focused on obsidian artefacts collected from the Admiralty Islands (Manus Province, Papua New Guinea). Her research on obsidian-tipped objects aimed to take advantage of known chronological differences in the economic context to evaluate archaeological methods previously developed elsewhere.[80] Torrence described two types of spear hafting: "The earliest museum collections contain spears hafted by two different methods, each of which is also decorated in a particular manner [...]. In one case the haft was made with a putty from the local parinarium nut which was applied over a loose bundle of sago fibres. It was then either painted or incised while still damp [...]. Daggers were always made by this technique [...]. In the second group, twine was wound around a wooden collar which joined the blade to the shaft [...] the design created by the intricate wrapping was usually painted [...]. Sometimes the base of the wooden collar was also carved, especially in the later periods [...]. Unfortunately, there is no historical data which would explain why two kinds of manufacture existed side by side, but it is interesting to note that both kinds were collected from one social group by members of the Challenger expedition. It is not known, however, whether the artifacts were made locally or traded from other areas."[81]

Doreen Bowdery described, based on personal communication, the hafting technique employed for obsidian daggers as observed and described by Ambrose on Lou Island. "A malleable substance known as 'putty nut' was moulded around the stem area of the Manus tool which was then pushed into a sago frond midrib. The midrib was then carved to the required shape. The midrib area was bound with string and this in turn had a further layer of putty nut moulded onto the area to form a smooth handle, the handle was then decorated."[82] In the 1970s, Ambrose collected obsidian knives and a spear with this type of hafting.

The decoration of the spears

Luschan briefly also dealt with the 'figurative' decoration of spears: "[...] *Hingegen hat man die oft sehr prächtigen Verzierungen, welche alle diese Speere an dem Verbindungsstück zwischen Schaftz und Spitze haben, bisher fast ganz übersehen, und doch bieten sie eine Fülle von sehr belehrenden Motiven. Das wesentliche hier ist das Vorhandensein zweier ziemlich ebener, rechteckiger Flächen, die sich aus der Art der Befestigung ergeben. Der Admiralty-Insulaner begnügt sich aber nicht nur mit der technisch vollendeten Lösung eines so schwierigen Problems; er hat auch das Bedürfnis, das ganze Zwischenstück zwischen Schaft und Spitze zu verzieren. Oft geschieht das durch eine neue oberflächliche Verschnürung in regelmässigen Mustern und in tadellos sorgfältiger Ausführung, häufig mit bunt gefärbten Feldern und mit sehr wirkungsvoller Anwendung der schönen, weissglänzenden Kerne von Coix Lacrima. In anderen Fallen wird die harzige Masse, noch vor dem Erstarren, al fresco mit tief eingeschnittenen Linien verziert, und da sind es besonders die beiden unmittelbar auf der flachen, breiten Wurzel der Obsidianspitze liegenden Flächen, welche bei dieser Art der Verzierung eigenartig behandelt werden.* [...] *Im Anfange derselben steht* [...] *ein ganz natürlich gebildeter Vogel. Wir haben leider nicht die allergeringste Kenntnis davon, was dieser Vogel bedeutet; er kann ein Familienzeichen sein, er kann mir dem schnellen Fluge des Speeres in symbolische Beziehung gebracht werden, er kann mit mythologischen Vorstellungen in Zusammenhang stehen* [...]. *Dieser Vogel kommt in gleicher Art auf einer ganzen Reihe von Speeren vor, aber er verliert allmählich an Deutlichkeit* [...]. *Seine Vorlage scheint ihm viel mehr Aehnlichkeit mit einem menschlichen Gesicht zu haben, dem nur die Augen fehlen* [...] *während die verkümmerten Schwingen bereits wie Ohren mit durchbohrtem Läppchen aussehen; er braucht nur ein Paar Augen einzusetzen, und ein völlig einwandfreies menschliches Gesicht*

79 Torrence 1986; Torrence 1993; Torrence 2000; Torrence 2002.

80 Torrence 1986.

81 Torrence 1993, 471–474; Torrence 2000, 112.

82 Bowdery 2001, 232.

is fertig […] *der Speermacher* […] *das Bedürfnis empfindet, zu den Köpfen auch die ganze Figur zu bilden* […] *Daneben aber kenne wir andere Speere, bei denen zu dieser Figur noch ein neues Element hinzutritt – der Kopf eines Krokodils. Wie das zu erklären ist und was es ursprünglich bedeutet, ist einstweilen unbekannt.*"[83]

Nevermann described in detail the decoration of the spear, especially that of the mounting. "The splinted and wrapped Parinarium-coated bindings are often decorated with a new wrapping with thin cords over the coat of resin. Diagonal cords are drawn over the new wrapping, and the triangles and diamonds confined by them are painted black, white, or red and stand out through their colours from the figures on the far side of the thread border. In them, or on the cross-over points of two diagonal threads, *Coix* seeds or white beads are caulked with *Parinarium* resin. This wrapping and painting is the sole decoration of many spears, and the shaft end and intermediate piece are not decorated further. At most, the visible central thick piece of the intermediate wood is painted red or black. In a few cases, the decoration of the wound cord is replaced by a braiding of black horizontal rattan strips and yellow vertical strips, particularly between the shaft and intermediate section, using the same technique as in the plaited rattan girdles. The intermediate section or, when it is absent, the upper end of the shaft, is readily coated with *Parinarium* resin decorated with incised and painted patterns (*inīn on Pāk*)."[84]

Based on Luschan, Nevermann described the representation of the frigate bird and the transformation of the stylised frigate bird into a human face; he also wrote about the carvings. "If the wooden intermediate section is not coated with 'putty', it is either carved in relief with similar patterns or carved three-dimensionally. In this case the human body (*hamăt on Pāk*) and the crocodile head are the predominant motifs. The thicker, upper end of the shaft also undergoes this three-dimensional treatment when the intermediate piece is missing. […] The ornamentation of the human figures is lines of single diamonds or triangles from the shoulders to the middle of the chest, vertically down the lower part of the front of the body and the spine, and horizontal rings round arms and legs. These probably represent tattooing or decorative scarification to a degree no longer seen on a body."[85]

