

CAUTION BAY STUDIES IN ARCHAEOLOGY 1

ARCHAEOLOGICAL  
RESEARCH AT CAUTION BAY,  
PAPUA NEW GUINEA

CULTURAL, LINGUISTIC AND  
ENVIRONMENTAL SETTING

Edited by

**Thomas Richards, Bruno David,  
Ken Aplin and Ian J. McNiven**

# ARCHAEOPRESS PUBLISHING LTD

Gordon House  
276 Banbury Road  
Oxford OX2 7ED

[www.archaeopress.com](http://www.archaeopress.com)

## CAUTION BAY STUDIES IN ARCHAEOLOGY 1

ISBN 978 1 78491 504 9  
ISBN 978 1 78491 505 6 (e-Pdf)

© Archaeopress, Monash University and authors 2016

Cover: Tanamu 2 excavations in progress, 27 November 2009. The site is located 110 metres inland of the mangrove-fringed coastline, on the western margin of Caution Bay's alluvial plain as it extends into the littoral zone. Occupation at the site peaked around 2500 cal BP (photograph by Ian J. McNiven).

All rights reserved. No part of this book may be reproduced, in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior written permission of the copyright owners.

Printed in England by Oxuniprint, Oxford  
This book is available direct from Archaeopress or from our website [www.archaeopress.com](http://www.archaeopress.com)

# Contents

<b>Contents</b> .....	i
<b>List of Figures</b> .....	v
<b>Editors' and Authors' Affiliations and Contacts</b> .....	viii
<b>Acknowledgements</b> .....	ix
<b>Chapter 1.</b>	
<b>Introduction to the Caution Bay Archaeology Project</b> .....	1
Thomas Richards, Bruno David, Ken Aplin, Ian J. McNiven and Matthew Leavesley	
Introduction.....	1
Research Goals and Themes.....	3
<i>Lapita Colonization</i> .....	3
<i>Ceramic Transformations</i> .....	4
<i>Long Distance Ceramic Trade</i> .....	4
<i>Historicizing the Ethnographic Koita and Motu</i> .....	4
<i>Spatial and Temporal Faunal Resource Utilization Patterns</i> .....	5
<i>Caution Bay Landscape Use</i> .....	5
<i>Raw Material Sources</i> .....	6
<i>Technological Transformations</i> .....	6
Scope and Organization of the Caution Bay Monographs.....	6
Organization of the Present Volume.....	7
<b>Chapter 2.</b>	
<b>Archaeology in Port Moresby and the Southern Lowlands of Papua New Guinea: Intellectual and Historical Contexts for Caution Bay</b> .....	9
Bruno David, Thomas Richards, Robert Skelly, Ian J. McNiven and Matthew Leavesley	
Introduction.....	9
Port Moresby Region.....	11
<i>Graeme Pretty</i> .....	11
<i>Susan Bulmer</i> .....	11
<i>Jim Allen</i> .....	13
<i>Pamela Swadling</i> .....	16
Yule Island-Hall Sound.....	19
<i>Ron Vanderwal</i> .....	19
Gulf of Papua Region.....	21
<i>Jim Rhoads, David Frankel and Bruno David</i> .....	21
<i>Bruno David and Robert Skelly</i> .....	22
Amazon Bay-Mailu.....	23
<i>Geoff Irwin</i> .....	23
Summary and Conclusions.....	24
<b>Chapter 3.</b>	
<b>The Motu-Koita: A Cultural and Social History</b> .....	27
Michael Goddard	
Introduction.....	27
A Provisional Prehistory.....	27
Social Organization.....	29
Lifeworld.....	31
Effects of European Contact and the Colonial Period.....	32
Independence and Afterwards.....	34

**Chapter 4.**

<b>Motu-Koita Contact in the Caution Bay Area of Central and Southeast Mainland Papua New Guinea:</b>	
<b>Some Linguistic Observations</b> .....	39
Tom Dutton	
Introduction .....	39
The Linguistic Scene at First Contact.....	39
<i>Motu</i> .....	39
<i>Koita</i> .....	42
Motu-Koita Contact: The Linguistic Evidence .....	43
<i>The British New Guinea Annual Report for 1889-90 Vocabulary</i> .....	43
<i>The 1994 Study</i> .....	45
Historical Implications of the Linguistic Evidence .....	46
<i>Three Comparative Cases</i> .....	47
Maisin .....	47
Ouma and Related Remnant Languages.....	48
Lau'una .....	50
Motu-Koita Contact in the Caution Bay Area.....	50
Conclusion .....	51

**Chapter 5.**

<b>Koita and Motu Landscapes and Seascapes of Caution Bay</b> .....	53
Linus S. digim'Rina, Thomas Richards, Bruno David, Matthew Leavesley, Michael Goddard, Tom Dutton, Robert Skelly, Brad Duncan, Laura Naidi and Julia Hagoria	
Introduction .....	53
Preliminary Place-Name Study .....	53
Detailed Mapping of Caution Bay Place-Names: The Focused Study .....	56
<i>Methods</i> .....	58
<i>Recorded Places</i> .....	58
Named Places in the Study Area .....	58
Named Places Near the Study Area .....	61
Conclusions.....	63

**Chapter 6.**

<b>Historicizing Motu Ceramics and the <i>Hiri</i> Trade</b> .....	65
Bruno David, Thomas Richards, Michael Goddard, Tom Dutton, Matthew Leavesley, Ian J. McNiven and Herman Mandui	
Introduction .....	65
The <i>Hiri</i> Trade.....	66
Origin of the <i>Hiri</i> .....	67
The Ceramic Industry.....	70
Conclusion .....	73

**Chapter 7.**

<b>The Natural Setting of Caution Bay: Climate, Landforms, Biota, and Environmental Zones</b> .....	75
Ken Aplin, Cassandra Rowe, Helene Peck, Brit Asmussen, Sean Ulm, Patrick Faulkner and Thomas Richards	
Introduction .....	75
<i>Location and General Topography</i> .....	75
<i>Sources of Information</i> .....	77
<i>Terminology of Environmental Zones and Habitats</i> .....	83
Climate.....	83
Environmental Zones and their Resources .....	85
<i>The Littoral Plains Zone</i> .....	85
Littoral Plains Zone Landforms .....	85
Littoral Plains Zone Soils .....	86
Littoral Plains Zone Plant Communities .....	87
Littoral Plains Zone Animal Resources .....	89
<i>The Hinterland Zone</i> .....	90

Hinterland Zone Landforms .....	91
Hinterland Zone Soils.....	93
Hinterland Zone Animal Resources .....	100
<i>The Inshore Marine Zone</i> .....	103
Inshore Marine Zone Substrates and Habitats .....	103
Inshore Marine Zone Animal Resources.....	104
<i>The Offshore Marine Zone</i> .....	105
Offshore Marine Zone Substrates and Habitats .....	105
Offshore Marine Zone Animal Resources .....	105
Environmental History .....	105
<i>Regional Scale Influences and Events</i> .....	105
<i>Local Influences and Events in Southern New Guinea</i> .....	107
Historical and Contemporary Land Use .....	108
<i>Terrestrial Environments</i> .....	108
Gardening.....	109
Cash Cropping.....	109
Hunting.....	110
Other Terrestrial Resources .....	110
<i>Marine Environment</i> .....	110
Concluding Comments.....	111
<b>Chapter 8.</b>	
<b>Archaeological Surveys at Caution Bay</b> .....	113
Bruno David, Thomas Richards, Robert Skelly, Siobhán Walker, Matthew Leavesley, Jeremy Ash and Herman Mandui	
Introduction.....	113
Archaeological Surveys .....	113
<i>Core Study Area Survey</i> .....	116
Core Study Area Survey Strategy, Methods and Intensity .....	117
Core Study Area Survey Results.....	117
<i>Peripheral Survey</i> .....	132
Peripheral Survey Strategy, Methods and Intensity.....	132
Peripheral Survey Results .....	132
<i>Vaihua River Survey</i> .....	136
<i>Papa Lea Lea Road Survey</i> .....	138
Papa Lea Lea Road Survey Strategy, Methods and Intensity .....	138
Papa Lea Lea Road Survey Results.....	139
<i>Other Sites</i> .....	140
Conclusions.....	143
<b>Chapter 9.</b>	
<b>The Caution Bay Project Field and Laboratory Methods</b> .....	145
Bruno David, Thomas Richards, Ian J. McNiven, Jerome Mialanes, Ken Aplin, Fiona Petchey, Helene Peck, Brit Asmussen, Sean Ulm, Katherine Szabó, Holly Jones-Amin, Patrick Faulkner, Claire Perrette, Cassandra Rowe, Matthew Leavesley and Bryce Barker	
Introduction.....	145
Project Personnel and Research Structure .....	145
Field Methods.....	146
Analytical Methods.....	154
<i>Pottery Analysis</i> .....	156
<i>Pottery Conservation</i> .....	157
Treatment.....	157
Final Comments on Pottery Conservation .....	160
<i>Stone Artefact Analysis</i> .....	160
Raw Materials.....	161
Technological Variables .....	161
Colours and Heat Alteration .....	163
<i>Non-Molluscan Faunal Remains</i> .....	163

Bone from Vertebrate Animals .....	164
Eggshell.....	166
Invertebrate Exoskeleton.....	166
Reporting.....	166
<i>Molluscan Remains</i> .....	167
Taxonomic Identification of Molluscan Remains .....	167
Modes of Quantification.....	167
<i>Worked Shell Analysis</i> .....	169
Determination of the Worked Shell Sample .....	169
Protocols for the Identification of Worked Shell .....	169
Analytical Procedures .....	170
Context of Interpretation.....	170
<i>AMS Radiocarbon Dating and Chronological Model-Building</i> .....	171
Caution Bay Marine Reservoir Corrections.....	171
Chronological Model-Building .....	173
Other Analyses.....	174
Concluding Comments.....	175
<b>Appendix A.</b>	
<b>Comparison of Motu and Koita Vocabulary in the <i>British New Guinea Annual Report for 1889-1890</i> (MacGregor 1890) with that in Dutton (1966) and Dutton (1975) .....</b>	<b>177</b>
<b>Appendix B.</b>	
<b>Other Apparent Borrowings in Motu and Koita in Dutton (1975) not Included in Appendix A.....</b>	<b>179</b>
<b>Appendix C.</b>	
<b>Established Borrowings in Koita with Comparative Evidence from Motu, Sinagoro and Keapara .....</b>	<b>181</b>
<b>Appendix D.</b>	
<b>Caution Bay Project Field Staff, 2009-2010 .....</b>	<b>183</b>
<b>References.....</b>	<b>185</b>

## Chapter 2.

# Archaeology in Port Moresby and the Southern Lowlands of Papua New Guinea: Intellectual and Historical Contexts for Caution Bay

Bruno David, Thomas Richards, Robert Skelly, Ian J. McNiven  
and Matthew Leavesley

### Introduction

Until the Caution Bay project, limited archaeological research in the Port Moresby region and, more broadly, along the entire southern lowlands of Papua New Guinea (PNG) had been almost exclusively restricted to sites of the past 2000 years, representing that period after the arrival of ceramicists (Figure 2.1; Chapter 1: Figure 1.1). This limited window of time covered by the archaeological evidence had critical impacts for how we have since come to understand the long-term history of the entire region, and thus for how the Caution Bay finds themselves came to be slotted-in to a predetermined cultural pattern incorporating hypothesized ceramic transactions along vast distances of coastline. Here we revisit this archaeological setting, as it sets the scene for how our understanding of the long-term history of the southern lowlands needs to be rethought in light of the Caution Bay results, and, on the other hand, for how some of these new results confirm other pre-existing patterns.

Given a paucity of known pre-ceramic sites across much of the southern PNG lowlands, debate on Port

Moresby's archaeology has focused on the wide variety of ceramic decorative styles revealed by surface surveys and excavations. Ceramics have been favoured by archaeologists not only because of their plasticity of manufacture – i.e., for their ability to reveal information on cultural practice including both historical traditions (conservativeness of practice) and artistic creativity (change) – but more particularly because the Port Moresby region was, ethnographically, a great centre of mass manufacture of pottery towards long-distance *hiri* maritime exchanges (see Chapter 6). Since the late 1960s and early 1970s, when professional archaeological investigations were initiated in Port Moresby and elsewhere in southern PNG (e.g., Allen 1972; Bulmer 1971, 1978; Irwin 1985; Vanderwal 1973, 1976, 1978), research has targeted ceramic sequences both within the pottery-producing (see Allen 1977a, 1977b, 1978, 1984; Allen and Rye 1982; Bulmer 1982) and pottery-receiving (see Frankel *et al.* 1994; Rhoads 1980, 1994) ends of the *hiri* system. Despite this considerable archaeological effort – particularly concentrated in the 1970s – and significant findings, few excavations and ceramic sequences had been reliably radiocarbon-dated or systematically published, making it difficult to

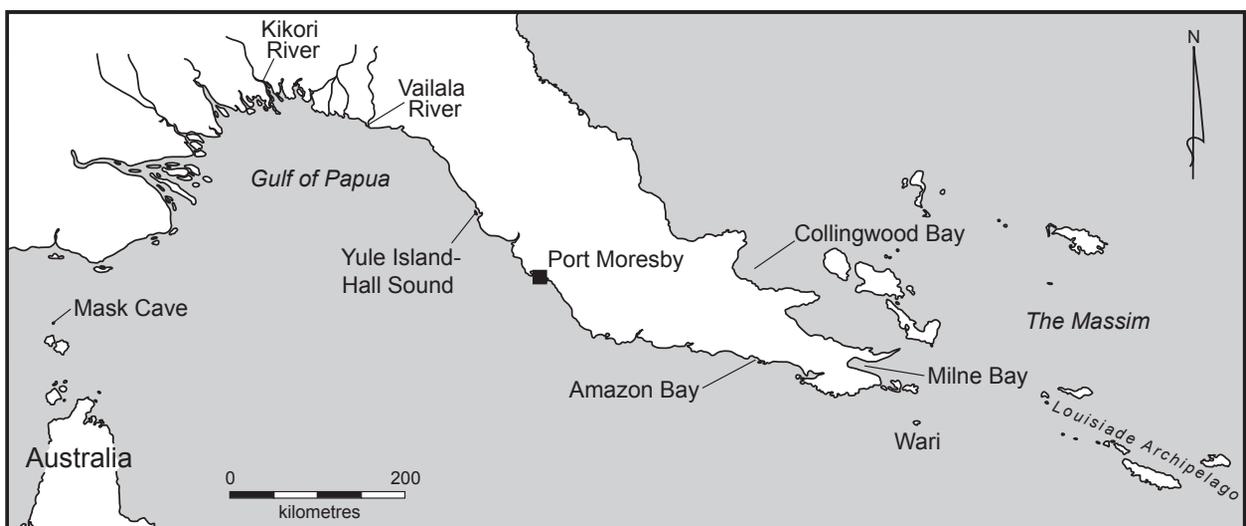


FIGURE 2.1. LOCATIONS OF PREVIOUS ARCHAEOLOGICAL RESEARCH AREAS INVOLVING EXCAVATION ALONG THE SOUTHERN PNG LOWLANDS, AND MASK CAVE IN TORRES STRAIT.

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

characterize, adequately model, or trace the evolution of ceramic sequences within and between the Port Moresby and Gulf of Papua regions. There are, of course, perfectly apt historical reasons for this situation (e.g., absence of AMS radiocarbon dating and advanced preparation chemistry of charcoal or shell samples; poorly understood species-specific  $\Delta R$  values for individual locations), but the fact remains that until recently ceramic chronologies have been compromised by limited chronological data that were often problematic.

Initially, researchers who tried to investigate the origins and history of the *hiri* generally concluded that the *hiri* system itself (as known from ethnography) began only a few hundred years ago (but see Rhoads 1982), with viewpoints ranging from around 800 to 300 years ago depending on the region of concern, the specific archaeological site, and the kind of evidence used (e.g., oral traditions, archaeological ceramics, archaeological evidence for settlement intensification and population increase, linguistic modelling). For example, Bulmer (1982: 117) concluded, largely from archaeological evidence in the Port Moresby region, that 'it is not necessary to search beyond the immediate Port Moresby area or further back in time than the past three to four hundred years to find the origins of the *hiri*'. For Allen (1977b: 408), the *hiri* probably developed 'since the ancestors of the Motu arrived on that [Western Motu] coast some 800 years ago'. Working in recipient villages near Kerema to the west of Port Moresby, Frankel *et al.* (1994: 47) concluded that the ceramics 'reflect ... 500 years of continuous trade between the Motu and villages in the Papuan Gulf leading to the ethnographically observed *hiri*'.

There has, however, also been widespread recognition that the *hiri* is only one of a number of post-Lapita long-distance Melanesian maritime trade systems operating during the late 1800s around mainland PNG's coastline and offshore islands (e.g., see Irwin 1985 for discussion of Mailu trade to the east of Port Moresby; Harding 1967 for Vitiaz Straits; Uberoi 1962 for the Kula system of the Massim), and whose ceramic ancestry somehow emerges from more ancient, Lapita cultural practices beginning in the Bismarck Archipelago off the northeast PNG mainland around 3300-3400 years ago. Along the southern PNG lowlands, however, the earliest ceramics prior to Caution Bay came from Nebira 4, Loloata, Oposisi, Eriava and Emo, all dated somewhat short of 2000 years ago (Allen 1972; Bulmer 1978; David *et al.* 2010; Rhoads 1980; Sullivan and Sassoon 1987; Vanderwal 1973; see also Macintyre and Allen 1990).

The past 2000 years of southern PNG's history was recently modelled in an influential paper by Summerhayes and Allen (2007) that divided the broader region's entire then-known ceramic history into three broad phases:

1. An early phase of widespread ceramic decorative styles and shapes beginning with the arrival of ceramicists *c.* 2000 years ago, termed Early Papuan Pottery (EPP).
2. A period of ceramic transformation uncertainly dated from *c.* 1200 to 800 years ago and previously coined the ceramic 'hiccup' by Irwin (1991; see also the 'Papuan hiccup' of Rhoads 1982: 146). This phase was a period of ceramic transformation that in some regions may have involved a lull in long-distance maritime trade and an abandonment of settlements, such as suggested by a hiatus in the cultural sequence of Yule Island/Hall Sound between *c.* 1200 and 700 cal BP, and, as more recently determined, of the mid-Kikori River further to the west between 950-500 cal BP (David 2008; Vanderwal 1973; see also Irwin 1991; Rhoads 1982).
3. A recent phase of highly specialized, regionalized ceramics beginning *c.* 800 years ago that represents the identifiable roots of ethnographic cultural practices including the *hiri*.

Antecedents of the ethnographic *hiri* trade were set in new focus a few years ago by the findings of red-slipped ceramics in northern Australian waters (Torres Strait). At Ormi and Mask Cave, Carter *et al.* (2004) and McNiven *et al.* (2006) have found stratified ceramic sherds on islands that have no ethnographically known pottery making (or using) traditions. The significance of these findings is highlighted by McNiven *et al.*'s (2006) claims for the presence of ceramic sherds dated to 2400-2600 cal BP from Mask Cave on the islet of Pulu, which they suggest may relate to the onset of southern PNG influences from the east into Torres Strait around 2600 cal BP (see also Barham 2000).

A major reason for preferring an eastern rather than western source for these Torres Strait ceramics is the known presence of ethnographic *hiri* trade ceramics in the Gulf of Papua region to the east. Ceramics have not yet been found archaeologically in neighbouring western regions, although there research has been very limited. Nevertheless, a western origin for Torres Strait's ceramic tradition(s) cannot be entirely dismissed, especially given that red-slipped ceramics have also been a feature of trade networks and archaeological sites further to the west (e.g., Aru Islands, Bomberai Peninsula of western New Guinea). Sourcing of the Pulu sand tempers by Dickinson (in McNiven *et al.* 2006) failed to specifically locate the manufacturing centre(s), but were tentatively identified to western Torres Strait sandy-clay sources. The Mask Cave results pre-dated any confirmed ceramics along the PNG southern coast prior to the Caution Bay research, thereby throwing into question what we thought we knew of southern PNG's ceramic history. This incongruity between the apparently earlier Torres Strait and later southern PNG ceramics led some

archaeologists to think that ceramicists had arrived in southern PNG somewhat earlier than the hitherto argued 2000 years ago, perhaps going back to Lapita itself (McNiven *et al.* 2006; see also David *et al.* 2004).

The temporal pattern in settlement and ceramics from the Gulf of Papua region in the west is of considerable significance for understanding the broader region's social history via exchanges with ceramic production centres in the Port Moresby area in the east (for ceramic sourcing studies see Bickler 1997; Worthing 1980). The occupational trends in the Gulf region indicate that settlement systems were never stable for very long, and we follow David's (2008) suggestion that the history of the southern lowlands is best understood as a sequence of *pulses* in occupation and long-distance maritime (ceramic) trade rather than as singular long-term trends. Because of the workings of the *hiri* system, cultural sequences in one part of southern coastal PNG are closely linked to those of other parts, even if many hundreds of kilometres apart (as recognized by previous researchers). In light of these findings, it is likely that ethnographically documented oral traditions about population movements, village and clan origins for this broader region relate to the latest (i.e., past *c.* 500 years), rather than earlier, phases of occupation or use. This ethnography also highlights that to understand land use across the southern lowlands, more than environmental conditions and environmental histories need to be understood, requiring a focus on the specifics of social interactions that, in this case, have come to guide settlement processes. Understanding the cultural history of places requires consideration of past social relationships. What the above results highlight is the significance of ceramic producing centres for understanding the history not just of those locations for themselves, but for understanding the history of the entire southern coastal region of PNG, as an interconnected social network.

Many of the sites discussed below possess their own language names (obtained from oral traditions or named after the general areas from which they are found) (e.g., Nebira), a name or number given by the discovering archaeologist as part of their own survey referencing system (e.g., Nebira 2), and/or a unique three or four letter reference code (e.g., ACJ), being the official designation on the PNG National Museum and Art Gallery site register (by convention, site lettering is organized by PNG Province; all registered cultural heritage sites from the Central Province and the National Capital District begin with the letter A). For example, the cultural heritage site known from oral traditions as Nebira has been sub-divided by archaeologists into a series of distinctive, archaeologically separate exposures each of which has been given a separate researcher reference number (e.g., Nebira 2, Nebira 4 etc.), and each of which has been given an official PNG National Museum and Art Gallery site code (Nebira 2 = ACJ; Nebira 4 = ACL).

The results of previous archaeological research are presented below by locality and researcher name, with emphasis on the Port Moresby region.

### Port Moresby Region

#### *Graeme Pretty*

In 1967, Graeme Pretty undertook reconnaissance archaeological surveys in the vicinity of Boera village, in search of a 'kitchen midden' that Maurice Leask (1943) had previously reported. Pretty undertook preliminary surveys on and around Stanley Hill, recording three sites (which he termed Sites A, B and C), but without finding the sought-after site. He notes that 'both the Summit and slopes were thickly strewn with potsherds, shell and other Melanesian habitation residue' (Pretty 1967: 34). During these investigations, Pretty visited Boera village and the nearby beach, recording in the process the important cultural heritage site of Edai Siabo's first *lagatoi* anchor (Pretty 1967: 35) (which he identifies as the anchor of the sailing ship by which Edai Siabo founded Boera; see Chapter 6, this volume for details of a legendary story of Edai Siabo and his first *lagatoi*). The anchor was partly covered with sand at the time of Pretty's visit.

#### *Susan Bulmer*

Susan Bulmer's 1978 doctoral thesis *Prehistoric Culture Change in the Port Moresby Region* is the largest single study ever undertaken on the archaeology of the Port Moresby area. Bulmer's work on the history and dynamics of ceramic production and settlement location was based on the analysis of pottery sherds collected from 67 archaeological sites within an area covering 800km<sup>2</sup>, and the excavation of Nebira 2 (ACJ) and Eriama 1 (ACV), two ancient village sites, and Taurama (AJA), a rock shelter. Her investigations focused on the region from Bootless Inlet in the east to Galley Reach in the west, from the coast northward to the Laloki River. Within this area the Koita and Motu have long lived in a 'complementary relationship in an overlapping territory' (Bulmer 1978: 2) involving trade and cohabitation in close social relations.

At Nebira 2 (ACJ), more than 55,000 pottery sherds were excavated, along with the skeletal remains of at least 45 individuals (Bulmer 1978: 135). Taurama (AJA) is a beachside 'foundation village of the western Motu' and is said to have been settled from Motupore around 14 generations before 1978 (corresponding well with the timing of abandonment at Motupore as evidenced by archaeological investigations) (Bulmer 1978: 258, after Oram 1969: 429; see also Golson 1968: 69). Taurama contains a rich assortment of shells, stone and shell artefacts (including imported obsidian flakes), beads, vertebrate faunal remains, almost 25,000 pottery sherds, and evidence of past structures (e.g., postholes). At

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

Eriama 1 (ACV), 48-50 burials were excavated, along with 1530 pottery sherds, shell and animal bone remains, and stone artefacts including a small amount of exotic obsidian, probably imported from Fergusson Island (Bulmer 1978: 202, 246). Many of these interments contain burial goods such as shell arm rings, beads, pottery, stone artefacts, or bone or tooth ornaments (e.g., Bulmer 1978: 182, 226-34, table 6.9).

Bulmer's (1978) doctoral research represents the culmination of research she began in 1967, and supersedes many of the conclusions she had previously presented (e.g., Bulmer 1969, 1971) about the region's archaeological past. Bulmer was interested in understanding the distribution and ecological and social inter-relationships of sites across the landscape, and how spatial variation and temporal change in ceramic conventions could be used to explore the region's cultural and social history. She argued that settlement-subsistence systems shifted through the course of Port Moresby's pre-European contact history, and these changes were accompanied by shifts in the location of pottery-producing centres and changes to ceramic styles. She suggested that during the Early Period of occupation, from around A.D. 0 to 1000, a relatively homogeneous pottery style was widespread along the Central Province coast, from Mailu in the east to Yule Island in the west. Towards the end of the Early Period, a large settlement could be found at Ranvetutu. During the Middle Period, from around A.D. 1000 to 1500, the earlier pottery style rapidly changed, making way for ceramic conventions akin to those of Milne Bay some 370km to the southeast. Towards the commencement of this period large pottery-producing communities were set up at Motupore and Boera, while previously established communities at Taurama, Nebira and Eriama continued to exist. During this time, pottery-using settlements became established on elevated hills in the coastal hinterland, probably for reasons of defence. The Middle Period was followed by the Proto-historic Period around A.D. 1500-1875, immediately preceding, and continuing into, the early European contact period, when 'Middle period pottery is replaced by a single style, which in the 18th and 19th centuries appears to sub-divide into the eastern and western variants' (Bulmer 1978: xxi). The late Proto-historic Period saw a predominance of settlement on the coastal hills and along the coast, and 'heavy dependence upon imported food based on the specialist manufacture of shell ornaments and pottery, was of relatively recent origin' (Bulmer 1978: xx). Bulmer (1978, 1982) argues that the people of the ancestral Nebira, Eriama and Taurama villages – spanning nearly 2000 years of occupation – were not specialized craft manufacturers (for an opposite view, see Allen 1977a; Allen and Rye 1982), and that while there is evidence in oral traditions and in the archaeological record for close contacts between coastal and inland communities, these sites

show little evidence of specialized trade (a point disputed by Jim Allen in particular – e.g., Allen and Rye 1982).

Bulmer suggests that early in the region's history large settlements containing ceramics were established on the inland river plains. For the past 300 years (based on oral traditions), she argues that settlements shifted towards the coast. She asks if the earlier, hinterland villages were occupied by the Koita (the 'people of the land', who possess the oral traditions about those older sites), while the later coastal settlements were occupied by the Motu 'people of the sea and trade' (sometimes together with the Koita). Using oral traditions and historical records, she interprets the archaeological evidence around the notion that the Koita 'had moved down from the mountains and across the plains to the coast, while the Motu arrived by sea to dwell with them', both movements taking place only during the past 400 to 500 years, with the Koita 'reaching their position in or near Motu villages in the 19th century' (Bulmer 1978: 39). Yet the Koita did not traditionally practice pottery-making, having learnt the craft from the Motu after the latter's arrival along the coast (perhaps 2000 cal BP, but perhaps more recently, with earlier ceramic manufacturers having arrived in the Port Moresby region before the Motu). If the hinterland villages indeed relate to early Koita occupation, what of the pottery found within those sites?

The archaeological ceramics of the Port Moresby region contain a range of vessel shapes and decorative designs, many of which are not represented by ceramic conventions of ethnohistoric times. Here we summarize the major pottery decorative styles identified by Bulmer (1978) for the Port Moresby region (incorporating Lea Lea-Boera). We note that while the chronological value and spatial integrity of these styles remain in contention by archaeologists (e.g., Allen 1977b; Swadling and Kaiku 1980), Bulmer's schema is one of only two detailed published accounts by which archaeologists previously ordered Port Moresby ceramics. And here-in lies a major problem: Bulmer's ceramic styles are ordered into an apparently chronological system but are not, in themselves, based on systematic temporal data.

Bulmer's study is largely based on 2977 ceramic sherds from 67 undated surface archaeological sites (Bulmer 1978: 76-77). She reports six decorative styles followed by the 'Historic Period' for which she does not attribute a specific style (Figure 2.2). Her six decorative styles are summarized in Figure 2.3. She argues that four cultural phases can be identified for the broader Port Moresby region based on changes in ceramic conventions (including decorative styles), as indicated by her surface ceramics, combined with radiocarbon dates from her three archaeological excavations (Nebira 2, Eriama 1 and Taurama) together with results of other excavations (principally Motupore, Nebira 4, Ava Garau) (Bulmer 1978: 340-41):

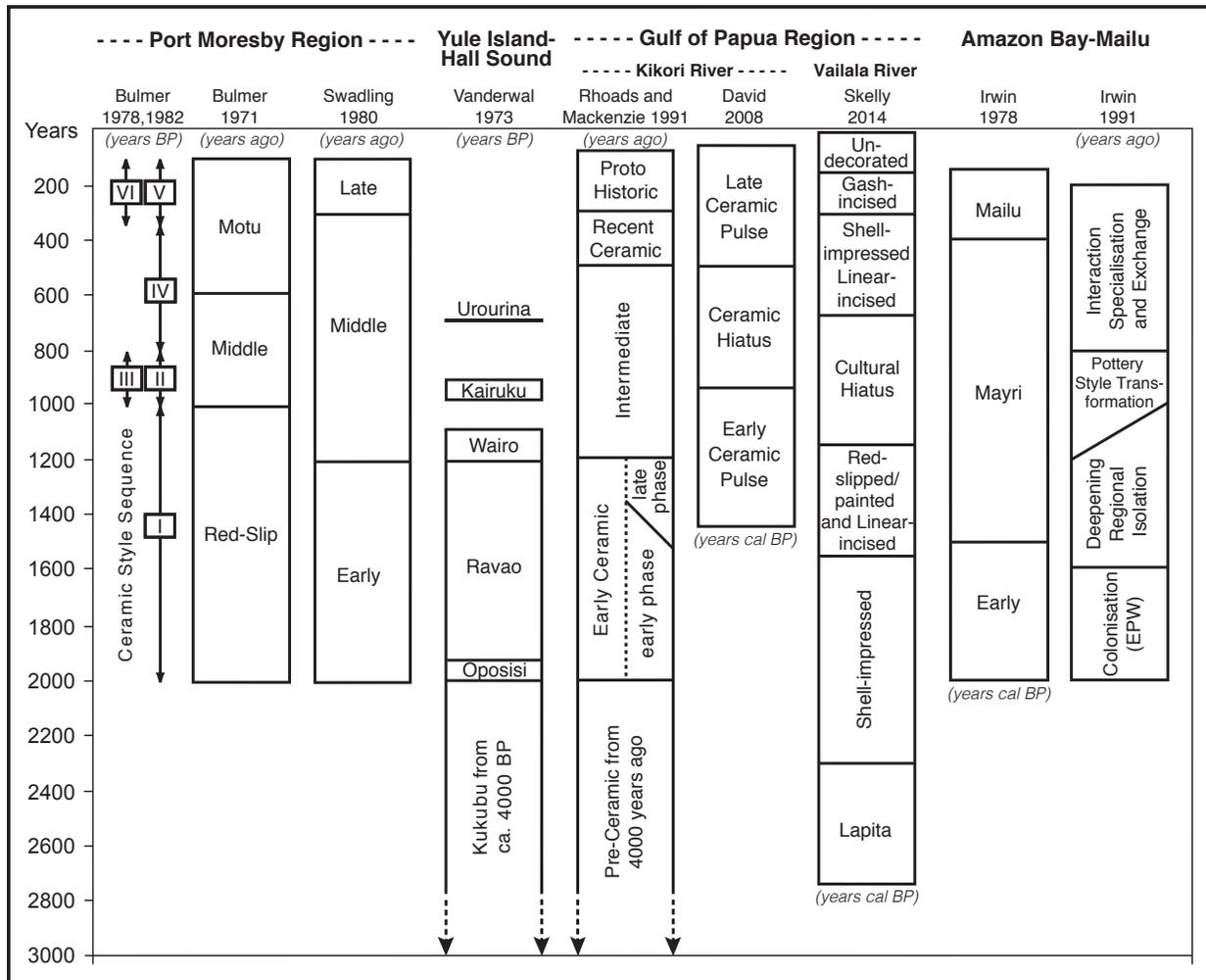


FIGURE 2.2. CULTURAL AND CERAMIC SEQUENCES FOR SOUTHERN LOWLAND PNG.

1. Early Period with Style I pottery: around A.D. 0-1000.
2. Middle Period with Styles II, III and IV pottery: around A.D. 1000-1500.
3. Proto-historic Period with Styles V and VI pottery: around A.D. 1500-1875.
4. Historic Period: after around A.D. 1875.

**Jim Allen**

Jim Allen’s work in the Port Moresby region involved both field research and the theoretical modelling of culture change in this ceramic manufacturing and ethnographically renowned long-distance maritime trading centre. Allen (e.g., 1984: 415-16) noted that the Motu, like other southern PNG lowlands Austronesian-speaking groups, did not settle rich agricultural landscapes but rather coastal regions fronted by resource-rich offshore reefs. He further pointed out that these were (and continue to be) specialized maritime peoples who also gardened, hunted and gathered, but it is the sea that

formed the focus of subsistence and settlement practices. Nevertheless the seasonally drought-prone Port Moresby region, and the paucity of agricultural products directly available to the maritime specialist Motu, meant that alternative means of obtaining food resources had to be developed to ensure long-term survival. The answer came in the form of craft specialization (ceramics and shell valuables used for bride price and the like) and the intensification of long-distance maritime trade (Allen 1982: 202) in time leading to the *hiri*. However, Allen (1977c: 399), also noted that ‘...the environmental stress hypothesis remains nothing more than an explanation for the developed system as first recorded by Europeans, and not necessarily an explanation of why it developed in the first place’. Allen (1977c: 406) further noted that ‘despite the economic imperatives it is impossible to separate the *hiri* as a subsistence expedition from the *hiri* as a social institution, for in the *hiri* ... socio-political and economic objectives were closely intertwined’. Nevertheless, regardless as to whether the *hiri* emerged as a subsistence strategy or not, ceramics and shell

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

Style		Common techniques	Vessel forms	Characteristic rim or lip form	Probable associated pot decoration
I	<i>Red Slip</i>	Slipping	Simple restricted bowl	Thickened, round	Slipping
		Burnishing	Simple unrestricted bowl	Thickened, square	Burnishing
		Incising	Composite restricted bowl	Round	Incising
		Combing, grooving	Composite unrestricted bowl	Round	Painting
II	<i>Eriama Incised/Applique</i> (formerly <i>Massim</i> )	Heavy line incising, perforation	IIa Composite bowl	Square, round	?
		Appliqué	IIb Simple unrestricted bowl	Thickened, square	
		Grooving	IIc simple restricted bowl	Thickened, round	
III	<i>Eriama Incised/Punctate</i> (formerly <i>Massim</i> )	Fine line incising, punctuation	Simple restricted bowl	Thin, round	?
IV	<i>Taurama Shell/Comb</i> (formerly <i>Boera/Taurama</i> )	Shell and comb impressing, combing	Composite bowl	Square	Shell and comb impressing, painting
V	<i>Taurama Incised/Punctate</i> (formerly <i>Motu</i> )	Heavy line incising	Simple bowl	Thickened round or square	Incising
VI	<i>Waigani</i>	Incising, finger impressing, shell impressing	Simple bowl	Thickened round or square	?