Crowe and Torrence described a mathematical approach not used previously in the study of the decoration of these spears.[86] Although two different types of spears were made in the Admiralty Islands, only the ones with the blade (spear point) attached to the shaft in one or more places by a cord wrapped around a wooden collar (socket) were described. The studies describe the geometric symmetry of the repetitive, usually bicolour pattern of the bindings securing the obsidian blade in the socket and the socket to the shaft of the spear. The detailed study was based on extensive collections in the Australian Museum in Sydney and the Field Museum of Natural History in Chicago. The authors believe that the differences between the assemblages of the two collections are small, and they contain a significant proportion of the known spears; thus, by studying them, they worked with a highly representative sample of spears from the Admiralty Islands. Crowe and Torrence's method was based on the systematic classification of all possible types of repetitive patterns by 19th-century European crystallographers. As a by-product of this classification, it is known that when discrete repetitive patterns are classified according to their symmetries, there are seven possible band patterns (one-dimensional) and 17 possible fill patterns (two-dimensional).[87] The question has immense abstract mathematical and group-theoretical aspects, and dozens of archaeological and/or ethnographic applications have been reported over the past decades.

83 von Luschan 1897, 80–81.

84 Nevermann 1934, 297, Figs 192–194.

85 von Luschan 1897.

86 Crowe – Torrence 1993.

87 See, for example, Washburn 1999; Crowe 2001.

Crowe used this idea to study several patterns found in various African contexts.[88] The four rigid motions that generate two-dimensional patterns are translation, rotation, mirror reflection, and glide reflection.[89] "The essence of the present note is the observation that there are five mathematically possible two-colourings of the pattern '*pmm*' and that all five of them are represented in Admiralty Islands spear bindings. The computer-drawn versions of this underlying *pmm* patterns [...] and its five two-colourings [...] are remarkably similar to the spear bindings shown in the accompanying drawings. [...] we briefly discuss the geometric characterization of the class of *pmm* patterns. [...] the notation has a straightforward common-sense interpretation. The 'p' can be thought of as standing for 'plane' or 'periodic', signifying that this is a two-dimensional (i.e. potentially plane-filling) pattern. The two 'm' s indicate that there are reflections in two directions. That is (referring to Fig. 1) there are lines—not drawn in this figure—in two perpendicular directions, with respect to each of which the pattern has bilateral symmetry. In the Figure 1 version of the *pmm* pattern, half of these lines pass through the centres of the diamond triangle groups, and the other half pass between the diamonds."[90]

The authors concluded, "[...] the twine which is wound around the wooden collar joining the obsidian blade to the spear shaft produces a natural pattern of rhombuses. By itself this common design, of crystallographic type pmm, is not particularly remarkable, since it is naturally produced by pulling the twine diagonally to form a tight binding of blade to the shaft. It is, however, remarkable that in the process of decoratively colouring the rhombuses (ordinarily with a third colour as the background) all five 'two-colourings' of *pmm* have been produced. Thus the combined geometric-permutation problem of finding all possible 'perfect two-colourings' of an underlying *pmm* pattern was solved, presumably in an entirely intuitive way, by the makers of these spears."[91]

Ohnemus presented the ethnographic material from the Alfred Bühler collection in the *Museum der Kulturen Basel* (formerly *Museum für Völkerkunde Basel*).[92] Based on their design and structure, the objects in the Basel collection can be divided into several groups. As there are no indigenous classifications, these are provisional, subjective categories.[93] Based on the study of the 63 obsidian-tipped spears in the collection, Ohnemus distinguished between ten types of obsidian tip socket decorations. "1) Undecorated mastic fixing (fitting snugly on the shaft in case of narrow blade, or goblet-shaped in case of wide blade. 2) The mastic formed into a goblet shape is decorated with incised patterns and, in most cases, painted in bands or zigzag, wave or triangle patterns with extensions (birds), as can be seen in the daggers. Objects from M'bunai, Batussi. 3) Same as 2, but a human face has been produced out of the triangle patterns (cf. also the decorations of the daggers). Objects from M'bunai. 4) A small, decorated connecting piece (wood) can be seen between the two parts of the wrapping. The part of the wrapping at the blade is angular or round. Objects from Buboi, Tingou, Bowat, Iru, Boamasau. 5) The connecting piece is longer than in 4, decorated with carving and painting. Objects from Buboi, Tulu, Tingou, Sau, Iru. 6) This connecting piece is carved as a crocodile's head. Objects from Buboi, Sembrum, Soheneliu, Sau, Iru. 7) The motif of a crocodile head and a human head (or crocodile and human as double head) appears on this connecting piece;

88 Crowe 1971; Crowe 1975; Crowe 1982.

89 Washburn 1999, 549. Translation is a term used in geometry to describe a function that moves an object a certain distance. The object is not altered in any other way.

90 Crowe – Torrence 1993, 387–388.

91 Crowe – Torrence 1993, 396.

92 Ohnemus 1998. Alfred Bühler, a Swiss ethnologist and explorer (1900–1981), went to the Admiralty Islands in December 1931 and worked there for six months on a field research and collecting mission for the city of Basel, Switzerland. During his stay on the islands, he established an ethnographic collection.