FIGURE 2.3. SUMMARY OF SOME CHARACTERISTICS OF DECORATIVE STYLES OF PORT MORESBY BOWLS (FROM BULMER 1978: TABLE 5.5).

valuables have high archaeological visibility enabling the history of such trade and social relations to be investigated.

Jim Allen undertook archaeological excavations at two ancient village sites in the Port Moresby region, Nebira 4 (ACL) and Motupore (AAK). Both sites contain rich cultural deposits, including flaked stone artefacts (among which are obsidian pieces imported from Fergusson Island, and drill points), pottery sherds, numerous animal bones (mainly pig, wallaby, fish and shell), shell artefacts (including beads and fragments of arm bands) and varied pieces of ochre and ground-stone artefacts from Nebira 4; and 40 burials, numerous stone drill bits, hundreds of shell disc beads, large volumes of shell and vertebrate faunal remains (particularly marine and wallaby), structural evidence in the form of pits and post holes, and very large quantities of ceramic sherds from

more extensive archaeological excavations at Motupore (e.g., Allen 1977a: 443, 444). One of these Motupore burials (a secondary burial with a dog's teeth necklace) dated to around 400 cal BP is interpreted as Koita, due to its similarity to Koita and Koiari burials of ethnographic times. The implication is that by that time Koita-Motu relations were already close enough for a Koita burial to be included in a predominantly Motu village, as practiced also during ethnographic times (Allen 1977a: 445).

Nebira 4 is believed to date from around 2000 cal BP to sometime before the colonial period. The similarity in age of the earliest cultural levels at each of these sites, along with Oposisi in the western Central Province where 2000 year old ceramics were also found, led Allen (1972: 121) to conclude: '... we appear to be dealing with a widespread maritime migration into the central coast about 2,000 years ago. These people established

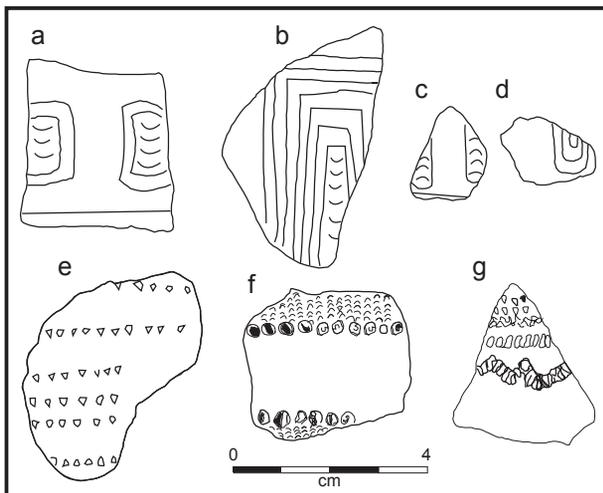


FIGURE 2.4. REPRESENTATIVE DECORATED SHERDS FROM NEBIRA 4 (ACL) (A-D = STYLE G, E-G = STYLE H) (AFTER ALLEN 1972: 106, FIGURE 2).

themselves widely and maintained good communications for at least a thousand years.'

The Nebira 4 faunal assemblage indicates a marine-oriented economy during the earliest cultural layers, becoming gradually less so through time (Allen 1972: 116). This change may be due to increasing dependence on inland gardens, as Allen (1972: 122) suggests, or to subsequent sedimentation of the coastal plains. The ceramic sequence indicates an early red slip (and sometimes burnished) tradition followed by a sequence of ceramic conventions including continuity of red slipping (Allen 1972: 99). Allen (1972: 105-109) identified nine decorative styles (Styles A-I), many, but not all, of which represent sequential changes in ceramic conventions (Figure 2.4).

The Nebira 4 ceramic sequence can be arranged into three successive phases (Allen 1972: 108, 109):

Horizon 1. Levels 1-8. Globular pots with heavily rolled horizontal rims; bowl forms shallow and open, often with a thickened lip; decorative style A the most distinctive marker, with a large percentage of painted pottery. [Corresponds with Styles IA and IB of Oposisi].

Horizon 2. Levels 9-15. Globular forms a mixture of horizontal and angled rims with the latter more popular; deeper bowls with straight sides; styles D and E the most common decorative styles with some temporal value, together with styles F and G. [Corresponds with Style IIA of Oposisi].

Horizon 3. Levels 16-19. Globular forms with angled rims; bowl forms most commonly restricted, and found in association with decorative styles F and G. Styles

H and I are the best indicators of this early horizon. [Corresponds with Styles IIB and IIC of Oposisi].

The age ranges of these phases remains unclear due to dating uncertainties and insufficient radiocarbon determinations to resolve such questions (Allen 1972: 121). Nevertheless, Nebira 4 clearly demonstrates some 2000 years of ceramic evolution.

Motupore in Bootless Inlet to the southeast of Nebira was established around A.D. 1200, and appears to have been abandoned around A.D. 1700 (Allen 1977a: 443). Motupore is only referred to once in the recorded oral traditions of the greater Port Moresby area, yet as determined archaeologically it was once a major site of ancestral Motu character (Allen 1977a: 442, 446). Allen (1984: 420) wrote that Motu (and to a lesser degree Koita) pottery 'underwrote the emergent maritime trading systems'. Allen (1977a) has suggested that socio-economic interactions between the Koita and Motu, and with trading partners further to the west in the Gulf Province, have intensified through time. Such intensifications are observable archaeologically in a simplification (decreased decoration) and standardization of Motu ceramics with the mass production of trade goods, along with an increased population evident in a concomitant proliferation of occupation sites. Among the Western Motu, amicable relations with the Koita led to the establishment of seaside villages, but further to the east less amicable relations between the Eastern Motu and the Koiari led to the construction of Motu villages over the sea for purposes of defence (Allen 1977a: 451). Allen notes that pottery-producing Motu settlements were located in low-rainfall parts of PNG subject to periodic droughts, encouraging the development of specialized pottery manufacture for which food products (in particular sago) could be traded in surplus quantities (Allen 1984). Nevertheless, the manufacture of (principally *hiri*) trade ceramics did not simply meet the dietary needs of the Motu villages, but also enabled high risk, status-enhancing long-distance maritime voyages and the acquisition of surplus products (sago) by which internal exchange relations could develop with Koita and other nearby groups. The development of specialized ceramic-for-food trade relations with long-distance trade partners (in the Gulf region) as well as with neighbouring groups (such as the Koita and Koiari, the latter bringing shell lime and highlands stone axes to the Motu) created social developmental momentum that gave rise to the complex Motu and Koita societies of ethnographic times.

Following Bulmer (1971), Allen (1977a: 439-442) initially divided Port Moresby's archaeological sequences into three broad periods, which he referred to as the Early Ceramic Horizon (A.D. 0-1000), followed by a 'middle period' onto a 'final period'. He suggested that during the initial ceramic phase,

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

Austronesian speakers came from the east and settled in an interconnected network of villages along the southern PNG coast, maintaining between themselves good inter-community communications and thereby a commonality of ceramic conventions. However, 'The demise of this Early Ceramic Horizon is sudden all along the coast' (Allen 1977a: 448). The subsequent phase of the 'middle period' saw 'the possible removal of the people from the valley floor site of Nebira 4 to the adjacent hilltop site of Nebira 2 and the occupation of the offshore island site of Daugo near Port Moresby' (Allen 1977a: 439-440). Allen here suggests that around A.D. 1000 the (presumably Austronesian-speaking) people of the Early Ceramic Horizon came under pressure from inland (ancestral Koita) groups as the latter began to move towards the coast, necessitating the establishment of settlements in more defensive positions (hilltops and offshore islands). Following Bulmer (1971), around A.D. 1000-1400 two new ceramic traditions then appeared in the Port Moresby area: intrusive (i.e., foreign) 'Massim' wares from the Milne Bay area, most evident from archaeological sites in the Boera area; and 'Boera/Taurama' wares that appeared to represent ancestral Motu ceramics. The pottery of the 'final period' corresponds to the ethnographically recorded Motu ceramics. Allen (1977a: 446) suggested that as Motupore was occupied continuously from around A.D. 1200 to 1700, and as Motupore's most ancient ceramic decorative styles could be shown to evolve uninterrupted into decorative conventions that are akin to Motu ethnographic examples, its inhabitants were likely ancestral to present-day Motuans. 'For this reason a certain adjustment needs to be made to Sue Bulmer's proposed culture sequence' (Allen 1977a: 446), which posited a sequence of interrupted ceramic styles representing external influences or replacements. Hence, as the ceramic conventions of Bulmer's 'Boera/Taurama' Middle Phase were found at Motupore, where they could be shown to be ancestral to, and evolving into, historic Motu incised/impressed wares, Allen (1977a: 446) suggested that the later two stages of Bulmer's sequence should be coalesced into one, reducing the entire Port Moresby sequence into two phases: an early phase spanning around A.D. 0-1000; and a later phase beginning 'somewhere before A.D. 1200 and continuing to present' (Allen 1977a: 446). Allen concludes that the long-debated

... hiatus between the two is therefore reduced, and it is into this hiatus the Massim industry described by Bulmer must be fitted. The status of the people represented by this pottery still requires elaboration ... On the present evidence it may well be that there was no hiatus at all, and that the Massim component infiltrated during the brief period of disequilibrium following the disappearance of the earlier inhabitants and during the establishment of ancestral Motuan

groups (Allen 1977a: 446; see also Swadling 1976).

Motupore has a ceramic industry that can be followed uninterrupted from around A.D. 1200 into ancestral Motu ceramics (Figure 2.5). This phase is interpreted by Allen (1977a: 446) as indicating that the Motu 'impinged upon the existing central Papuan coastal population from outside the research area some 800 years ago'. That is, around A.D. 1200 a new wave of Austronesian speakers came from the east to the Port Moresby area with new ceramic decorative conventions, establishing a base at Motupore. These were the ancestors of the ethnographic Motu. Through time, as the Motu established and consolidated their villages along the coast, the Motu proliferated on the coast and the Koita both inland and on the coast as the two groups entered into symbiotic social and economic relations (Allen 1977a: 449). Allen (1984: 423) later argued that craft specialization was 'vitaly important' to the Western Motu (and Koita) trade economy, and that they were 'the only notable producers of pottery along some 400km of the south Papuan coast'. Of note is the highly standardized ceramics that emerged during this recent, monopolizing phase, which Allen (1984: 423) associated with increasing commercialization of production. Following Groves (1960), Allen (1984) noted that the heightened levels of trade generated by establishing trade partnerships led to increased (and surplus) food returns into the Motu villages, which in turn fed increasing trade relations with neighbouring groups who brought hinterland food products (garden produce, wallaby meat) for imported surplus sago and ceramics, positively feeding back to higher populations that enabled the system to grow. By the later stages of the recent phase, this demographic growth had led to further increasing demands on food resources that led the ceramic-manufacturing women to work 'at break-neck speed' to produce the very large quantities of pots necessary for exchange expectations, in particular in the form of the long-distance *hiri* expeditions; 'insufficient care in making the pots' led to substandard pots that often broke in the making, and a lack of time for elaboration of designs led to the 'simplification of shapes and decoration' evident in recent phase ceramics (Allen 1984: 423).

#### **Pamela Swadling**

Swadling (1977a: 38) states that by 1977, about 400 archaeological sites were known from the coastal lowlands of the Central Province by the PNG National Museum and Art Gallery; the oldest of these (e.g., Nebira 4, Eriama 1; subsequently, Loloata Island) dated to around 2000 cal BP, indicating the rarity and great difficulty of finding older cultural materials, despite well-documented archaeological deposits tens of thousands of years old in the highlands. She further noted that at the time of early European contact,

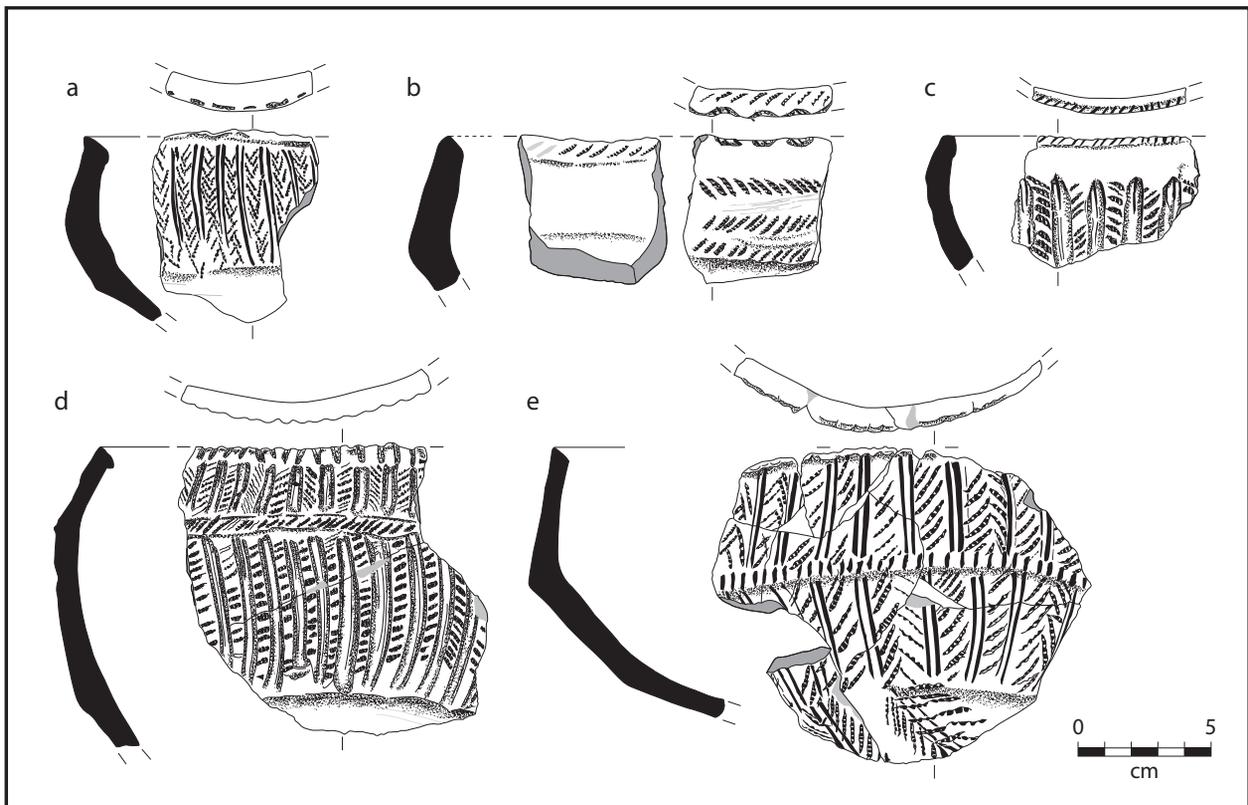


FIGURE 2.5. SHELL-IMPRESSED BOWL SHERDS WITH 'HERRINGBONE' PATTERNS FROM THE 'EARLY LEVELS' OF MOTUPORE (AAK).

... the largest villages were those of the Motu; but from Pari westwards, all Motu villages also had Koita residents ... The Koita however had other settlements located on the coastal lowlands inland from the coast, or on hills overlooking the sea (Swadling 1977a: 37).

Swadling and Kaiku (1980) excavated two sites in the broader Caution Bay landscape: in the north at Papa they excavated a 'fireplace in the clay surface of an eroded village site in the Papa salt pans' (Swadling and Kaiku 1980: 86), dated to  $1280 \pm 170$  BP; and in the south they excavated a large archaeological village site at Ava Garau located on a coastal ridge to the northwest of Boera, dated to  $1220 \pm 95$  BP. The Papa site contained red slipped ceramic sherds typical of the earliest phase of human occupation in the Port Moresby region (e.g., Style I of Bulmer 1978; at Nebira 4, Horizon 3 of Allen 1972).

At Ava Garau, which Swadling identified as an ancestral Boera site,

... pottery was found which shows that both old and new pottery ideas were used by people living there 1,200 years ago. ... The influence of new potting ideas, especially in bowl decoration and rim shapes, from the D'Entrecasteaux, Amphlett

and Goonenough Islands cannot be denied. (Swadling 1977a: 39)

Swadling (1977a: 42) concluded that while the ancient ceramic assemblages of the broader Port Moresby region showed close formal and decorative affinities with those of the D'Entrecasteaux, Amphlett and Goonenough Islands as well as Milne Bay, Motuan history could not be reduced to recent or foreign arrivals 'to the shores of Port Moresby' (as Allen similarly concluded for the past 800 years, see above). Rather, oral traditions 'do not tell of a far away homeland, but of old village sites along the Central Province coastline. Some of these old villages are said to be very old, whereas others have been recently settled' (Swadling 1977a: 42).

Swadling (1980) divided the Port Moresby region ceramics into three phases: Early Period (a.k.a. Bulmer's 'Red Slip', c. 2000-1200 cal BP), Middle Period (a.k.a. Bulmer's 'Boera-Taurama-Motupore', c. 1200-300 cal BP) and Late Period (a.k.a. Bulmer's 'traditional Motu' of the past 300 years) (Figure 2.2). She argued that major stylistic changes in ceramic designs took place between the late Early Period and the Middle Period (broadly but imprecisely corresponding to the 'Papuan hiccup' of Rhoads [1982: 146], 'hiccup' of Irwin [1991]; 'ceramic hiccup' of Summerhayes and Allen [2007]; and 'hiatus' of Allen *et al.* [1997]). Her study of the sources and

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

antiquity of a small sample of the ceramic vessels found in Central Province and Gulf Province archaeological sites (including sherds from Daugo Island site AAQ, the Papa Salt Pan site [AWL], and Ava Garau [AMH] near Boera) indicates that

... early Middle Period sites do not seem to extend as far west as those of the late Early Period. Does this reflect some settlement changes in the Gulf or the impact of the changing situation in the Central Province, as the early Middle Period marks a rather abrupt, but not total, stylistic change in the Port Moresby region (Swadling 1980: 108-9).

She continues (Swadling 1980: 115):

... the people living at the late Early Period sites in the Port Moresby region were using a number of different clay sources. Why the people living at Ranvetutu were using pots made from Boera clay, rather than clay from near their own village, is not known. ... The intricate decoration and complex shapes of the pots made during the late Early Period indicates that considerable time and effort was spent on pot making. These people were certainly not involved in the quick, mass production of pots which occurred in the Port Moresby region at the time of contact.

Swadling clearly suggests major cultural change across the Port Moresby region between the late stages of the earliest ceramic phase and the classic Motuan ceramic tradition that we are familiar with from ethnography, changes akin to those argued by Allen concerning the period between 1200 and 800 cal BP in particular. Furthermore, farther to the west in the Gulf region sites receiving Port Moresby region ceramics, 'the bulk of the late Early Period potsherds ... come from sources in the LeaLea-Boki area. None come from Boera' Swadling (1980: 119).

Swadling (1980: 119-21) thus further noted:

The same pattern with most coming from LeaLea-Boki and none from Boera continues in the early Middle Period potsherds from Tei Hill ... This finding suggests that the same clay sources continued to be used during the rather abrupt, but not total, ceramic stylistic change which occurred between the late Early Period ceramics in the Port Moresby region. No settlement sites with early Middle Period ware are known from the LeaLea area, but it would not be unrealistic to envisage the continued use of this clay source by descendants of people who may have moved to reside in the Boera village complex from the LeaLea area. ... Perhaps the biggest surprise of all, is the lack of late Early Period and Middle Period sherds made

from Boera clay in the Gulf sites. ... This seems contrary to the widely acknowledged Motuan legend which claims that the *hiri* was started by Edai Siabo from the Boera area. ... The results to hand would indicate that it was the people formerly resident in the LeaLea area, who may have been responsible for producing, using their former clay sources, most of the early Middle Period ware which reached the Gulf.

While the people using the Boki clay source in the LeaLea area were the main suppliers to the Gulf of both Early Period and early Middle Period ware, the coming of the Middle Period seems to mark a total decline in the movement of Central Province pots to the Gulf. The author is not aware of any middle Middle Period [ware] ... having been collected in the Gulf. In other words, it would seem that soon after the founding of the huge village complex at Boera, that potsherds dating to that period no longer appear in the Gulf.

A likely explanation is that the oral traditions (including the legendary Edai Siabo story) relate largely, if not entirely, to the most recent phase or pulse (dating to the past 500 years), of cultural activity in the Gulf of Papua and Port Moresby regions.

A related question that has dogged the archaeology of the southern PNG lowlands concerns whether or not a hiatus in human occupation and long-distance maritime trade occurred around 1000 cal BP. Swadling (1976: 1) poses this question for the Port Moresby region, pointing out that 'The excavations and surveys of Bulmer, Allen and Vanderwal along the central south Papuan coast all suggested that there was a chronological break about 1,000 years ago'. A paucity of radiocarbon dates on individual pieces of charcoal (thereby avoiding the potential mixing of charcoal pieces of varied ages) notwithstanding, Swadling (1976: 2-3) suggested that the Ava Garau radiocarbon determination near Boera 'removes the likelihood of a hiatus in the Port Moresby sequence', and instead 'suggests continuity into what has been called the Boera-Taurama-Motupore tradition', as the Boera-Taurama-Motupore tradition is interpreted as a local development of earlier (imported) ceramic manufacturing conventions of the Port Moresby region (in line with Allen's [1977a] interpretations). Like Allen (1977a), Swadling (1976: 4) suggested that the Boera-Taurama wares were ancestral to recent Motu ceramics as documented ethnographically. Nevertheless, the question of a hiatus in regional occupation and long-distance ceramic trade between 950-500 cal BP remains for the Kikori River area of the Gulf region. Disruptions in settlement systems, trade relations, and ceramic production in the pottery-producing Port Moresby region villages is key to understanding the lull in ceramics and

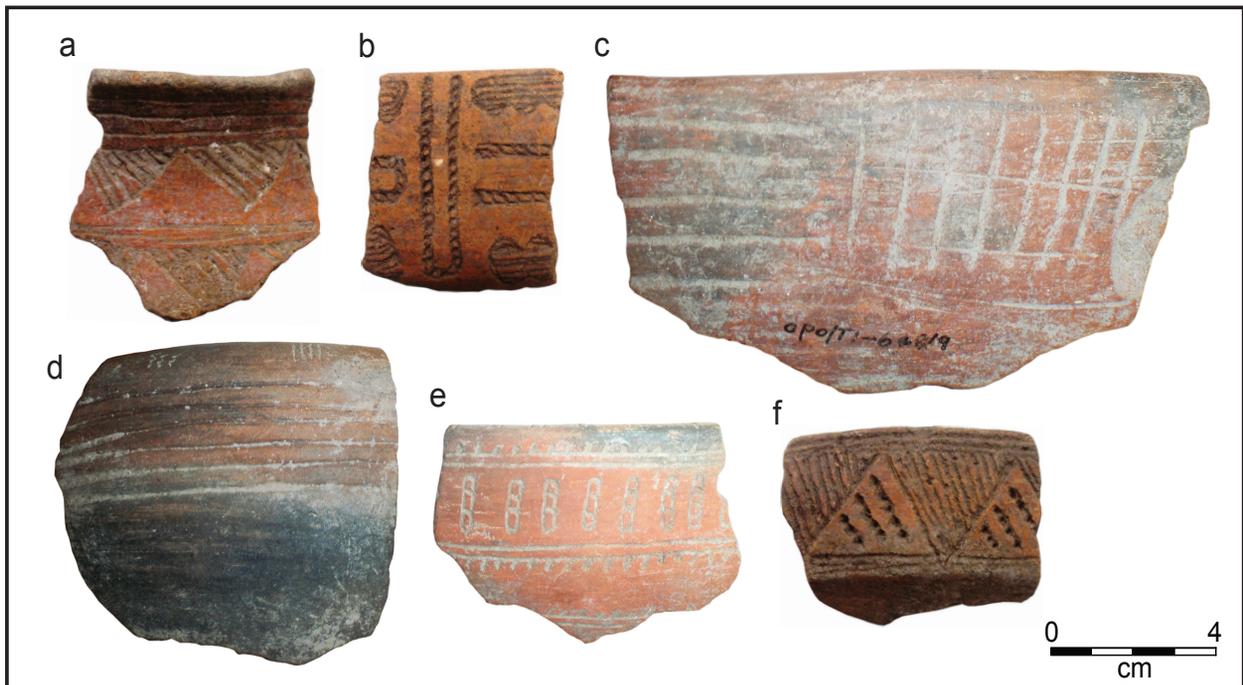


FIGURE 2.6. REPRESENTATIVE SHERDS FROM THE YULE ISLAND 'TYPE COLLECTION', PNG NATIONAL MUSEUM AND ART GALLERY: A = TYPE T, B = TYPE T, C = TYPE M, D = TYPE K, E = TYPE R, F = TYPE T (PHOTO: ROBERT SKELLY).

paucity of known archaeological villages between the occupational pulses in the Gulf region.

### Yule Island-Hall Sound

#### Ron Vanderwal

From mid-1969 to 1970, Ron Vanderwal undertook his PhD research in the Yule Island-Hall Sound area, located on the brink of the Gulf of Papua (Vanderwal 1973). He identified 13 sites and excavated five, Urourina, Sirirou, Abe and Kukuba Cave, and most notably Oposisi on Yule Island. Vanderwal excavated 30m<sup>2</sup> at Oposisi, a deeply stratified site with a rich ceramic assemblage, from which six charcoal radiocarbon determinations were obtained (and which greatly influenced other archaeologists working along the entire south coast of PNG). There were a number of dating inversions, but Vanderwal concluded that a date of 1890±305 BP (ANU-425) from the 'bottom level (14)' in Zone IIC, approximated the commencement of occupation at the site, with the uppermost undisturbed cultural deposits dating approximately 600-800 years later. He well-recognised, however, that the 'mid-periods of Oposisi are not well dated' (Vanderwal 1973: 50).

Vanderwal (1973: 99-108) identified 18 ceramic Types at Oposisi, primarily from vessel form, but surface decoration also contributed to his typological determinations (Figures 2.6, 2.7). However, surface

decoration was used only to corroborate and refine determinations based on vessel form. As a consequence, some decorations are attributed to a number of different ceramic Types, whereas others are limited to just one Type. Largely on the basis of Types A-C shell-impressed sherds (e.g., Figure 2.6a-g, 2.6k-m), restricted to the basal Zone IIC at Oposisi, Vanderwal concluded that:

The evidence from both Yule Island and Port Moresby [the Bulmer and Allen excavations] suggests that what I have called the Oposisi ceramics are the earliest in the region. Accompanying the pottery in the research area is an entire range of cultural items, many of which are limited, on the available evidence, to the phase in question. ... the Oposisi people might have been supported by a parent community, with certain items like obsidian and even adzes traded in from a source to the east, and they might have been traders themselves, bringing pottery to an area that had previously not known it. ... Nevertheless the archaeological evidence shows the case to be not one of trait intrusions ... but one of site unit intrusion where cultural identity has been maintained and actual migration involved. (Vanderwal 1973: 233).

Further, he states, 'there can be little room for doubt that the Oposisi culture is another transformation of the Pacific Lapita' (Vanderwal 1973: 234). Vanderwal later

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

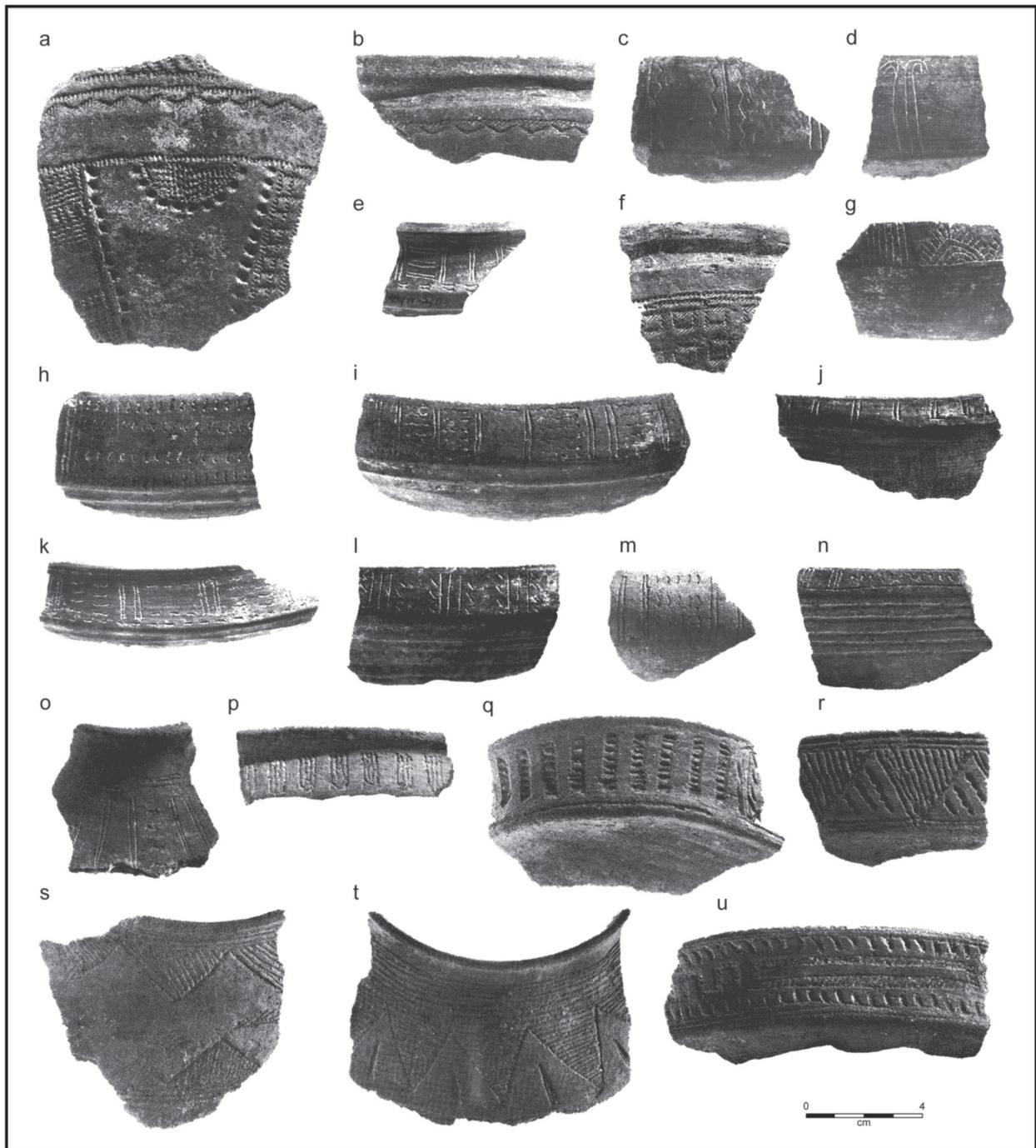


FIGURE 2.7. REPRESENTATIVE DECORATED SHERDS FROM OPOSI: A = TYPE A, B = TYPE A, C = TYPE B, C, D, E, D = TYPE B, C, D, E, E = TYPE B, C, D, E, F = TYPE A, G = TYPE B, C, D, E, H = TYPE G, I = TYPE G, J = TYPE K, K = TYPE B, C, D, E, L = TYPE B, C, D, E, M = TYPE B, C, D, E, N = TYPE K, O = TYPE F, P = TYPE S, Q = TYPE W, R = TYPE W, S = TYPE T, T = TYPE T, U = TYPE W (AFTER VANDERWAL 1973: FIGURES VI-6-10).

modified his interpretation to suggest that 'the Oposisi assemblage, as represented in Zone IIC, was transported to this part of Papua through exchange media probably mostly after initial settlement' (Vanderwal 1978: 424), rather than representing colonising traders who settled at Yule Island. But during those initial, influential

formative years of south coast archaeology, Vanderwal argued that Oposisi held evidence for the arrival of a new people introducing pottery for the first time to the southern shores of PNG, and given the age of Zone IIC, dating to around 2000 cal BP.

For his study area, using data from all of his excavated sites, Vanderwal (1973: 195-198) defined four cultural phases:

- *Pre-ceramic phase* (c. 4000 BP): represented by stone artefacts from Kukuba Cave.
- *Initial Ceramic phase* (c. 2000 BP): pottery was introduced by intrusive horticulturists who maintained external contacts possibly with founding groups.
- *Developmental phase* (<2000 BP to probably <1000 BP): represents a time of 'greater control and knowledge' of mainland resources (Vanderwal 1973: 197).
- *Intrusive Ceramic phase* (>700 BP): represented only by ceramic traits evident at the Urourina site.

The same data and periods were also divided into six chronologically sequential technological complexes spanning the period c. 4000-700 BP (Vanderwal 1973: 167-74). The first of these was a pre-ceramic phase; specific ceramic Types formed the basis of differentiation for the subsequent five ceramic complexes (Figure 2.2):

- *Kukuba complex* (c. 4000-2000 BP). Consists of stone artefacts in pre-ceramic levels at Kukuba Cave (the only pre-ceramic assemblage known from the southern coast of PNG prior to the Caution Bay research).
- *Oposisi complex* (c. 2000 BP). Ceramic Types A, B and C (Figures 2.7a and 2.7b) from basal levels of Oposisi. These earliest ceramics signalled the first arrival of ceramics across the region.
- *Ravao complex* (c. <2000-1200 BP). Ceramic Types H and J. Contains fewer bone and shell artefacts than the Oposisi complex.
- *Wairo complex* (c. 1100-1200 BP). Ceramic Type S (Figure 2.7p), plus ceramic forms found in the later part of the preceding Ravao complex, and the subsequent Kairuku complex.
- *Kairuku complex* (c. 1000-900 years ago). Ceramic Types T and W (Figures 2.6a, 2.6b, 2.6f, 2.7t and 2.7u).
- *Urourina complex* (c. 700 BP). Includes sherds with a distinctive type of shell-impressed decoration and 'multi-pronged' impressed decoration found at Urourina.

More recently Allen and colleagues excavated a column sample on the edge of the original excavation pit at Oposisi, the results of which generally confirmed and slightly extended the age of basal deposits at c. 2000 cal BP, and refined the overlying ceramic chronology. Obsidian from the period c. 2000-1500 cal BP was sourced to Fergusson Island in the Massim off the eastern tip of New Guinea, demonstrating strong links with the east for this early phase (Allen *et al.* 2011).

## Gulf of Papua Region

### *Jim Rhoads, David Frankel and Bruno David*

The Gulf of Papua represents the recipient end of the *hiri* trade. Archaeological excavations began there during the 1970s, first with Rhoads (1980) in the mid-Kikori River and at the site of Popo at Orokolobay (Rhoads 1994), then by Frankel and Vanderwal at Kinomere on Urama at the mouth of the Purari River and at a number of sites near Kerema (Frankel and Vanderwal 1982, 1985; Frankel *et al.* 1994). Between 2006 and 2009, Bruno David, Ian McNiven, Bryce Barker and Lara Lamb excavated a number of sites from the mouth of the Kikori River inland to Baina at the foothills of the Highlands. Frankel *et al.* (1994: 46) have pointed out for the coast that:

No sites in the Gulf have been securely dated between 700 and 500/400 years ago. This is probably a product of the limited amount of research and the difficulty of locating sites without pottery, but may well reflect [a] decline in long-distance trade, at least in pottery (Frankel *et al.* 1994: 46).