93 Classification based on find region was also necessary because, in many cases, the spear's place of origin or procurement was unknown; cf. Ohnemus 1998, Figs 433.1–10.

in some cases, the design is complemented by a perforated disc. Objects from Iru, Soheneliu, M'bunai. 8) The connecting piece is carved as a human figure (man or woman). Objects from Soheneliu, Iru. 9) Here, the connecting piece shows perforated carved patterns. Objects from Buboi, Sabo, Iru, and Nada. 10) One spear in the Basel collection differs from the others in the round form of its blade."[94]

Exchange of spear points

As a detailed discussion of the topic is beyond the scope of this overview, only some basic literature dealing in detail with spear point exchange is mentioned here.[95] While Torrence was studying obsidian-tipped spears from Admiralty Island in various museum collections, Fredericksen drew many conclusions about the production and exchange of spear points based on his evaluation of some finds excavated on Lou Island. "[…] [I]ntensive manufacture was carried out at Sasi and Emsin, but this could have been accommodated by local requirements over the medium term. Examination of obsidian procurement patterns and manufacturing methods revealed nothing which would contradict the conclusion that production was undertaken to satisfy local demand and perhaps a low level of exchange. Variability in point manufacture was found between the four localities. Sasi points are both trapezoidal and triangular in sectional shape, with no strong correlation between width or thickness. A different production strategy appears at Emsin, one in which points were made to an equilateral triangular shape. This was achieved through the application of extensive and skilfully executed secondary retouching. […] Occupation at Umleang involved the production of a different point type. This is a tanged form with minimal or no retouching. Manufacture of this type took place alongside the production of presumably untanged points, of which only a few are extensively modified triangular pieces resembling the Emsin type. The presence at Emsin of triangular points exhibiting a remarkably uniform cross-sectional shape provides unquestionable evidence of the work of a skilled artisan or artisans. Earlier, subsequent and perhaps contemporary manufacture on Lou does not display a similar level of implement shaping. An argument could be made that this high degree of standardisation represents the outcome of routine production for regular trade with external consumers. However, assuming that production purely for trade is correlated with attempts to decrease the amount of time and energy devoted to manufacture, then the application of extensive point retouching can be viewed as an inefficient use of time, if the desire was to maximise production output. […] The blades of obsidian-tipped weapons used and traded in historic times were notable for the absence or minimal use of shaping. […] Technological simplification could be a response to a number of factors, including (1) an increase in demand resulting in a need for greater production efficiency, (2) production by individuals who lacked the requisite skills, or perhaps rights, to manufacture finely worked points, and (3) stochastic stylistic variation."[96]

94 The crocodile as a decorative element was also mentioned by other authors; see, e.g., von Luschan 1897, 80–81; Parkinson 1907, 354–355; Parkinson 2010, 274. Concerning crocodile-and-human compositions, extremely common in the Pacific Islands, Badner wrote, "Though several adaptations of this iconographic ensemble exist, the usual composition represents the human image either standing on the snout or protruding out of the maw of a crocodile. The configuration of man on or in a crocodile's mouth seems to indicate an act of devouring or regurgitation, yet the actual meaning of the motif in Admiralty Island art remains unknown […]. The totem animal-human identity of an ancestor or his actual transformation into an animal after death is not an unusual concept in the Pacific. It was quite common in the Solomons, where after death, men were believed to be embodied in such creatures as the shark, eel, frigate bird, turtle, lizard and crocodile […]. The crocodile by itself was frequently carved in the Admiralty Islands […]. For a general discussion of the crocodile in the art of the South Seas, see Nevermann 1928, and for the Admiralities in particular, p. 151 of that article." (Badner 1968, 143). See also Codrington 1891, 177–180.

95 Fredericksen 1994, 165–168; Torrence 2000; Torrence 2002.

96 Fredericksen 1994, 165–169.

Conclusion

Chronological position of the spears

According to Torrence, the recent economic history of the Admiralty Islands can be divided into six periods. Europeans could observe obsidian-tipped spears first in 1767 during a hostile encounter with the islanders.[97] Lasting contact with the West only began in the mid-19th century, when Europeans made short forays in search of marine products. Until the end of the century, exchange took place mainly at sea. Captain Herbert Cayley-Webster also reviewed obsidian-tipped spears, writing, "This obsidian which they utilize for their spear-heads is a volcanic substance resembling thick green glass, generally worked in a triangular form, sharpened at the point to the fineness of a needle, and having the shape of a tongue of fire, about twelve inches in length. It is then fitted into the hard wood of the spear, and at once becomes a very formidable weapon."[98] Caucasian people of the *H. M. S. Challenger* scientific expedition disembarked on the island for the first time in 1875.[99] Around that time, traders established the first permanent stations in New Britain and tried (unsuccessfully) to set up outposts in Admiralty Islands.[100] Germany annexed New Guinea in 1887 but did not establish a government post in the Admiralty Islands until 1912.

Because of the assumed age of the objects in the collection of the Museum of Ethnography, the third period in Torrence's definition (1876–1910), and primarily the end of the 19th century within that is the most interesting for our study. The trends observed by Torrence concerning the making, workmanship, and decoration of spears were, to some extent, most probably valid even at the end of the 19th century. Torrence begins the presentation of his results by writing, "Originally, production was aimed at local people, so the 'business end' of the artifact was the most important. Obsidian blades comprised a sizeable proportion of the total, and a great deal of time and effort was invested in ensuring that the blades were effective weapons. After 1911, with the change in consumers from 'fighters' to 'collectors', the relative importance of the decoration increased."[101]

Spear-makers gradually increased the overall efficiency of production with time. First, they saved time and energy by reducing the quality of workmanship, as reflected by the decreasing quality of the tightness of the binding and the pattern painting, the gradually fewer serrations, the uneven thickness of the incised lines, and the lower precision of the wood carving. Second, work became standardised. As a result, fewer spear types were produced, and designs became more uniform. Third, carved and incised designs became simpler over time. For example, while the intricate frigate bird pattern on a spear from 1877 usually features depictions of the heads, bodies, and wingtips of four birds, such an item from 1884 usually displays only two birds, often in a form simplified or reduced to a simple 'V' shape.[102] Fourth, as consumers demanded more decoration, spear makers started reducing the obsidian blades' size. Until 1910, long, slender blades (usually trapezoidal in cross-section) were detached from prepared cores and retouched where necessary to produce a long and very sharp point with a triangular cross-section,[103] while in periods of accelerated warfare (1875–1910), the average blade size increased. After the First World War, the primary production of obsidian blades ceased, and manufacturers scavenged old artefacts and started utilising old waste

97 See, for example, Wallis 1966, 193–196.

98 Cayley-Webster 1898, 301–318.

99 See, for example, Moseley 1877; Moseley 1892; Campbell 1876, 258–263; Spry 1877, 267–272.

100 Hernsheim 1983; Robson 1965.

101 Torrence 1993, 472. The term 'business end' means the functional part of a tool or device, the essential or basic part of a process or operation.

102 Torrence 1993, 473, Pl. 1.a, 474, Pl. 1.a,c.

103 Torrence 1993, 473, Pl. 1.a–b.

and by-products.[104] As a result, the blades decreased in size and became more irregular, and an increasingly large number included cortex parts.

The blades used for making obsidian points show no sign of standardising the spear point-making process, which would indicate an advanced blade technology. One possible reason is that there was no standardised technology for blade or spear point production in a strict sense; however, examining that is beyond the scope of this study. Another possible reason is that the obsidian-tipped spears in the collection are from different areas; they may also be from different ages and represent different traditions. The Admiralty Islands is an archipelago of eighteen islands, and obsidian spear points were produced at different locations, even within the main island (Manus). It is also possible that some of the 'decline' phenomena described by Torrence regarding spear-point making had already occurred earlier.[105]

Based on their quantitative and qualitative characteristics, the studied obsidian spear points generally contradict the tendency Torrence outlined based on a significantly larger sample.[106] She became of the opinion (see above) that originally, the functional part of the points was the most important, and much time and effort were invested in ensuring that the blades were effective weapons. This is in no way supported by our data.

The function of the spears

The marks of non-standardization on obsidian spear points (irregular profile and/or irregular cross-section, bent tip) and the conclusions on spear shafts presented above raise serious questions about the usefulness of the spears. The irregular shape of the spear points and the crooked or thin, weak shafts generate ballistic problems, calling into question whether the spears were fit for being used as weapons, i.e., throwing spears. Although 'throwing spears' volleyed *en masse* at ships were often reported in connection with the early, often hostile encounters with natives,[107] the description of the spears themselves was imprecise and contained no details on their metric properties. William J. J. Spry depicted an obsidian-tipped spear from the Admiralty Islands,[108] the top binding of which had a geometric pattern, while the lower part also featured a simple geometric pattern and decorative beads. The proportions of the figure suggest that the spear had a long, straight, but rather thin shaft.

Moseley's illustrations suggest that some of the spears depicted also had thin shafts,[109] akin to some spears presented by Parkinson.[110] These examples, however, do not resolve the problem of thin shafts as the authors did not include references on the function of the published specimens. Consequently, the problem of the function of the spears cannot be determined due to a lack of data.

Therefore, it is worth examining the literature on Australian spears for orientation. Cristopher J. Ellis[111] mentions that several authors[112] pointed out a definite connection between lightweight shafts of bamboo or cane (reed) and stone-tipped spears in Australia. Spears with such light shafts can be thrown farther and more accurately than heavy ones without stone tips. However, because bamboo or cane spears designed for killing from a longer distance were lighter or had a smaller mass than

104 Torrence 1993, 473, Pl. 1.d.

105 Torrence 1993.

106 Torrence 1993, 472.

107 Hawkesworth 1773, 603; Wallis 1966, 194–195.

108 Spry 1877, Fig. 1.

109 Moseley 1877, Pl. 20.

110 Parkinson 1907, 354–355; Parkinson 2010, 274.

111 Ellis 1997, 47.

112 Davidson 1934, 61; Kelly 1970, 79–80, 142, 147; Akerman 1978.

wooden ones, they lacked the 'killing force' of heavy spears. To compensate for the disadvantage a light shaft represented, such spears were fitted with stone points.

According to Daniel S. Davidson,[113] there was no consistency in the total length of spears in Australia, as some spears were less than four feet [121.92 cm] long, while others could be over twelve feet [365.76 cm]. It must be considered that the spears were made for different purposes. In all but one case, the cane-shafted spear appeared to have been thrown with the aid of a spear thrower (also known as *atlatl*). The only known tribes that did not use a spear thrower for cane spears have been the Arunta and their neighbours in Central Australia, who used such spears with unaided hands for fishing. Kim Akerman wrote that the six spears he examined were very light (170 g on average).[114] Their shaft was made of a 150–200 cm long reed or bamboo cane attached to a thin hardwood socket. The stone spear point was placed in the other, notched (hollowed) end of the socket.

Because of its Hungarian aspect, a brief reference must be made to the ethnographic artefacts brought home from the Admiralty Islands by Mária Molnár, an ill-fated missionary deaconess (1886–1943). She performed missionary service between 1928 and 1943, primarily on the island of Pitilu, while regularly visiting the main island, Manus, and other surrounding islands. In 1935, she returned to Hungary for a short visit, bringing her collection, which has been preserved in the Museum of Sárospatak since then, with her. The objects in the collection (203 items from the Admiralty Islands, six items from New Guinea and New Ireland, and five items from Southeast Asia) were studied and published by Judit Antoni.[115] The collection also includes some obsidian-tipped spears and daggers, most decorated with stylised frigate birds, while some with carved human figures. After entering into contact with Europeans, including the time when Mária Molnár lived there, obsidian-tipped spears have been used mainly as barter goods or during dances. This is indicated, among other things, by the poor quality and fragility of the blade and shaft jointing, as well as the abundance of carvings and painted patterns, which made the spears unsuitable for their original purpose, that is, to be used as weapons. Mead described a ceremony in which, during the dance, both men and women held spears.[116]

Torrence wrote, "There are numerous descriptions of spears having been used in local warfare and against Europeans during the latter part of the nineteenth century. Since the highly decorated examples appear to be far too heavy to be effective weapons, one might assume that they were status objects, whereas the plainer variety might have been the more functional object, but there is no direct historical information to support this hypothesis. […]."[117] It is not clear what she meant by 'plainer variety', but she likely refers to the frigate bird depiction with relatively simple additional decorative elements.