Most researchers (e.g., Allen 1977a; Swadling 1976) have suggested that the *hiri* as known from ethnography immediately post-dates the 'ceramic hiccup' phase of transformation in pottery styles (in Central Province pottery-producing communities) or apparent ceramic absence (in Gulf Province pottery recipient communities), and is probably only 500 to 300 years old (Rhoads and Mackenzie's [1991] 'Recent Ceramic' phase). This most recent ceramic phase in recipient Gulf Province sites is usually taken to indicate some 500-300 years of continuous trade, an increasing standardisation of trade goods (including increasing specialisation and centralisation of ceramic production within the ceramic producing areas), population increases and the establishment of large settlements in the Gulf region (e.g., Allen 1977a, 1977b; Frankel *et al.* 1994: 45-47). More recently and consistent with these views, David (2008) has demonstrated major shifts in ceramic trade into the western sections of the Gulf region beginning 500 cal BP, attributed to the onset of the *hiri* continuing uninterrupted into ethnographic times. This most recent pulse in occupation, ceramics and radiocarbon dates in the Gulf region, dated to 500-0 cal BP, corresponds well with Rhoads and Mackenzie's (1991) Recent Ceramic and Proto-historic phases (Figure 2.2). This period of time contains the greatest number of ceramic sherds, traceable to the onset of the ethnographically documented *hiri* system (again in agreement with Rhoads and Mackenzie's earlier interpretations). Precisely how the newly excavated ceramics from this most recent period formally, decoratively, economically and occupationally relate to the earlier ceramic phases – in particular how

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

they relate to an earlier pulse of high archaeological representation 1450-950 cal BP also associated with large quantities of imported ceramic sherds (David 2008) – remains a matter of debate.

While the major pulses in occupation in the mid-Kikori River area suggest the existence of active exchange relations 1450-950 and again 500-0 cal BP separated by a hiatus in the arrival of ceramics during the intervening period, they also indicate a loosening of village stability presumably in concert with a breakdown in long-distance trade relations between 950-500 cal BP, a period so far characterized by an absence of (imported) ceramics. It is significant to note that this period in the mid-Kikori River area lies largely within the ‘ceramic hiccup’ phase of the Central Province – a period of transformation of pottery styles in the ceramic production end of the *hiri* system. The paucity of radiocarbon dates and the apparent absence of ceramics between 950 and 500 cal BP in the Kikori River area may thus reflect contemporaneous and/or shortly earlier disturbances in ceramic producing sites and cultural sequences further to the east. If the precise dating of cultural sequences in the Port Moresby region sites is correct (which is not certain), the rejuvenation of ceramic-sago exchange in the Gulf region around 500 cal BP appears to post-date the start of intensified pottery production and the most recent ceramic phase (immediately following the ‘ceramic hiccup’) in the Port Moresby region by perhaps 200 years (possibly involving Koita-Motu displacements there; Allen 1977a; Bulmer 1978). During this most recent period, the establishment of a new phase of trade partnerships and stable settlement locations were associated with new forms of regionalized ceramics, indicating a break-down of the earlier and more widespread ceramic conventions. Critical to understanding the onset of this new phase is, therefore, the period known as the ‘ceramic hiccup’, a perceived gap between the earlier and later phases of ceramic production and long-distance maritime trade. In such ways the archaeology of the Gulf of Papua has profound significance for understanding the socio-cultural history of the ceramic-producing villages in the Port Moresby region, and vice versa.

### **Bruno David and Robert Skelly**

On 20 August 2007 the *Post-Courier* (PNG’s major daily newspaper) announced that two wrecked *lakatoi* (*hiri* trading vessel) hulls had been discovered near Epemeavo and Kea Kea villages east of the Vailala River in the mid-region of the Gulf of Papua. One week later archaeologists Bruno David and Nick Araho (PNG National Museum and Art Gallery) arrived to investigate the finds (see David *et al.* 2008 for details). Following community discussions and completion of initial investigations of the hulls site, clan leaders representing Epemeavo and Kea Kea villages led the archaeological team to Keveoki (OKE and OKG) and Meiharo swamps

(OKF) where large amounts of buried ceramics had recently been exposed through gardening activity (see David *et al.* 2009; Moffat *et al.* 2011; Skelly *et al.* 2010). Comparing ceramic conventions of the Keveoki assemblage with those known from the ethnographic *hiri* trade, David *et al.* (2009: 18) described a ‘predominance of everted carinated dishes and everted indirect pots at Keveoki 1 [OKE surface collection] ... consistent with the predominance of Motu *uro*, *nau* and perhaps *hodu*’. David *et al.* (2009: 18) concluded that,

Keveoki 1 [OKE] belongs chronologically to the early part of the late ceramic phase in the Gulf Province (see David 2008 for discussion), the one immediately following the so-called ‘Ceramic Hiccup’ on the southern Papuan coast (see Summerhayes and Allen 2007), and located at the beginning of the ceramic sequence that then continues uninterrupted to the period of the ethnographic *hiri*.

Based on promising results from investigations at Keveoki and Meiharo, for his doctoral research Robert Skelly investigated other cultural sites from the same region of what is locally known as the Kouri lowlands. Skelly excavated 10 archaeological sites in 2010, shortly after the Caution Bay fieldwork and the discovery of Lapita sites there, but his research is relevant to the interpretation of the Caution Bay finds and therefore to discussions presented in forthcoming Caution Bay volumes. Noteworthy is a detailed ceramic sequence that starts with a small Late Lapita ceramic assemblage with dentate-stamped body and lip decorations from the Hopo site (OJS) dated to *c.* 2600 cal BP (Skelly *et al.* 2014) (Figure 2.2). This is followed by several post-Lapita ceramic phases with shell-impressed body decorations dating to an uncertain time within the period 2300-1550 cal BP, followed by a phase of red-slipped/painted and linear incised decorations dating to *c.* 1550-1175 cal BP. This is then followed by a period of some 500 years (*c.* 1175-675 cal BP) when no cultural evidence is apparent, a period that corresponds well with the ceramic ‘hiccup’ previously identified by Rhoads (1982), Irwin (1991) and Summerhayes and Allen (2007) for various parts of the southern lowlands (see above). Ceramics then reappeared *c.* 675 cal BP in the Kouri lowlands, continuing unabated into the ethnographic period (Skelly 2014). Ceramics in that most recent, post-‘hiccup’ phase were initially decorated with linear arrangements of individually-impressed shell valve lip impressions on the bodies of pots, with deeply-incised lip decorations leaving distinctive crenulated vessel profiles also being characteristic of the period. After *c.* 540 cal BP these decorations declined in complexity, and after *c.* 300 cal BP body decoration consisted of gash-incisions or punctations along vessel contours and shallowly incised lips. Body and lip decoration ceased entirely by *c.* 150

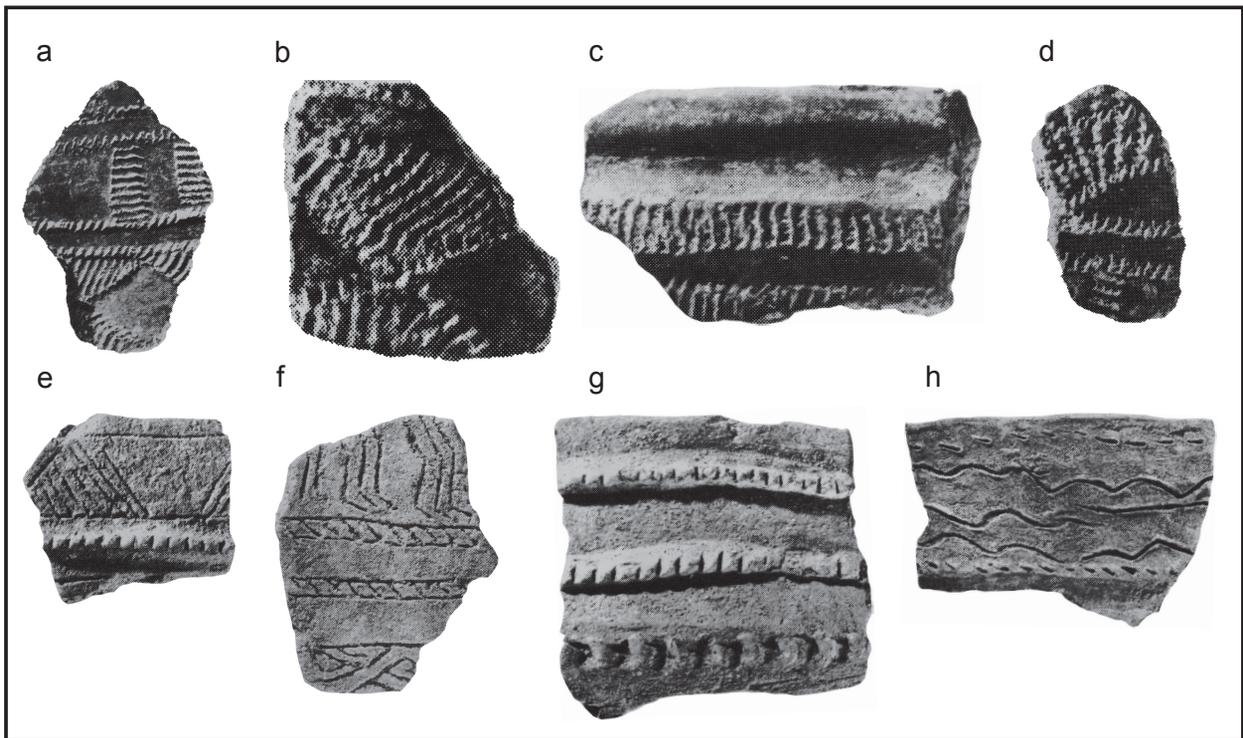


FIGURE 2.8. REPRESENTATIVE SHERDS FROM AMAZON BAY-MAILU EXCAVATIONS (A-D = EARLY PERIOD, E-G = MAYRI PERIOD, H = MAYRI-MAILU TRANSITIONAL) (AFTER IRWIN 1985: 248-251, PLATES 1-3).

cal BP (Skelly 2014), a period largely corresponding with the ethnographic *hiri* of the colonial period.

### Amazon Bay-Mailu

#### Geoff Irwin

Geoff Irwin's archaeological fieldwork in the Amazon Bay-Mailu region from 1972 to 1974, along the coast 260km to the east of Port Moresby, revealed historical trends of relevance to the latter region for several reasons, not least also being its importance as an ethnographic period ceramic manufacturing and trading centre. Irwin excavated three sites on Mailu Island, Oraido 1 and 2 and Mailu 3, and the beach-fronting Selai site on the Amazon Bay mainland. Like other archaeologists working along the southern coast of PNG, his basic premise was that 'One can identify settlement patterns simply by plotting the distribution of archaeological sites shown to be highly similar in their ceramic inventories' (Irwin 1978: 301). Irwin (1978) initially argued that the history of the Mailu area, as indicated by archaeological research, could be divided into three major periods, which he called Early, Mayri and Mailu (Figures 2.2, 2.8). The Early period (2000 to around 1500 cal BP) was characterized by a series of pottery-producing villages along the mainland coast and on offshore islands. There is some ambiguity as to the timing of the Mayri and Mailu periods, for Irwin (1978: 302) also writes that the Mayri period 'dates some

6-800 b.p.'; that is, that it continues to around 600 to 800 years ago. As Irwin here discusses settlement patterns specifically, it is likely that he is referring here only to the distinctive (regionalized) Mayri settlements lasting until 600 to 800 years ago, rather than to the Mayri period of ceramic conventions (which lasts until about 400 years ago). 'Through time' – i.e., during the Mayri period (from around 1500 to 400 cal BP) into the early Mailu period (after approximately 400 cal BP, at the time of writing [1978] identified as '350 b.p.' by Irwin) – writes Irwin (1978: 299),

... the density of mainland settlement increased and there was an associated shift in village site location. In addition, one settlement began to differentiate from others at a rate which accelerated through time. By the period of European contact, the small island of Mailu was the location of a settlement that can be described as a central place. It was larger, socially more stratified, more influential and functionally specialized than any other place.

During the Mayri period, 'pottery making was a widespread skill and occurred in several villages' (Irwin 1978: 300). By the time of the early European contact period, the entire region was dominated by a single pottery-making village (on the island of Mailu) holding a monopoly over production and ceramic trade as well

## ARCHAEOLOGICAL RESEARCH AT CAUTION BAY, PAPUA NEW GUINEA

as use of large ocean-going canoes, despite the fact that by that time there were many more villages than previously along the coast, and that these villages were more closely but less regularly spaced than during earlier periods (being on average 7km, 6km and 3km apart during the Early, Mayri and Mailu periods respectively) (Irwin 1978: 304, 305). Along with this increasing centralization and specialization of ceramic production and trade, and increasing populations and village density, also came a move from coastal village locations to hilltops for purposes of defence, a further indication that social relations were significantly different between the latest (ethnographic) phase and earlier times (Irwin 1985: 11). Because of insufficient radiocarbon dating, Irwin (1978: 315) concludes that ‘The major change in pattern occurred between early in the Mayri Period and 1890’ – a period covering from around 1500 to 150 cal BP.

Irwin later compared his earlier material to sites of similar age to the west, noting that the lower levels of Oraido 1 revealed sherds with shell-impressed decoration apparently comparable to Type A from Zone IIC at Oposisi on Yule Island and Style H from Horizon 3 from Nebira 4 near Port Moresby, with a radiocarbon date of 1900±70 BP (ANU-1229) from Oraido 1 suggesting near-contemporaneity of the three pottery assemblages (Irwin 1985: 67). Shell-impressed sherds similar to those from Oraido 1 were also found at Selai on the mainland, where radiocarbon dates of 1790±70 BP (ANU-1316) and 1770±70 BP (ANU-1317) were obtained.

Irwin (1991: 503) coined the term ‘Early Papuan Ware’ (EPW) for the earliest pottery phase from Amazon Bay-Mailu, which although locally made, he suggested was part of a sequence of styles also found along much of the south coast of PNG. EPW remained current as a progression of styles in Amazon Bay-Mailu c. 2000-1200 years ago (Irwin 1991: 504-505). Between c. 1600-1000 years ago, however, there was divergence in local ceramic traditions from similar, contemporaneous ceramic traditions elsewhere along the south coast of PNG, with the EPW pottery tradition ending abruptly in all locations c. 1200 BP (Irwin 1991: 507). Irwin (1991: 504) characterized this later period (c. 1600-1000 years ago) of stylistic divergence as signalling a lessening of communication along the approximately 400km of coastline between Amazon Bay and Yule Island.

Based primarily on results from Amazon Bay-Mailu, but also referencing investigations further to the west, Irwin (1991) presented a four-phase cultural sequence for the south coast of PNG (Figure 2.2):

- **Colonisation** (2000-1600 years ago). Settlements using EPW pottery appear along the south coast of PNG.

- **Deepening Regional Isolation** (1600-1000 years ago). Coastal groups fragment, creating a series of local ceramic traditions, with ceramics in Amazon Bay-Mailu diverging from those of the Port Moresby region and Yule Island-Hall Sound.
- **Pottery Style Transformation** (1200-800 years ago). Earlier ceramic traditions are ‘abruptly replaced’ by new traditions broadly similar in style to each other, but not as uniform as during the Colonisation period.
- **Interaction, Specialisation and Exchange** (800-200 years ago). Areas along the south coast of PNG become locally integrated while coastal communication and exchange relationships fluctuate in their spatial extents.

### Summary and Conclusions

Prior to the Caution Bay research, only eight sites had been professionally archaeologically excavated and reported from Port Moresby northwestward to Papa; none of these dated prior to 2000 cal BP and no preceramic sites had been investigated. There was a focus on ceramic sequences, investigating archaeological evidence for the *hiri*, and speculating on the introduction and spread of, and nature of connections between, the earliest known ceramic horizons along the southern lowlands of PNG.

The Caution Bay excavation results, with their >1000 AMS radiocarbon dates and numerous rich cultural sequences, are now forcing us to rethink the known history of the Port Moresby region built from a handful of sites and few more radiocarbon dates. These new results contain virtually continuous dated occupation evidence from c. 4500 cal BP to the ethnographic period. The discovery of a Lapita colony beginning c. 2900 cal BP at Caution Bay, and the record of ceramic transformations from numerous well-dated excavated components, have instantly rendered obsolete the old models regarding the introduction and spread of what was thought to be the earliest ceramic horizon attributed to post-Lapita Austronesian-speakers, the EPP dated to c. 2000 cal BP. And yet the question remains as to how to make sense of various cultural patterns, such as those established during the pioneering years of research, in light of this significantly extended cultural chronology.

The more recent discovery of another locality containing Late Lapita ceramics on the southern lowlands of PNG, some 250km (by sea) to the west of Caution Bay in the Gulf of Papua region, strongly indicates long-distance Late Lapita westward expansions by c. 2600 cal BP, representing a further challenge to the previous orthodoxy involving the post-Lapita EPP (Skelly 2014; Skelly *et al.* 2014). Such questions of pre-EPP exploration and colonization by Lapita ceramicists, and how they come to connect with the EPP, remain to be elucidated.

While the new Caution Bay database represents a manifold increase in both the number of excavated sites and in the number of available radiocarbon dates for the broader Port Moresby region, pioneering research since the 1960s has also revealed critical patterns leading to enduring models of south coast cultural dynamics. The Caution Bay research represents a quantum increase in excavation data, more finely excavated and significantly

more well dated, and spanning greater than twice the time-depth of much of the earlier work. We will therefore be primarily constructing ceramic and cultural sequences specific to Caution Bay based on this new dataset, rather than patching up and expanding the existing chronological models, although much reference will be made to the results of the earlier work.