The frigate bird has a significant role in the mythology of all Austronesian peoples.[118] Although we accept the common interpretation of the bird figure as a frigate bird, it should be noted that the realistic bird figures depicted on the spears usually lack the species' characteristic hooked beak and throat pouch. As Luschan wrote in connection with the bird figure in the decoration of a spear, "[…] *er kann mir dem schnellen Fluge des Speeres in symbolische Beziehung gebracht werden, er kann mit mythologischen Vorstellungen in Zusammenhang stehen.*"[119] This symbolic interpretation seems very plausible since the spears used as weapons in the Admiralty Islands were throwing spears.

113 Davidson 1934, 61.

114 Akerman 1978.

115 Antoni 2019.

116 Mead 1934, 251–252.

117 Torrence 2002, 74.

118 See, for example, Codrington 1891, 173; Balfour 1905; Balfour 1917; Krieger 1932; Ivens 1927; Ivens 1934; Ross 1981; Lee 2000; Pollock 2009; Feinberg 2020; Simon 2020; Waite 2021.

119 von Luschan 1897, 81.

Acknowledgements

The authors are grateful to Lajos Kemecsi, the director of the Museum of Ethnography in Budapest, who made the lithic collection available to them. Special thanks go to Anna Biró, a museologist at the Museum of Ethnography in Budapest, who helped a lot in researching the places of origin of the object, the circumstances of their collecting, and the related literature. We are also indebted to Hajnalka Bagi, collection manager of the Museum of Ethnography in Budapest, who provided us with the necessary technical assistance.

References

Akerman, K. 1976: Notes on the experimental manufacture of long blades and points by percussion flaking. In: Lauer P. K. P. - Koepping K.-P. (eds): *Occasional Papers in Anthropology. Vol. 6.* St. Lucia. 117–128.

Akerman, K.: 1978: Notes on the Kimberley Stone-Tipped Spear Focusing on the Point Hafting Mechanism. *Mankind* 11, 486–489. https://doi.org/10.1111/j.1835-9310.1978.tb01190.x

Akerman, K. 2007: To make a Point: Ethnographic Reality and the Ethnographic and Experimental Replication of Australian Macroblades Known as Leilira. *Australian Archaeology* 64, 23–34. https://doi.org/10.1080/03122417.2007.11681846

Allen, J. – Gosden, C. (eds) 1991: *Report of the Lapita Homeland Project.* Occasional Papers in Prehistory 20. Canberra.

Ambrose, W. R. 1976: Obsidian and its prehistoric distribution in Melanesia. In: Barnard, N. (ed.): *Ancient Chinese Bronzes and Southeast Asian Metal and other Archaeological Artifacts.* Melbourne, 351–378.

Ambrose, W. R. 1978: The Loneliness of the Long-Distance Trader in Melanesia. *Mankind* 11, 326–333. https://doi.org/10.1111/j.1835-9310.1978.tb00663.x

Ambrose, W. R. 1988: An early bronze artefact from Papua New Guinea. *Antiquity* 62, 483–491. https://doi.org/10.1017/S0003598X00074585

Ambrose, W. R. 1991: Lapita or not Lapita: The case of the Manus pots. In: Allen, J. – Gosden, C. (eds): *Report of the Lapita Homeland Project.* Occasional Papers in Prehistory 20. Canberra, 103–112.

Ambrose, W. R. – Johnson, W. 1986: Unea: An obsidian non-source in Papua New Guinea. *Journal of the Polynesian Society* 95, 491–497.

Antcliff, P. 1988: *Obsidian points from Emsin (GEB), Lou Island.* BA Dissertation, Australian National University, Canberra. https://doi.org/10.5281/zenodo.6497323

Antoni, J. 2019: *'Vidd el a te faludba…' Molnár Mária misszionárius melanéziai gyűjteménye.* Sárospatak.

Badner, M. D. 1968: *The Figural Sculpture and Iconography of Admiralty Island Art.* PhD Dissertation, Columbia University, New York.

Bakó, B. 1993: Fenichel Sámuel életútja és emlékei Nagyenyeden. *Földrajzi Múzeumi Tanulmányok* 12, 57–64.

Balfour, H. 1905: Bird and Human Designs from the Solomon Islands, Illustrating the Influence of One Design Over Another. *Man* 5, 81–83. https://doi.org/10.2307/2788349

Balfour, H. 1917: Some Ethnological Suggestions in Regard to Easter Island, or Rapanui. *Folklore* 28, 356–381. https://doi.org/10.1080/0015587X.1917.9719007

Bodrogi, T. 1954: Fenichel Sámuel. *Ethnographia,* 567–580.

Bowdery, D. 2001: Phytolith and starch data from an obsidian tool excavated at Bitokara, New Britain Province, Papua New Guinea: A 3400-year-old hafting technique? In: Meunier, J. D. – Colin, F. (eds): *Phytoliths: Applications in Earth Sciences and Human History.* Lisse, 225–237. https://doi.org/10.1201/NOE9058093455.ch17

Bulmer, R. 1961: Political Aspects of the Moka Exchange System Among the Kyaka People of the Western Highlands of New Guinea. *Oceania* 31, 1–13. https://doi.org/10.1002/j.1834-4461.1960.tb01736.x

Bühler, A. 1935: Versuch einer Bevölkerungs- und Kulturanalyse auf den Admiralitätsinseln. *Zeitschrift für Ethnologie*, 67, 1–32.

Campbell, G. 1876: *Log Letters from 'The Challenger'*. London. https://doi.org/10.5962/bhl.title.96927

Cayley-Webster, H. 1898: *Through New Guinea and the Cannibal Countries*. London.

Codrington, R. H. 1891: *The Melanesians — Studies in their Anthropology and Folklore*. Oxford.

Coello, F. 1885: Conflicto hispano-alemán. *Boletín de Sociedad Geográfica de Madrid* 19, 273–335.

Crabtree, D. E. 1968: Mesoamerican polyhedral cores and prismatic blades. *American Antiquity* 33, 446–478. https://doi.org/10.2307/278596

Crabtree, D. E. 1972: *An Introduction to Flintworking*. Occasional Papers of the Idaho State Museum 28. Pocatello, ID.

Crowe, D. W. 1971: The geometry of African art I: Bakuba art. *Journal of Geometry* 1, 169–182. https://doi.org/10.1007/BF02150270

Crowe, D. W. 1975: The geometry of African art II: A catalog of Benin patterns. *Historia Mathematica* 2, 253–271. https://doi.org/10.1016/0315-0860(75)90063-4

Crowe, D. W. 1982: The geometry of African art III: The smoking pipes of Begho. In: Davis, C. – Grünbaum, B. – Sherk, F. A. (eds): *The Geometric Vein: The Coxeter Festschrift*. New York, 177–189. https://doi.org/10.1007/978-1-4612-5648-9_11

Crowe, D. W. 2001: *Symmetries of culture*. Madison, WI.

Crowe, D. W. – Torrence, R. 1993: Admiralty Islands Spear Decorations: A Minicatalog of pmm Patterns. *Symmetry: Culture and Science* 4, 385–396.

Culin, S. 1899: Hawaiian Games. *American Anthropologist* 1, 201–247. https://doi.org/10.1525/aa.1899.1.2.02a00010

Davidson, D. S. 1934: Australian Spear Traits and Their Derivations. *Journal of the Polynesian Society* 43, 41–72, 143–162.

Egloff, B. J. 1975: Archaeological investigations in the coastal Madang area and on Elouae Island of the St. Matthias Group. *Records of the Papua New Guinea Public Museum and Art Gallery* 5, 15–31.

Ellis, C. J. 1997: Factors influencing the use of stone projectile tips: an ethnographic perspective. In: Knecht, H. (ed.): *Projectile Technology*. New York–London, 37–74. https://doi.org/10.1007/978-1-4899-1851-2_2

Feinberg, R. 2020: People, Birds, Canoes, and Seafaring in the Pacific Islands. *Český lid* 107, 335–350. https://doi.org/10.21104/CL.2020.3.03

Fredericksen, C. F. K. 1994: *Patterns in Glass: Obsidian and Economic Specialisation in the Admiralty Islands*. PhD Dissertation, Australian National University, Canberra.

Fredericksen, C. F. K. 1997a: Changes in Admiralty Islands obsidian source use: The view from Pamwak. *Archaeology in Oceania* 32, 30–35. https://doi.org/10.1002/j.1834-4453.1997.tb00372.x

Fredericksen, C. F. K. 1997b: The maritime distribution of Bismarck Archipelago obsidian and island Melanesian prehistory. *The Journal of the Polynesian Society* 106, 375–394.

Fredericksen, C. 2000: Point of Discussion. Obsidian Blade Technology in the Admiralty Islands, 2100 BP to 50 BP. *Bulletin of the Indo-Pacific Prehistory Association* 20, 93–106.

Friederici, G. 1912: *Beiträge zur Völker- und Sprachenkunde von Deutsch Neuguinea. Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908. Vol. 2.* Mitteilungen aus den Deutschen Schutzgebieten, Ergänzungsheft 5. Berlin.

Fullagar, R. – Torrence, R. 1991: Obsidian exploitation at Umleang, Lou Island. In: Allen, J. – Gosden, C. (eds): *Report of the Lapita Homeland Project*. Occasional Papers in Prehistory 20. Canberra, 113–143.

Golitko, M. – Schauer, M. – Terrell, J. E. 2013: Obsidian Acquisition on the Sepik Coast of Northern Papua New Guinea During the Last Two Millennia. In: Summerhayes, G. R. – Buckley, H. (eds): *Pacific Archaeology: Documenting the Past 50,000 Years*. University of Otago Studies in Archaeology 25. Otago, 43–57.

Gosden, C. – Allen, J. – Ambrose, W. A. – Anson, D. – Golson, J. – Green, R. – Kirch, P. – Lilley, I. – Specht, J. – Spriggs, M. 1989: Lapita sites of the Bismarck Archipelago. *Antiquity* 63, 561–586. https://doi.org/10.1017/S0003598X00076559

Green, R. C. 1976: Lapita sites in the Santa Cruz Group. In: Green, R. C. – Cresswell, M. M. (eds): *Southeast Solomon Islands Cultural History*. Royal Society of New Zealand 11. Wellington, 245–265.

Green, R. C. 1987: Obsidian results from Lapita sites of the Reef/Santa Cruz Islands, In Ambrose, W. R. – Mummery, J. M. J. (eds): *Archaeometry: Further Studies in Australasia.* Canberra, 239–249.

Hanslip, M. D. 2001: *Expedient technologies? Obsidian artefacts in Island Melanesia.* PhD Dissertation, Australian National University, Canberra.

Hawkesworth, J. 1773: *An Account of the Voyages Undertaken by the Order of His Present Majesty for making Discoveries in the Southern Hemisphere. Vol. 1.* London.

Hedrick, J. D. 1971: Lapita style pottery from Malo Island. *Journal of the Polynesian Society* 80, 5–19.

Hernsheim, E. 1983: *South Sea Merchant.* Boroko.

Inizan, M.-L. – Reduron-Ballinger, M. – Roche, H. – Tixier, J. 1999: *Technology and terminology of knapped stone.* Nanterre.

Ivens, W. G. 1927: *Melanesians of the South-east Solomon Islands.* New York.

Ivens, W. 1934: The Diversity of Culture in Melanesia. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 64, 45–56. https://doi.org/10.2307/2843946

Kelly, A. 1970: *The Australian Spearthrower.* BA Dissertation, University of Sydney, Sydney.