## References

- Abbot, R. T. and Dance, S. P. 1982. *Compendium of Seashells*. New York, E. P. Dutton.
- Afiati, N. 2007. Gonad maturation of two intertidal blood clams: *Anadara granosa* (L.) and *Anadara antiquata* (L.) (Bivalvia: Arcidae) in central Java. *Journal of Coastal Development* 10: 105–113.
- Allen, B. and Bourke, R. M. 2009. People, land and environment. In R. M. Bourke and T. Harwood (eds), *Food and Agriculture in Papua New Guinea*: 28–121. Canberra, ANU E Press.
- Allen, J. 1972. Nebira 4: an early Austronesian site in central Papua. *Archaeology and Physical Anthropology in Oceania* 8: 92–124.
- Allen, J. 1977a. Fishing for wallabies: trade as a mechanism for social interaction, integration and elaboration on the central Papuan coast. In J. Friedman and M. J. Rowlands (eds), *The Evolution of Social Systems*: 419–455. London, Duckworth.
- Allen, J. 1977b. Sea traffic, trade and expanding horizons. In J. Allen, J. Golson and R. Jones (eds), *Sunda and Sahul*: 387–417. London, Academic Press.
- Allen, J. 1977c. Adaptations to the food quest in prehistoric Papua New Guinea. In J. V. S. Megaw (ed.), *Hunters, Gatherers, and First Farmers Beyond Europe*: 167–188. London, Leicester University Press.
- Allen, J. 1978. The physical and cultural setting of Motupore Island, Central Province, Papua New Guinea. *Bulletin of the Indo-Pacific Prehistory Association* 1: 47–55.
- Allen, J. 1982. Pre-contact trade in Papua New Guinea. In R. J. May and H. Nelson (eds), *Melanesia: Beyond Diversity*: 193–206. Research School of Pacific Studies, Canberra, Australian National University.
- Allen, J. 1984. Pots and poor princes: a multidimensional approach to the role of pottery trading in coastal Papua. In S. E. van der Leeuw and A. C. Pritchard (eds), *The Many Dimensions of Pottery*: 407–463. Amsterdam, University of Amsterdam.
- Allen, J. 1991. Hunting for wallabies: the importance of *Macropus agilis* as a traditional food resource in the Port Moresby hinterland. In A. Pawley (ed.), *Man and a Half: Essays in Pacific Anthropology and Ethnobiology in Honour of Ralf Bulmer*: 457–451. The Polynesian Society Memoir 48. Auckland, The Polynesian Society.
- Allen, J., Holdaway, S. and Fullagar, R. 1997. Identifying specialisation, production and exchange in the archaeological record: the case of shell bead manufacture on Motupore Island, Papua. *Archaeology in Oceania* 32: 13–38.
- Allen, J. and Rye, O. S. 1982. The importance of being earnest in archaeological investigations of prehistoric trade in Papua. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 99–115. Pacific Research Monograph 8, Research School of Pacific Studies, Australian National University, Canberra, Australian National University.
- Allen, J., Summerhayes, G. R., Mandui, H. and Leavesley, M. 2011. New data from Oposisi: implications for the Early Papuan Pottery phase. *Journal of Pacific Archaeology* 2: 69–81.
- Allen, M. S. and Wallace, R. 2007. New evidence from the East Polynesian gateway: substantive and methodological results from Aitutaki, Southern Cook Islands. *Radiocarbon* 49: 1163–1179.
- Allison, A. 2007. Herpetofauna of Papua. In A. J. Marshall and B. M. Beehler (eds), *The Ecology of Papua, Part One*: 564–616. The Ecology of Indonesia Series, Volume VI. Hong Kong, Periplus Editions.
- Arifin, K. 1990. *Social Aspects of Pottery Manufacture in Boera, Papua New Guinea*. Unpublished MA thesis, Australian National University.
- Bailey, G. 1993. Shell mounds in 1972 and 1992: reflections on recent controversies at Ballina and Weipa. *Australian Archaeology* 37: 1–18.
- Barham, A. J. 2000. Late Holocene maritime societies in the Torres Strait Islands, northern Australia: cultural arrival or cultural emergence? In S. O'Connor and P. Veth (eds), *East of Wallace's Line: Studies of Past and Present Maritime Cultures of the Indo-Pacific Region*: 223–314. Rotterdam, A. A. Balkema.
- Barnett, G. L. 1978. *A Manual for the Identification of Fish Bones: A Guide to the Comparative Skeletal Collection in the Department of Prehistory, Australian National University*. Technical Bulletin of the Department of Prehistory, Research School of Pacific Studies, Canberra, Australian National University.
- Baron, J. and Clavier, J. 1992. Effects of environmental factors on the distribution of the edible bivalves *Atactodea striata*, *Gafrarium tumidum* and *Anadara scapha* on the coast of New Caledonia (SW Pacific). *Aquatic Living Resources* 5: 107–114.
- Barton, F. R. 1910. The annual trading voyages to the Papuan Gulf. In C. G. Seligmann (ed.), *The Melanesians of British New Guinea*: 96–120. Cambridge, Cambridge University Press.
- Bastard, E. M. 1918. Vocabularies: Abau Station, Eastern Division. Name of tribe, Lau'una. Names of villages, Bulumai, Dedele, and Bomguina River, E.D. In J. H.

- P. Murray (ed.), *Papua: Annual Report for the Year 1917-18*: 89. Melbourne, Government Printer.
- Beehler B. M., Pratt, T. K. and Zimmerman, D. A. 1986. *Birds of New Guinea*. Princeton, Princeton University Press.
- Beesley P. L., Ross, G. J. B. and Wells, A. (eds) 1998. *Mollusca: The Southern Synthesis*. Fauna of Australia. Volume 5. Melbourne, CSIRO Publishing.
- Bell, H. L. 1982. Abundance and seasonality of the savanna avifauna at Port Moresby, Papua New Guinea. *Ibis* 124: 252-274.
- Bellchambers, L. M., Meeuwig, J. J., Evans, S. N. and Legendre, P. 2011. Modelling habitat associations of the Common Spider Conch in the Cocos (Keeling) Islands. *Marine Ecology Progress Series* 432: 83-90.
- Bellwood, P., Fox, J. J. and Tryon, D. (eds) 2006. *The Austronesians: Historical and Comparative Perspectives*. Canberra, ANU E Press.
- Belshaw, C. 1957. *The Great Village*. London, Routledge and Kegan Paul.
- Bickler, S. H. 1997. Early pottery exchange along the south coast of Papua New Guinea. *Archaeology in Oceania* 32: 151-162.
- Blust, R. 1990. Three recurrent changes in Oceanic languages. In J. H. C. S. Davidson (ed.), *Pacific Island Language: Essays in Honour of G. B. Milner*: 7-28. London, School of Oriental and African Studies, University of London.
- Bonaccorso, F. J. 1998. *Bats of Papua New Guinea*. Conservation International Tropical Field Guide Series, 2. Washington D.C., Conservation International.
- Bonnardin S. 2003. La parure funéraire des 6e et 5e millénaires avant J.-C. dans le bassin Parisien et la plaine du Rhin supérieur: traces d'usage, fonctionnement et fonction des objets de parure. In P. Chambon and J. Leclerc (eds), *Pratiques Funéraires du Néolithique Ancien et Moyen en France et dans les Régions Limitrophes entre 5000 et 3500 Environ av. J.-C.*: 93-113. *Musée des Antiquités Nationales, Saint-Germain-en-Laye, Mémoire de la Société Préhistorique Française*, t. XXXIII.
- Bonnardin S. 2012. Parures de coquillages du Néolithique en Europe (VIe-Ve millénaires av. J.-C.). In E. Faugère and I. Sénépart (eds), *Itinéraires de Coquillages, Techniques & Culture*: 27-43. *Edition de la Maison des Sciences de l'Homme*, n°59.
- Bowdler, S. 1984. *Hunter Hill, Hunter Island*. Terra Australis 8. Canberra, Research School of Pacific Studies, Australian National University.
- Bowdler, S. 2014. Shell middens and mollusks. In J. Balme and A. Paterson (eds), *Archaeology in Practice: A Student Guide to Archaeological Analyses*: 361-384. Chichester, John Wiley and Sons Inc.
- Bradley, S., Shashoua, Y. and Walker, W. 1999. A novel inorganic polymer for the conservation of ceramic objects. In J. Bridgland and J. Brown (eds), *ICOM-CC 12th Triennial Meeting/Conference Preprints, Lyon, 29th August-3rd September 1999*: 770-776. London, ICOM Committee for Conservation.
- British Broadcasting Corporation [BBC]. 2006. Average conditions, Port Moresby, Papua New Guinea. [http://www.bbc.co.uk/weather/world/city\\_guides/results.shtml?tt=TT003090](http://www.bbc.co.uk/weather/world/city_guides/results.shtml?tt=TT003090) (15 September 2008).
- Brock, J. 2001. *Native Plants of Northern Australia*. Sydney: Reed New Holland Press.
- Bronk Ramsey, C. 1995. Radiocarbon calibration and analysis of stratigraphy: the OxCal Program. *Radiocarbon* 37: 425-430.
- Bronk Ramsey, C. 2009a. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51:337-360.
- Bronk Ramsey, C. 2009b. Dealing with outliers and offsets in radiocarbon dating. *Radiocarbon* 51: 1023-45.
- Bronk Ramsey, C. 2013. OxCal Program v4.2.2. Radiocarbon Accelerator Unit, University of Oxford.
- Broom, M. J. 1985. *The Biology and Culture of Marine Bivalve Molluscs of the Genus Anadara*. Manila, International Center for Living Aquatic Resources Management.
- Bulmer, S. E. 1969. Archaeological Field Survey and Excavations in Central Papua, 1968. Report to the Department of Anthropology and Sociology, the University of Papua and New Guinea.
- Bulmer, S. E. 1971. Prehistoric settlement patterns and pottery types in the Port Moresby area: a preliminary review. *Journal of the Papua and New Guinea Society* 5(2): 28-91.
- Bulmer, S. E. 1978. *Prehistoric Culture Change in the Port Moresby Region*. Unpublished PhD thesis, University of Papua New Guinea.
- Bulmer, S. E. 1982. West of Bootless Inlet: archaeological evidence for prehistoric trade in the Port Moresby area and the origins of the Hiri. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 117-130. Pacific Research Monograph 8, Research School of Pacific Studies. Canberra, Australian National University.
- Bureau of Meteorology [BoM]. 2015a. Climate and past weather. Commonwealth of Australia, Bureau of Meteorology, Canberra. <http://www.bom.gov.au/climate/> (27 January 2015).
- Bureau of Meteorology [BoM]. 2015b. Southern hemisphere tropical cyclone data portal. Canberra, Commonwealth of Australia, Bureau of Meteorology. <http://www.bom.gov.au/cyclone/history/tracks/> (2 February 2015).
- Burns, T. 2000. *Late Holocene Indigenous Economies of the Tropical Australian Coast: An Archaeological Study of the Darwin Region*. Unpublished PhD thesis, Northern Territory University.
- Buys, S. and Oakley, V. 1993. *Conservation and Restoration of Ceramics*. London, Butterworth-Heinemann.

- Carpenter, K. E. and Niem, V. H. (eds) 1998. *The Living Marine Resources of the Western Central Pacific. Volume 1: Seaweeds, Corals, Bivalves and Gastropods*. Rome, Food and Agriculture Organisation of the United Nations.
- Carter, M., Barham, A. J., Veth, P., Bird, D. W., O'Connor, S. and Bird, R. B. 2004. The Murray Islands Archaeological Project: preliminary results of excavations on Mer and Dauar, eastern Torres Strait. In I. J. McNiven and M. Quinnell (eds), *Torres Strait Archaeology and Material Culture*: 163–182. Memoirs of the Queensland Museum, Cultural Heritage Series, No. 3, Pt. 1. South Brisbane, Queensland Museum.
- Cernohorsky, W. O. 1972. *Marine Shells of the Pacific*, Volume 2. Sydney, Pacific Publications.
- Cernohorsky, W. O. 1978. *Tropical Pacific Marine Shells*. Sydney, Pacific Publications.
- Chalmers, J. 1887. History and description of pottery trade: a Papuan Enoch Arden. In J. W. Lindt (ed.), *Picturesque New Guinea*: 118–125. London, Longmans, Green.
- Chalmers, J. 1895. *Pioneering Life and Work in New Guinea 1877-1894*. London, Religious Tract Society.
- Chappell, J. 2005. Geographic changes of coastal lowlands in the Papuan past. In A. Pawley and R. Attenborough (eds), *Papuan Pasts: Cultural, Linguistic and Biological Histories of Papuan-Speaking Peoples*: 525–539. Canberra, ANU Press.
- Chatterton, P. 1968. The story of a migration. *The Journal of the Papua and New Guinea Society*, 2: 92–95.
- Chatterton, P. 1980. *Day that I have Loved*. Sydney, Pacific Publications.
- Chester, H. M. 1878. *Narrative of Expedition to New Guinea*. Brisbane, Government Printer.
- Claassen, C. L. 1998. *Shells*. Cambridge, Cambridge University Press.
- Clarkson, C. and Schmidt, L. 2011. Stone artefact manufacture at the Natunuku, Votua, Kulu and Ugaga Sites, Fiji. In G. Clark and A. Anderson (eds), *The Early Prehistory of Fiji*: 345–372. Terra Australis 31. Canberra, ANU E Press.
- Coates, B. J. 1985. *The Birds of Papua New Guinea, Including the Bismarck Archipelago and Bougainville. Volume I, Non-Passerines*. Alderley, Queensland, Dove Publications.
- Coates, B. J. 1990. *The Birds of Papua New Guinea, Including the Bismarck Archipelago and Bougainville. Volume II, Passerines*. Alderley, Queensland, Dove Publications.
- Coffey Natural Systems [CNS]. 2008a. Nearshore marine impact assessment. Report prepared by Coffey Natural Systems Pty Ltd for Esso Highlands Ltd, PNG LNG Project. Appendix 23 in CNS 2009, PNG LNG Project. Environmental Impact Statement. [http://www.pnglng.com/downloads/eis\\_appendix23.pdf](http://www.pnglng.com/downloads/eis_appendix23.pdf) (27 January 2015).
- Coffey Natural Systems [CNS]. 2008b. Resource use survey of Caution Bay. Report prepared by Coffey Natural Systems Pty Ltd for Esso Highlands Ltd, PNG LNG Project. Appendix 24 in CNS 2009, PNG LNG Project. Environmental Impact Statement. [http://www.pnglng.com/downloads/eis\\_appendix24.pdf](http://www.pnglng.com/downloads/eis_appendix24.pdf) (27 January 2015).
- Coffey Natural Systems [CNS]. 2009. PNG LNG Project. Environmental impact statement. Environmental impact statement commissioned by ExxonMobil Corporation for the purpose of section 50 of the Environment Act 2000 (PNG) and prepared by Esso Highlands Ltd and Coffey Natural Systems Pty Ltd. <http://www.pnglng.com/commitment/environment/eis> (27 January 2015).
- Coleman, N. 2003. *Sea Shell Catalogue of Indo Pacific Mollusca*. Springwood, Litho Art.
- Constancio, C., Franco, L., Russo, A., Anjinho, C., Pires, J., Vaz, M. and Carvalho, A. 2010. Studies on polymeric conservation treatments of ceramic tiles with Paraloid B-72 and two alkoxy silanes. *Journal of Applied Polymer Science* 116: 2833–2839.
- Coote, K. and Sand, C. 1999. The conservation of Lapita pottery: ignore it at your peril. In J. C. Galipaud and I. Lilley (eds), *The Western Pacific from 5000 to 2000 BP. Colonisation and Transformations*: 333–343. Paris, IRD Éditions.
- Cotterell, B. and Kamminga, J. 1987. The formation of flakes. *American Antiquity* 52: 675–708.
- Cribb, A. B. 1990. Coral reefs. In M. N. Clayton and R. J. King (eds), *Biology of Marine Plants*: 350–366. Melbourne, Longman Cheshire.
- Crocombe, M. 1982. Ruatoka: a Cook Islander in Papuan history. In R. Crocombe and M. Crocombe (eds), *Polynesian Missions in Melanesia*: 55–78. Suva, University of the South Pacific.
- Dance, S. P. 1977. *The Encyclopedia of Shells*. Sydney, Australia and New Zealand Book Company.
- David, B. 2008. Rethinking cultural chronologies and past landscape engagement in the Kopi region, Gulf Province, Papua New Guinea. *The Holocene* 18: 463–479.
- David, B., Araho, N., Barker, B., Kuaso, A., and Moffat, I. 2009. Keveoki 1: exploring the Hiri ceramics trade at a short-lived village site near the Vailala River, Papua New Guinea. *Australian Archaeology* 68: 11–23.
- David, B., Araho, N., Kuaso, A., Moffat, I. and Tapper, N. 2008. The Upihoi find: wrecked wooden Bevaia (Lagatoi) hulls of Epemeavo Village, Gulf Province, Papua New Guinea. *Australian Archaeology* 66: 1–14.
- David, B., Geneste, J.-M., Aplin, K., Delannoy, J.-J., Araho, N., Clarkson, C., Connell, K., Haberle, S., Barker, B., Lamb, L., Stanisic, J., Fairbairn, A., Skelly, R. and Rowe, C. 2010. The Emo site (OAC), Gulf Province, Papua New Guinea: resolving long-standing questions of antiquity and implications