Kennedy, J. – Wadra, F. – Akon, U. – Busasa, R. – Papah, J. – Piamnok, M. 1991: Site Survey of Southwest Manus: A Preliminary Report. *Archaeology in Oceania* 26, 114–118. https://doi.org/10.1002/j.1834-4453.1991.tb00275.x

Kirch, P. V. 1991: Prehistoric Exchange in Western Melanesia. *Annual Review of Anthropology* 20, 141–165. https://doi.org/10.1146/annurev.anthro.20.1.141

Krieger, H. W. 1932: Design areas in Oceania. *Proceedings of the National Museum, Smithsonian Institution* 79, 1–53. https://doi.org/10.5479/si.00963801.79-2896.1

Labillardière, M. 1800: *Voyage in Search of La Pérouse. Performed by Order of the Constituent Assembly during the Years 1791, 1792, 1793, and 1794.* London. https://doi.org/10.5962/bhl.title.34766

Leask, M. F. 1947: Tools of a Canoe-Building industry from Cape Wom, northern New Guinea. *Oceania* 17, 300–309. https://doi.org/10.1002/j.1834-4461.1947.tb00155.x

Lee, G. 2000: The Birds of Paradise. *Rapa Nui Journal* 14, 111–114.

Lewis, A. B. 1932: *Ethnology of Melanesia.* Field Museum of Natural History, Department of Anthropology, Guide Part 5. Chicago.

Lewis, A. B. 1951: *The Melanesians — People of the South Pacific.* Chicago.

Linton, R. 1926: *Ethnology of Polynesia and Micronesia.* Field Museum of Natural History, Department of Anthropology, Guide Part 6. Chicago.

von Luschan, F. 1897: *Beiträge zur Völkerkunde der deutschen Schutzgebiete.* Erweiterte Sonderausgabe aus dem 'Amtlichen Bericht über die erste Deutsche Kolonial-Ausstellung' in Treptow 1896. Berlin.

Malinowski, B. 1922: *Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagos of Melanesian New Guinea.* London.

Mead, M. 1934: *Kinship in the Admiralty Islands.* Anthropological Papers of the American Museum of Natural History 34/2. New York.

Mead, M. 1937: The Manus of the Admiralty Islands. In: Mead, M. (eds): *Cooperation and Competition among Primitive Peoples.* New York–London, 210–239. https://doi.org/10.1037/13891-007

Meier, J. P. 1906: Berichtigungen zu Dr. Schnee's Mitteilungen über die Sprache der Moanus (Admiralitäts-Inseln). *Anthropos* 1, 210–228, 472–482.

Mitchell, A. 1896: An Archaeologist's Study of the Admiralty Islanders. *Proceedings of the Society of Antiquaries of Scotland* 30, 357–369. https://doi.org/10.9750/PSAS.030.357.369

Moore, M. W. 2003a: Flexibility of stone tool manufacturing methods on the Georgina River, Camooweal, Queensland. *Archaeology in Oceania* 38, 23–36. https://doi.org/10.1002/j.1834-4453.2003.tb00518.x

Moore, M. W. 2003b: Australian Aboriginal blade production methods on the Georgina River, Camooweal, Queensland. *Lithic Technology* 28, 35–63. https://doi.org/10.1080/01977261.2003.11721001

Moseley, H. N. 1877: On the Inhabitants of the Admiralty Islands. *The Journal of the Anthropological Institute of Great Britain and Ireland* 6, 379–429. https://doi.org/10.2307/2841093

Moseley, H. N. 1892: *Notes by a Naturalist. An Account of Observations made during the Voyages of H.M.S. Challenger.* New York–London. https://doi.org/10.5962/bhl.title.14281

de Navarrete, M. F. 1837: *Coleccion de los viages y descubrimientos. Tomo V., Viages al Maluco – Segundo – El del Comendador Fr. Garcia de Loaisa, Tercero – El de Alvaro de Saavedra.* Madrid.

Nevermann, H. 1928: Das Krokodil in der Südseekunst. *Der Erdball* 2, 148–152.

Nevermann, H. 1934: *Admiralitäts-Inseln.* In: Thilenius, G. (ed.): *Ergebnisse der Südsee-Expedition 1908–1910, II. Ethnographie: A. Melanesien Band 3.* Hamburg.

Nevermann, H. 2013: *Admiralty Islands. Results of the Expedition to the South Seas 1908–1910.* Dunedin.

Newman, K. – Moore, M. W. 2013: Ballistically anomalous stone projectile points in Australia. *Journal of Archaeological Science* 40, 2614–2620. https://doi.org/10.1016/j.jas.2013.01.023

Ohnemus, S. 1998: *An Ethnology of the Admiralty Islanders: The Alfred Bühler Collection, Museum der Kulturen, Basel.* Honolulu.

'Ongka's Big Moka: The Kawelka of Papua New Guinea' 1976: England's Granada TV's *Disappearing World* series. https://www.youtube.com/watch?v=NyQ8rW25Iy8 (last accessed: 09. 01. 2024).

Parkinson, R. 1907: *Dreißig Jahre in der Südsee. Land und Leute, Sitten und Gebräuche im Bismarckarchipel und auf den deutschen Salomoinseln.* Stuttgart.

Parkinson, R. 2010: *Thirty Years in the South Seas — Land und People, Customs and Traditions in the Bismarck Archipelago and on the German Solomon Islands.* Sydney. https://doi.org/10.30722/sup.9781920899639

Parry, W. 1994: Prismatic Blade Technologies in North America. America. In: Carr, P. J. (ed.): *The Organization of North American Prehistoric Chipped Stone Tool Technologies.* Archaeological Series 7. Ann Arbor, MI, 87–98.

Parry, W. 2002: Aztec Blade Production Strategies in the Eastern Basin of Mexico. In: Hirth, K. – Andrews, B. (eds): *Pathways to Prismatic Blades: A Study in Mesoamerican Obsidian Core-Blade Technology.* Cotsen Institute of Archaeology – Monograph 45. Los Angeles, 37–45. https://doi.org/10.2307/j.ctvhhhfbz.6

Pollock, N. J. 2009: The Frigate Bird Cult in Eastern Micronesia. *People and Culture in Oceania* 25, 97–100.

Ray, S. H. 1917: The People and Language of Lifu, Loyalty Islands. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 47, 239–322. https://doi.org/10.2307/2843343

Reepmeyer, C. – Spriggs, M. – Bedford, S. – Ambrose, W. 2011: Provenance and Technology of Lithic Artefacts from Teouma Lapita Sdite, Vanuatu. *Asian Perspectives* 49, 205–225. https://doi.org/10.1353/asi.2010.0004

Robson, R. W. 1965: *Queen Emma: the Samoan-American girl who founded an empire in 19th century New Guinea.* Sydney.