- for the history of the ancestral *Hiri* maritime trade. *Australian Archaeology* 70: 39–54.
- David, B., McNiven, I. J., Jones-Amin, H., Connaughton, S. P., Parkinson, C., Rowe C., Richards, T., Leavesley, M., Barker, B., Mandui, H., Campanelli, G. and Flood, N. 2013. Three reconstructed Lapita pots from Caution Bay, south coast of mainland Papua New Guinea. In G. R. Summerhayes and H. Buckley (eds), *Pacific Archaeology: Documenting the Past 50,000 Years*: 157–170. University of Otago Studies in Archaeology No. 25.
- David, B., McNiven, I. J., Leavesley, M., Barker, B., Mandui, H., Richards, T. and Skelly, R. 2012. A new ceramic assemblage from Caution Bay, south coast of mainland Papua New Guinea: the Linear Shell Edge-Impressed tradition from Bogi 1. *Journal of Pacific Archaeology* 3: 73–89.
- David, B., McNiven, I. J., Mitchell, R., Orr, M., Haberle, S., Brady, L. and Crouch, J. 2004. Badu 15 and the Papuan-Austronesian settlement of Torres Strait. *Archaeology in Oceania* 39: 65–78.
- David, B., McNiven, I. J., Richards, T., Connaughton, S. P., Leavesley, M., Barker, B. and Rowe, C. 2011. Lapita sites in the Central Province of mainland Papua New Guinea. *World Archaeology* 43: 576–593.
- Davies, H. L. and Jaques, A. L. 1984. Emplacement of ophiolite in Papua New Guinea. In I. G. Gass, S. J. Lippard and A. W. Shelton (eds), *Ophiolites and Oceanic Lithosphere*: 341–349. Geological Society, London, Special Publications, Volume 13. London, Geological Society.
- Davies, H. L. and Smith, I. E. 1971. Geology of Eastern Papua. *Geological Society of America Bulletin* 82: 3299.
- Dearden, P. N. 1987. *Soil Survey and Land Use Potential of the Aroa River Area Central Province*. Research Bulletin No. 40. Port Moresby, Department of Primary Industry.
- Dell, R. K. 1951. A key to the common chitons of New Zealand. *Tuatara* 4(1): 4–12.
- Denham, T., Bronk Ramsey, C. and Specht, J. 2012. Dating the appearance of Lapita pottery in the Bismarck Archipelago and its dispersal to remote Oceania. *Archaeology in Oceania* 47: 39–46.
- Domínguez-Rodrigo, M., Egeland, C. P. and Barba, R. 2007. The ‘physical attribute’ taphonomic approach. In M. Domínguez-Rodrigo, R. Barba and C. P. Egeland (eds), *Deconstructing Olduvai: A Taphonomic Study of the Bed I Sites*: 23–32. Vertebrate Paleobiology and Paleoanthropology Series. Dordrecht, Springer.
- Dutton, T. E. 1966. Koita Word Lists. Unpublished manuscript in possession of author.
- Dutton, T. E. 1969. *The Peopling of Central Papua: Some Preliminary Observations*. Australian National University, Pacific Linguistics, Series B, No. 9. Canberra, Australian National University.
- Dutton, T. E. 1970. Notes on the languages of the Rigo area of the Central District of Papua. In S. A. Wurm and D. C. Laycock (eds), *Pacific Linguistics Studies in Honour of Arthur Capell*: 879–985. Australian National University, Pacific Linguistics, Series C, No. 13. Canberra, Australian National University.
- Dutton, T. E. 1971. *Languages of South-East Papua: A Preliminary Survey*. Australian National University, Pacific Linguistics, Series A, No. 28. Canberra, Australian National University.
- Dutton, T. E. 1975. A Koita grammar sketch and vocabulary. In T. E. Dutton (ed.), *Studies in Languages of Central and South-East Papua*: 281–412. Australian National University, Pacific Linguistics, Series C, No. 29. Canberra, Australian National University.
- Dutton, T. E. 1978. Language and trade in central and south-east Papua. *Mankind* 11: 341–353.
- Dutton, T. E. 1979. Simplified Koriki: a second trade language used by the Motu in the Gulf of Papua. *Kivung* 12: 3–74.
- Dutton, T. E. 1982a. Towards a history of the Hiri: some beginning linguistic observations. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 65–98. Australian National University, Research School of Pacific Studies, Pacific Research Monograph, No. 8. Canberra, Australian National University.
- Dutton, T. E. 1982b. Borrowing in Austronesian and non-Austronesian languages of coastal south-east mainland Papua New Guinea. In A. Halim, L. Carrington and S. A. Wurm (eds), *Papers from the Third International Conference on Austronesian Linguistics: Currents in Oceania*: 109–177. Australian National University, Pacific Linguistics, Series C, No. 74. Canberra, Australian National University.
- Dutton, T. E. 1983. Birds of a feather: a pair of rare pidgins from the Gulf of Papua. In E. Woolford and W. Washabaugh (eds), *The Social Context of Creolization*: 77–105. Chicago, Karoma Press.
- Dutton, T. E. 1985. *Police Motu: Iena Sivarai*. Port Moresby, University of Papua New Guinea Press.
- Dutton, T. E. 1994. Motu-Koiarian contact, Papua New Guinea. In T. E. Dutton and Darrell Tryon (eds), *Language Contact and Change in the Austronesian World*: 181–232. Berlin, Mouton de Gruyter.
- Dutton, T. E. 2007. A Dictionary of Koita, Papua New Guinea. Unpublished typescript, National Archives of Papua New Guinea, Port Moresby and in the Pacific Research Archives in the Menzies Library, Australian National University, Canberra.
- Dutton, T. E. 2010a. *Reconstructing Proto Koiarian: The History of a Papuan Language Family*. Australian National University, Pacific Linguistics, 610. Canberra, Australian National University.
- Dutton, T. E. 2010b. The dialects of Koiari revisited. In K. A. McElhanon and G. P. Reesink (eds), *A Mosaic of Languages and Cultures: Studies Celebrating the*

- Career of Karl J. Franklin*: 111–137. Dallas, Summer Institute of Linguistics International.
- Dutton, T. E. and Kakare, I. 1977. *The Hiri Trading Language of Central Papua: A First Survey*. Occasional Paper 15. Port Moresby, Department of Language, University of Papua New Guinea.
- Eden, M. J. 1974. The origin and status of savanna and grassland in southern Papua. *Transactions of the Institute of British Geographers* 63: 97–110.
- Eden, M. J. 1993. Swidden cultivation in forest and savanna in lowland southwest Papua New Guinea. *Human Ecology* 21: 145–166.
- Ellison, J. 2005. Holocene palynology and sea-level change in two estuaries in southern Irian Jaya. *Palaeogeography, Palaeoclimatology, Palaeoecology* 220: 291–309.
- Feld, S. 2012. *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli Expression*. Durham, Duke University Press.
- Filer, C. 2011. New land grab in Papua New Guinea. *Pacific Studies* 34: 269–294.
- Filer, C. 2012. Why green grabs don't work in Papua New Guinea. *Journal of Peasant Studies* 39: 599–617.
- Finsch, O. 1903. Papua-töpferei. *Globus* 84: 329–34.
- Finsch, O. 1914. *Südseearbeiten. Gewerbe- und Kunstfleiss, Tauschmittel und 'Geld' der Eingeborenen auf Grundlage der Rohstoffe und der geographischen Verbreitung*. Abhandlungen des Hamburgischen Kolonialinstituts, Band XIV. Reihe B, Völkerkunde, Kulturgeschichte und Sprachen, Band 9. Hamburg, L. Friederichsen and Co.
- Firth, S. 1975. The Missions: from Chalmers to indigenisation. *Meanjin* 34: 342–350.
- Fitzpatrick, E. A. 1965. Climate of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea*: 83–97. Commonwealth Scientific and Industrial Research Organisation, Land Research Series No. 14. Melbourne, CSIRO.
- Flannery, T. F. 1995a. *Mammals of New Guinea*. New Edition. Chatswood, Reed Books.
- Flannery, T. F. 1995b. *Mammals of the South-West Pacific and Moluccan Islands*. Chatswood, Reed Books.
- Fort, G. S. 1886. *British New Guinea. Report on British New Guinea from Data and Notes by the Late Sir Peter Scratchley, Her Majesty's Special Commissioner*. Melbourne, John Ferres, Government Printer.
- Fox, R. 1976. *Kinship and Marriage*. Middlesex, Penguin Books.
- Frankel, D., Thompson, K. and Vanderwal, R. 1994. Kerema and Kinomere. In D. Frankel and J. W. Rhoads (eds), *Archaeology of a Coastal Exchange System: Sites and Ceramics of the Papuan Gulf*: 1–49. Division of Archaeology and Natural History, Research School of Pacific and Asian Studies, Australian National University. Canberra, Australian National University.
- Frankel, D. and Vanderwal, R. 1982. Prehistoric research at Kinomere Village, Papua New Guinea, 1981: preliminary field report. *Australian Archaeology* 14: 86–95.
- Frankel, D. and Vanderwal, R. 1985. Prehistoric research in Papua New Guinea. *Antiquity* 59: 113–115.
- Franzoni, E., Pigino, A., Leema, A. and Lura, P. 2013. Use of TEOS for fired-clay bricks consolidation. *Materials and Structures* 47: 1175–1184.
- Freestone, I. C. 2001. Post depositional changes in archaeological ceramics and glasses. In D. R. Brothwell and A. M. Pollard (eds), *Handbook of Archaeological Sciences*: 615–625. West Sussex, John Wiley and Sons, Ltd.
- Friedman, G. M. 1959. Identification of carbonate minerals by staining methods. *Journal of Sedimentary Petrology* 29: 87–97.
- Frodin, D. G. and Gressitt, J. L. 1982. Biological exploration of New Guinea. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 87–130. The Hague, Dr W. Junk Publishers.
- Fruscher, S. D. 1983. The ecology of juvenile Penaeid prawns, Mangrove Crab (*Scylla serrata*) and the Giant Freshwater Prawn (*Macrobrachium rosenbergii*) in the Purari Delta. In T. Petr (ed.), *The Purari – Tropical Environment of a High Rainfall River Basin*: 341–353. Monographiae Biologicae, 51. The Hague, Springer Netherlands.
- Gagan, M. K., Henty, E. J., Haberle, S. G. and Hantoro, W. S. 2004. Post-glacial evolution of the Indo-Pacific Warm Pool and El Niño-Southern Oscillation. *Quaternary International* 118: 127–143.
- Georges, A. and Thomson, S. 2010. Diversity of Australasian freshwater turtles, with an annotated synonymy and keys to species. *Zootaxa* 2496: 1–37.
- Gillison, A. N. 1983. Tropical savannas of Australia and the southwest Pacific. In F. Bourlière (ed.), *Ecosystems of the World: Tropical Savannas*: 183–238. Amsterdam, Elsevier Publishing.
- Gillon, D. 1983. The fire problem in tropical savannas. In F. Bourlière (ed.), *Ecosystems of the World: Tropical Savannas*: 617–638. Amsterdam, Elsevier Publishing.
- Glaessner, M. 1952. Geology of Port Moresby, Papua. In M. F. Glaessner and E. A. Rudd (eds), *Sir Douglas Mawson Anniversary Volume, Contributions to Geology in Honour of Professor Sir Douglas Mawson's 70th Birthday Anniversary*: 63–86. Adelaide, The University of Adelaide.
- Goddard, M. 2001. Rethinking Western Motu descent groups. *Oceania* 71: 313–333.
- Goddard, M. 2003. The age of steam: constructed identity and recalcitrant youth in a Papua New Guinea village. In S. Dinnen (ed.), *A Kind of Mending: Restorative Justice in the Pacific Islands*: 45–72. Canberra, Pandanus Books.

- Goddard, M. 2007. Le Fijien fou avec le singe et autres histoires d'une petite île près de Port Moresby (Papuasie Nouvelle-Guinée). *Journal de la Société des Océanistes* 125: 237–247.
- Goddard, M. 2008. From 'my story' to 'the story of myself': colonial transformations of personal narratives among the Motu-Koita of Papua New Guinea. In B. Lal and V. Luker (eds), *Telling Pacific Lives: Prisms of Progress*: 35–50. Canberra, ANU E Press.
- Goddard, M. 2010. Heat and history: the Motu-Koita and Moresby. In M. Goddard (ed.), *Villagers and the City: Melanesian Experiences of Port Moresby, Papua New Guinea*: 19–46. Wantage, Sean Kingston Press.
- Goddard, M. 2011a. Bramell's rules: custom and law in contemporary land disputes among the Motu-Koita of Papua New Guinea. *Pacific Studies* 34: 323–349.
- Goddard, M. 2011b. Historicizing Edai Siabo: a contemporary argument about the pre-colonial past among the Motu-Koita of Papua New Guinea. *Oceania* 81: 280–296.
- Goddard, M. 2013. Knowing and the truth: three histories of Daugo Island, Papua New Guinea. *Australian Journal of Anthropology* 24: 1–17.
- Golson, J. 1968. Introduction to Taurama archaeological site Kirra Beach. *Journal of the Papua and New Guinea Society* 2: 67–71.
- Grayson, D. K. 1984. *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Fauna*. Orlando, Academic Press.
- Green, R. C. 1991. The Lapita Cultural Complex: current evidence and proposed models. *Bulletin of the Indo-Pacific Prehistory Association* 11: 295–305.
- Gregory, C. 1980. Gifts to men and gifts to God: gift exchange and capital accumulation in contemporary Papua. *Man* 15: 626–652.
- Grindrod, J., Moss, P. and van der Kaars, S. 2002. Mangrove palynology in continental shelf and deep sea cores in the North Australia-Indonesian region. In P. Kershaw, B. David, N. J. Tapper, D. Penny, and J. Brown (eds), *Bridging Wallace's Line, the Environmental and Cultural History and Dynamics of the SE Asian-Australian Region*: 119–146. Advances in GeoEcology 34. Reiskirchen: Catena Verlag.
- Grist, R. W. 1926. Languages of the Abau District. In J. H. P. Murray (ed.), *Territory of Papua: Annual Report for the Year 1925-1926*: 92–97. Melbourne, Government Printer.
- Groves, M. 1954. Dancing in Poreporena. *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 84: 75–90.
- Groves, M. 1958. Motu kinship terminology. *Man* 58: 131–132.
- Groves, M. 1960. Motu pottery. *Journal of the Polynesian Society* 69: 3–22.
- Groves, M. 1963. Western Motu descent groups. *Ethnology* 2: 15–30.
- Groves, M. 1972. Hiri. In P. Ryan (ed.), *Encyclopaedia of Papua and New Guinea*: 523–526. Melbourne, Melbourne University Press.
- Groves, M. 2011. *The Motu of Papua: Tradition in a Time of Change*. Vancouver, Webzines of Vancouver.
- Gwilliam, J. W. 1982. Some religious aspects of the Hiri. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 35–63. Pacific Research Monograph 8, Research School of Pacific Studies, Australian National University. Canberra, Australian National University.
- Habe, T. 1964. *Shells of the Western Pacific in Color*, Volume 2. Osaka, Hoikusha Publishing Company.
- Haddon, A. C. 1894. *The Decorative Art of British New Guinea: A Study in Papuan Ethnography*. Cunningham Memoir 10. Dublin, Royal Irish Academy.
- Haddon, A. C. 1900. Studies in anthropogeography of British New Guinea. *Geographical Journal* 16: 265–291, 414–441.
- Haddon, A. C. 1975 [1937]. *The Canoes of Melanesia, Queensland, and New Guinea*, Volume 2 of *Canoes of Oceania*, A. Haddon and J. Hornell. Bernice P. Bishop Museum Special Publications, 28. Honolulu, Bishop Museum.
- Halvaksz, J. 2003. Singing about the land among the Biangai. *Oceania* 7: 153–169.
- Hanslip, M. D. 2001. *Expedient Technologies?: Obsidian Artefacts in Island Melanesia*. Unpublished PhD thesis, Australian National University.
- Harding, T. G. 1967. *Voyagers of the Vitiaz Strait: A Study of a New Guinea Trade System*. Seattle, University of Washington Press.
- Harris, M., Weisler, M. and Faulkner, P. 2015. A refined protocol for calculating MNI in archaeological molluscan shell assemblages: a Marshall Islands case study. *Journal of Archaeological Science* 57: 168–179.
- Hastenrath, S. 2012. Contemporary climate and circulation of the tropics. In S. E. Metcalfe and D. J. Nash (eds), *Quaternary Environmental Change in the Tropics*: 34–43. Oxford, Blackwell Scientific Publishers.
- Hatab, L. 1990. *Myth and Philosophy: A Contest of Truths*. Illinois, Open Court.
- Hauck, V., Mandie-Filer, A. and Bolger, J. 2005. *Ring the Church Bell: The Role of Churches in Governance and Public Performance in Papua New Guinea*. European Centre for Development Policy Management, Discussion Paper no. 57E. Maastricht, European Centre for Development Policy Management.
- Haynes, C. 1990. *Urban Land Tenure and Administration in Papua New Guinea*. Unpublished PhD thesis, Australian National University.
- Hedges, R. E. M. 2002. Bone diagenesis: an overview of processes. *Archaeometry* 44: 319–328.