Ross, K. 1981: Shell ornaments of Malaita: Currency and Ritual Valuables in the Central Solomons. *Expedition* 23, 20–26.

Sahlins, M. 1963: Poor Man, Rich Man, Big-Man, Chief: Political Types in Melanesia and Polynesia. *Comparative Studies in Society and History* 5, 285–303. https://doi.org/10.1017/S0010417500001729

Schnee, H. 1904: *Bilder aus der Südsee. Unter den kannibalischen Stämmen des Bismarck-Archipels.* Berlin.

Schwartz, T. 1963: Systems of areal integration: Some considerations based on the admiralty Islands of Northern Melanesia. *Anthropological Forum* 1, 56–97. https://doi.org/10.1080/00664677.1963.9967181

Sheppard, P. J. 1993: Lapita Lithics: Trade/Exchange and Technology. A View from the Reefs/Santa Cruz. *Archaeology in Oceania* 28, 121–137. https://doi.org/10.1002/j.1834-4453.1993.tb00303.x

Sheppard, P. 2010: Pacific obsidian sourcing by portable XRF. *Archaeology in Oceania* 45, 21–30. https://doi.org/10.1002/j.1834-4453.2010.tb00074.x

Simon, S. 2020: Flying the Pacific, Culturing Oceania: Human-Bird Entanglements and Austronesian Worlds. *Senri Ethnological Studies* 103, 65–87.

Sisk, M. L. – Shea, J. J. 2011: The African origin of complex projectile technology: an analysis using tip cross-sectional area and perimeter. *International Journal of Evolutionary Biology*, 1–8. https://doi.org/10.4061/2011/968012

Specht, J. 1972: Evidence of early trader in northern Melanesia. *Mankind* 8, 310–312.

Specht, J. 1981: Obsidian Sources at Talasea, West New Britain, Papua New Guinea. *The Journal of the Polynesian Society* 90, 337–356.

Spry, W. J. J. 1877: *The Cruise of Her Majesty's Ship 'Challenger.' Voyages over many Seas, Scenes in many Lands.* New York. https://doi.org/10.5962/bhl.title.112294

Summerhayes, G. R. 2003: The rocky road: the selection and transport of Admiralties Obsidian to Lapita communities. *Australian Archaeology* 57, 135–142. https://doi.org/10.1080/03122417.2003.11681772

Summerhayes, G. R. 2009: Obsidian network patterns in Melanesia – Sources, characterisation and distribution. *Bulletin of the Indo-Pacific Prehistory Association* 29, 109–123. https://doi.org/10.7152/bippa.v29i0.9484

Summerhayes, G. R. – Kennedy, J. – Matzisoo-Smith, E. – Mandui, H. – Ambrose, W. – Allen, C. – Reepmeyer, C. V. – Torrence, R. – Wadra, F. 2014: Lepong: A New Obsidian Source in the Admiralty Islands, Papua New Guinea. *Geoarchaeology: An International Journal* 29, 238–248. https://doi.org/10.1002/gea.21475

Terrell, J. E. – Welsch, R. L. 1997: Lapita and the temporal geography of prehistory. *Antiquity* 71, 548–572. https://doi.org/10.1017/S0003598X0008532X

Thurnwald, R. 1910: Im Bismarckarchipel und auf den Salomoinseln 1906–1909. *Zeitschrift für Ethnologie* 42, 98–147. https://doi.org/10.2307/199989

Torrence, R. 1986: *Production and Exchange of Stone Tools: Prehistoric Obsidian in the Aegean.* Cambridge.

Torrence, R. 1993: Ethnoarchaeology, museum collections and prehistoric exchange: Obsidian-tipped artifacts from the Admiralty Islands, *World Archaeology* 24, 467–481. https://doi.org/10.1080/00438243.1993.9980220

Torrence, R. 2000: Just Another Trader? An archaeological perspective on European barter with Admiralty Islanders, Papua New Guinea. In: Torrence, R. – Clarke, A. (eds): *The Archaeology of Difference: Negotiating cross-cultural engagements in Oceania.* London, 104–141.

Torrence, R. 2002: Obsidian-tipped Spears and Daggers: what we can learn from 130 years of museum collecting. In: Kaufmann, C. – Kocher Schmid, C. – Ohnemus, S. (eds): *The Admiralty Islands: Art from the South Seas.* Zürich, 73–80.

Valentin, P. 1968: *Die melanesischen Pfeile und Bogen im Basler Museum für Völkerkunde.* PhD Dissertation, Universität Basel, Basel.

Vargyas, G. 2008: The Oceania Collection. In: Gyarmati, J. (ed.): *Taking them back to my homeland… Hungarian Collectors – Non-European Collections of the Museum of Ethnography in a European Context.* Budapest, 207–248.

Waite, D. 2021: Canoe Carvings from Western Solomon Islands. *Pacific Arts* 21, 76–106. https://doi.org/10.5070/PC221155085

Wallis, H. (ed.) 1966: *Carteret's Voyage Round the World 1766–1769.* New York.

Washburn, D. 1999: Perceptual Anthropology: The Cultural Salience of Symmetry. *American Anthropologist* 101, 547–562. https://doi.org/10.1525/aa.1999.101.3.547

White, J. P. – Specht, J. 1971: Prehistoric pottery from Ambitle Island, Bismarck Archipelago. *Asian Perspectives* 14, 88–94.

White, J. P. – Downie, J. E. – Ambrose, W. R. 1978: Mid-recent occupation and resource exploitation in the Bismarck Archipelago. *Science* 199, 877–879. https://doi.org/10.1126/science.199.4331.877

White, J. P. – Downie, J. E. 1980: Excavations at Lesu, New Ireland. *Asian Perspectives* 23, 193–220.

Zöller, H. 1891: *Deutsch-Neu Guinea und meine Ersteigung des Finisterre-Gebirges.* Stuttgart–Berlin–Leipzig.