- Hemer, M. A., Harris, P. T., Coleman, R. and Hunter, J. 2004. Sediment mobility due to currents and waves in the Torres Strait – Gulf of Papua region. *Continental Shelf Research* 24: 2297–2316.
- Henty, E. E. 1982. Grasslands and grassland succession in New Guinea. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 459–474. The Hague, Dr W. Junk Publishers.
- Heyligers, P. C. 1965. Vegetation and ecology of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea*: 146–173. Commonwealth Scientific and Industrial Research Organisation, Land Research Series No. 14. Melbourne, CSIRO.
- Heyligers, P. C. 1966. Observations on *Themeda australis*-Eucalypt savannah in Papua. *Pacific Science* 20: 477–489.
- Heyligers, P. C. 1972. Analysis of the plant geography of the semideciduous scrub and forest and the eucalypt savannah near Port Moresby. *Pacific Science* 26: 229–241.
- Hicks, A. 1973. An account of the origins of Porebada Village. *Oral History* 4: 3–8.
- Hide, R. 2003. *Pig Husbandry in New Guinea. A Literature Review and Bibliography*. ACIAR Monograph No. 108. Canberra, Australian Centre for International Agricultural Research.
- Hinton, A. 1972. *Shells of New Guinea and the Central Pacific Indo-Pacific*. Port Moresby, Robert Brown and Associates and Jacaranda Press.
- Hiscock, P. 1985. The need for a taphonomic perspective in stone artefact analysis. *Queensland Archaeological Research* 2: 82–97.
- Hiscock, P. 1988. *Prehistoric Settlement Patterns and Artefact Manufacture at Lawn Hill, Northwest Queensland*. Unpublished PhD thesis, University of Queensland.
- Hiscock, P. 1990. A study in scarlet: taphonomy and inorganic artefacts. In S. Solomon, I. Davidson and D. Watson (eds), *Problem Solving in Taphonomy*: 34–49. Tempus Archaeology and Material Culture Studies in Anthropology, Vol. 2. St. Lucia, Anthropology Museum, University of Queensland.
- Hiscock, P. 2002. Quantifying the size of artefact assemblages. *Journal of Archaeological Science* 29: 251–258.
- Hitchcock, G. 1998. First record of the False Water-Rat, *Xeromys myoides* (Rodentia: Muridae), in New Guinea. *Science in New Guinea* 23: 141–144.
- Hoare, R. 2005. Climate data for 9°S 147°E: Port Moresby, Papua New Guinea. <http://www.worldclimates.com/city-climate-port-moresby-papua-new-guinea-ocania/> (17 August 2014).
- Hogg, A. G., Higham, T. F. G. and Dahm, J. 1998. <sup>14</sup>C dating of modern marine and estuarine shellfish. *Radiocarbon* 40: 975–84.
- Holy, L. 1996. *Anthropological Perspectives on Kinship*. London, Pluto.
- Honda, K., Nakamura, Y., Nakaoka, M., Uy, W. H. and Fortes, M. D. 2013. Habitat use by fishes in coral reefs, seagrass beds and mangrove habitats in the Philippines. *PLoS ONE* 8(8): e65735. doi:10.1371/journal.pone.0065735.
- Hope, G. 2007. Palaeoecology and palaeoenvironments of Papua. In A. J. Marshall and B. M. Beehler (eds), *The Ecology of Papua*: 255–266. Singapore, Periplus Editions.
- Hope, G. and Aplin, K. 2005. Environmental change in the Aru Islands. In S. O'Connor, M. Spriggs and P. Veth (eds), *The Archaeology of the Aru Islands, Eastern Indonesia*: 25–40. Terra Australis 22. Canberra, ANU E Press.
- Hope, G., Kershaw, A. P., van der Kaars, S., Xiangjun, S., Liew, P.-M., Heusser, L. E., Takahara, H., McGlone, M., Miyoshi, N. and Moss, P. T. 2004. History of vegetation and habitat change in the Austral-Asian region. *Quaternary International* 118–119: 103–126.
- Horie, V. 2010. *Materials for Conservation: Organic Consolidants, Adhesives and Coatings*, 2nd Edition. Oxford, Butterworth-Heinemann.
- Houbrick, R. S. 1987. Anatomy, reproductive biology, and phylogeny of the Planaxidae (Cerithiacea: Prosobranchia). *Smithsonian Contributions to Zoology* 445: 1–68.
- Huber, M. E. 1994. An assessment of the status of the coral reefs of Papua New Guinea. *Marine Pollution Bulletin* 29: 69–73.
- Hudson, B. T. 1977. *Dugong: Distribution, Hunting, Protective Legislation and Cultural Significance in Papua New Guinea*. Wildlife in Papua New Guinea, No. 77/16. Port Moresby, Wildlife Division, Dept. of Lands and Environment.
- Hydrobiology, 2008. Aquatic fauna impact assessment. Report prepared by Hydrobiology Pty Ltd for the PNG LNG Project. Appendix 13 in CNS 2009, PNG LNG Project. Environmental Impact Statement. [http://www.pnglng.com/downloads/eis\\_appendix13.pdf](http://www.pnglng.com/downloads/eis_appendix13.pdf) (27 January 2015).
- Irwin, G. R. 1978. Pots and entrepots: a study of settlement, trade and the development of economic specialization in Papuan prehistory. *World Archaeology* 9: 299–319.
- Irwin, G. R. 1985. *The Emergence of Mailu as a Central Place in Coastal Papuan Prehistory*. Department of Prehistory, Research School of Pacific Studies, Terra Australis 10. Canberra, Australian National University.
- Irwin, G. R. 1991. Themes in the prehistory of coastal Papua and the Massim. In A. Pawley (ed.), *Man and a Half: Essays in Pacific Anthropology and Ethnobiology in Honour of Ralph Bulmer*: 503–511. Auckland, Polynesian Society.
- Johns, R. J. 1982. Plant zonation. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 309–330. The Hague, Dr W. Junk Publishers.

- Johnstone, I. M. 1982. Ecology and distribution of the seagrasses. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 497–512. The Hague, Dr W. Junk Publishers.
- Johnstone, I. M. and Frodin, D. G. 1982. Mangroves of Papuan subregion. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 513–528. The Hague, Dr W. Junk Publishers.
- Jones, D. S. and Morgan, G. J. 1994. *A Field Guide to Crustaceans of Australian Waters*. Chatswood, Reed Books.
- Jones, D. N., Dekker, R. W. R. J. and Roselaar, C. S. 1995. *The Megapodes: Megapodiidae*. Oxford, Oxford University Press.
- Kaars, S. v. d., Wang, X., Kershaw, P., Guichard, F. and Setiabudi, D. A. 2000. A late Quaternary palaeoecological record from the Banda Sea, Indonesia: patterns of vegetation, climate and biomass burning in Indonesia and northern Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology* 155: 135–153.
- Kauga, R. (ed.) 2008. A Brief History of Caution Bay. Report given by local community representatives to Bruno David.
- Keesing, R. 1975. *Kin Groups and Social Structure*. New York, Holt, Rinehart and Winston.
- Keith, M. L., Anderson, G. M. and Eichler, R. 1964. Carbon and oxygen isotopic composition of mollusk shells from marine and fresh-water environments. *Geochimica et Cosmochimica Acta* 28: 1757–86.
- Kidu, C. and Homoka, S. 2001. Towards a Sustainable Development for Motu Koita Landowners in the National Capital District of Papua New Guinea. Paper presented at Indigenous Rights in the Commonwealth South Pacific Regional Expert Meeting, Nadi, Fiji, 15–16 October 2001.
- King, C. E. and Nijboer, J. 1994. Conservation considerations for crowned pigeons, genus *Goura*. *Oryx* 28: 22–30.
- King, J. 1909. *W. G. Lawes of Savage Island and New Guinea*. London: Religious Tract Society.
- Kira, T. 1965. *Shells of the Western Pacific in Color*. Volume 1. Revised Edition. Osaka, Hoikusha Publishing Company.
- Kirk, R. L. 1992. Population origins in Papua New Guinea – a human biological overview. In R. D. Attenborough and M. P. Alpers (eds), *Human Biology in Papua New Guinea: The Small Cosmos*: 172–197. Oxford, Clarendon Press.
- Koler-Matznick, J., Yates, B. C., Bulmer, S. and Brisbin, I. L., Jr 2007. The New Guinea singing dog: its status and scientific importance. *Australian Mammalogy* 29: 47–56.
- Koob, S. 2009. Paraloid B-72: 5 years of use as a consolidant and adhesive for ceramics and glass. In J. Ambers, C. Higgitt, L. Harrison and D. Saunders (eds),  *Holding it All Together Ancient and Modern Approaches to Joining, Repairs and Consolidation*: 113–119. London, Archetype Publications.
- Koon, H. E. C., Nicholson, R. A. and Collins, M. J. 2003. A practical approach to the identification of low temperature heated bone using TEM. *Journal of Archaeological Science* 30: 1393–1399.
- Lampert, R. J. 1968. Some archaeological sites of the Motu and Koiari areas. *The Journal of the Papua and New Guinea Society* 2: 73–78.
- Lamprell, K. and Healy, J. 1998. *Bivalves of Australia*. Volume 2. Leiden, Backhuys Publications.
- Lamprell, K. and Whitehead, T. 1992. *Bivalves of Australia*. Volume 1. Bathurst, Crawford House Press.
- Larson, G., Cucchi, T., Fujita, M., Matisoo-Smith, E., Robins, J., Anderson, A., Rolett, B., Spriggs, M., Dolman, G., Kim, T.-H., Thuy, N. T. D., Randi, E., Doherty, M., Due, R. A., Bollt, R., Djubiantono, T., Griffin, B., Intoh, M., Keane, E., Kirch, P., Li, K.-T., Morwood, M., Pedriña, L. M., Piper, P. J., Rabett, R. J., Shooter, P., Van den Bergh, G., West, E., Wickler, S., Yuan, J., Cooper, A. and Dobney, K. 2007. Phylogeny and ancient DNA of *Sus* provides insights into neolithic expansion in Island Southeast Asia and Oceania. *Proceedings of the National Academy of Sciences* 104: 4834–4839.
- Lawes, W. 1879. Ethnological notes on the Motu, Koitapu and Koiari tribes of New Guinea. *Journal of the Anthropological Institute of Great Britain and Ireland*, 8: 369–377.
- Leach, F., Davidson, J., Claridge, G., Ward, G. and Craib, J. 2008. The physical and mineralogical characteristics of pottery from Mochong, Rota, Mariana Islands. In G. Clarke, F. Leach and S. O'Connor (eds), *Islands of Enquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*: 435–452. Terra Australis 29. Canberra, ANU E Press.
- Leask, M. F. 1943. A kitchen midden in Papua. *Oceania* 13: 235–242.
- Lees, B. G. 1992. Geomorphological evidence for late Holocene climatic change in northern Australia. *Australian Geographer* 23: 1–10.
- Lennox, C. 1903. James Chalmers of New Guinea: Missionary, Pioneer, Martyr. Chapter 14 – Work and Adventures in the Gulf: 1883. [http://www.electricscotland.com/History/other/james\\_chalmers\\_14.htm](http://www.electricscotland.com/History/other/james_chalmers_14.htm) (25 June 2014).
- Lévi-Strauss, C. 1969. *The Elementary Structures of Kinship*. Boston, Beacon Press.
- Lewis, D. 1994. *We, the Navigators: The Ancient Art of Landfinding in the Pacific*. Honolulu, University of Hawai'i Press.
- Lewis, S. E., Sloss, C. R., Murray-Wallace, C. V., Woodroffe, C. D. and Smithers, S. G. 2013. Post-glacial sea-level changes around the Australian margin: a review. *Quaternary Science Reviews*, 74: 115–138.

- Liem, D. S. and Haines, A. K. 1977. *The Ecological Significance and Economic Importance of the Mangrove and Estuarine Communities of the Gulf Province, Papua New Guinea*. Purari River (Wabo) Hydroelectric Scheme Environmental Studies, Vol. 3. Waigani, Papua New Guinea, Office of Environment and Conservation.
- Lindt, J. W. 1887. *Picturesque New Guinea*. London, Longmans, Green and Co.
- Lister-Turner, R. and J. B. Clark. 1931. *A Dictionary of the Motu Language of Papua*. 2nd edition, ed. P. Chatterton. Sydney, A. H. Pettifer, Government Printer.
- Löffler, E. 1977. *Geomorphology of Papua New Guinea*. Canberra, Commonwealth Scientific and Industrial Research Organisation and Australian National University Press.
- Löffler, E. 1982. Landforms and landform development. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea: 57–76*. The Hague, Dr W. Junk Publishers.
- Loo, I. 2007. ‘Wow, you must be really good at jigsaws’: the Lapita pot reconstruction, Australian Museum, Jan-Feb 2007, *Sc@mogram*, Easter Edition, SC@M, Melbourne University.
- Mabbutt, J. A. 1965. Geomorphology of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea: 106–128*. Commonwealth Scientific and Industrial Research Organization, Land Research Series, 14. Melbourne, CSIRO.
- Mabbutt, J. A., Heyligers, P. C., Pullen, R., Scott, R. M. and Speight, J. G. 1965. Land systems of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea: 20–82*. Commonwealth Scientific and Industrial Research Organization, Land Research Series, 14. Melbourne, CSIRO.
- Macgillivray, J. 1852. *Narrative of the Voyage of the H.M.S. Rattlesnake*. London, T. and W. Boone.
- MacGregor, W. 1890. *British New Guinea. Annual Report by Her Majesty's Administrator of the Government, from 1st July 1889 to 30th June 1890; With Appendices and Maps*. Brisbane, James C. Beal, Government Printer.
- Macintyre, M. and Allen, J. 1990. Trading for subsistence: the case from the southern Massim. In D. E. Yen and J. M. J. Mummery (eds), *Pacific Production Systems: Approaches to Economic History: 120–136*. Occasional Papers in Prehistory 18, Department of Prehistory, Research School of Pacific Studies. Canberra, Australian National University.
- Mack, A. L. 1995. Distance and non-randomness of seed dispersal by the Dwarf Cassowary *Casuarius bennetti*. *Ecography* 18: 286–295.
- Mack, A. L. and Wright, D. D. 2005. The frugivore community and the fruiting plant flora in a New Guinea rainforest: identifying keystone frugivores. In L. J. Dew and J. P. Boubli (eds), *Tropical Fruits and Frugivores: The Search for Strong Interactors: 18–203*. The Netherlands, Springer.
- Mackay, R. D. 1970. *The Birds of Port Moresby and District*. Melbourne, Thomas Nelson (Australia) Limited.
- Malaquias, M. A. and Reid, D. G. 2008. Systematic revision of the living species of *Bullida* (Mollusca: Gastropoda: Cephalaspidea), with a molecular phylogenetic analysis. *Zoological Journal of the Linnean Society* 153: 453–543.
- Malinowski, B. n.d. Fieldnotes. Photocopy in Nigel Oram Papers 1963–69, Box 5, Folder 32, National Library of Australia, Canberra.
- Mason, R. D., Peterson, M. L. and Tiffany, J. A. 1998. Weighing vs counting: measurement reliability and the California school of midden analysis. *American Antiquity* 63: 303–324.
- May, R. 2001. *State and Society in Papua New Guinea: The First Twenty-Five Years*. Adelaide, Crawford House Publishing.
- McAlpine, J. R., Keig, G. and Falls, R. 1983. *Climate of Papua New Guinea*. Canberra, Commonwealth Scientific and Industrial Research Organisation and Australian National University Press.
- McCoy, P. C. 1982. Manufacturing technology. In P. V. Kirch and D. E. Yen (eds), *Tikopia: The Prehistory and Ecology of a Polynesian Outlier: 261–269*. B. P. Bishop Museum Bulletin, No. 238. Honolulu, Bishop Museum Press.
- McKenzie, N., Jacquier, D., Isbell, R. and Brown, K. 2004. *Australian Soils and Landscapes*. Melbourne, Commonwealth Scientific and Industrial Research Organisation Publishing.
- McNiven, I. J. 1992. Bone Cave, Stone Artefact Initial Attribute Analysis. Report produced for the Southern Forests Archaeological Project, La Trobe University, Bundoora, Australia.
- McNiven, I. J., David, B., Aplin, K., Mialanes, J., Asmussen, B., Ulm, S., Faulkner, P., Rowe, C. and Richards, T. 2012a. Terrestrial engagements by terminal Lapita maritime specialists on the southern Papuan coast. In S. G. Haberle and B. David (eds), *Peopled Landscapes: Archaeological and Biogeographic Approaches to Landscapes: 121–156*. Terra Australis 34. Canberra, ANU E Press.
- McNiven, I. J., David, B., Brady, L. and Brayer, J. 2004. Kabadul Kula rock-art site, Dauan Island, Torres Strait. In I. J. McNiven and M. Quinnell (eds), *Torres Strait: Archaeology and Material Culture: 227–255*. Memoirs of the Queensland Museum, Cultural Heritage Series, No. 3, Pt. 1. South Brisbane, Queensland Museum.
- McNiven, I. J., David, B., Richards, T., Aplin, K., Asmussen, B., Mialanes, J., Leavesley, M., Faulkner, P. and Ulm, S. 2011. New direction in human colonisation of the Pacific: Lapita settlement of south coast New Guinea. *Australian Archaeology* 72: 1–6.

- McNiven, I. J., David, B., Richards, T., Rowe, C., Leavesley, M., Mialanes, J., Connaughton, S. P., Barker, B., Aplin, K., Asmussen, B., Faulkner, P. and Ulm, S. 2012b. Lapita on the south coast of Papua New Guinea: challenging new horizons in Pacific archaeology. *Australian Archaeology* 75: 16–22.
- McNiven, I. J., Dickinson, W. R., David, B., Weisler, M., von Gnielinski, F., Carter, M. and Zoppi, U. 2006. Mask Cave: red-slipped pottery and the Australian-Papuan settlement of Zenadh Kes (Torres Strait). *Archaeology in Oceania* 41: 49–81.
- Menzies, J. I. 2006. *The Frogs of New Guinea and the Solomon Islands*. Sofia, Bulgaria, Pensoft Publishers.
- Mercieca, A. 2000. Burnt and broken: an experimental study of heat fracturing in silcrete. *Australian Archaeology* 51: 40–47.
- Moffat, I., David, B., Barker, B., Kuaso, A., Skelly, R. and Araho, N. 2011. Magnetometer surveys in archaeological research in Papua New Guinea: Keveoki 1, Gulf Province. *Archaeology in Oceania* 46: 17–22.
- Mohr, E. C. J., van Baren, F. A. and van Schuylenborgh, J. 1972. *Tropical Soils. A Comprehensive Study of their Genesis*. The Hague, Mouton Publishing.
- Moi, K. 1979. The first Hiri trade expedition from the Central Province. *Oral History* 7: 41–81.
- Moi, O. 1979. Boera association: impact of the association of the social, political and economic activities of the village people. *Yagl-Ambu* 6: 19–30.
- Mowat, F. 1995. *Variability in Western Arnhem Land Shell Midden Deposits*. Unpublished MA thesis, Northern Territory University.
- Muckle, R. J. 1985. *Archaeological Considerations of Bivalve Shell Taphonomy*. Unpublished MA thesis, Simon Fraser University.
- Munro, I. S. R. 1967. *The Fishes of New Guinea*. Port Moresby, Department of Agriculture, Stock and Fisheries.
- Munsell Color. 2011. *Geological Rock-Color Chart*, 2009 Revised Edition. Rock-Color Chart Committee. Grand Rapids, Geological Society of America.
- Murray, H. 1925. *Papua of Today*. London, P. S. King and Son.
- National Capital District Commission [NCDC]. 1992. National Capital District Commission (Motu-Koitabu Village Development Committees) Regulation 1992. Port Moresby, National Capital District Commission.
- Niles, D. 2000. Polynesian hymns in Papua: the synthesis of a Christian educational tool and local creative expression. *Journal of International Development and Cooperation* 6: 145–158.
- Nix, H. A. and Kalma, J. D. 1972. Climate as a dominant control in the biogeography of northern Australia and New Guinea. In D. Walker (ed.), *Bridge and Barrier: The Natural and Cultural History of Torres Strait*: 63–92. Canberra, Research School of Pacific Studies, Department of Biogeography and Geomorphology, Australian National University.
- O'Connor, S., Barham, A., Aplin, K., Dobney, K., Fairbairn, A. and Richards, M. 2011. The power of paradigms: examining the evidential basis for early to mid-Holocene pigs and pottery in Melanesia. *Journal of Pacific Archaeology* 2: 1–25.
- Odegaard, N., Carroll, S. and Zimmit, W. S. 2005. *Material Characterization Tests for Objects of Art & Archaeology*, 2nd Edition. London, Archetype Publications Ltd.
- O'Malley, J. T. 1912. Native affairs. In *Papua Annual Report, Year Ending 30 June 1912*: 98–105. Canberra, Government Printer.
- O'Malley, J. T. and Stanley, E. R. 1918. *Map of the Central Division, Papua – 1916*. Sydney, H. E. C. Robinson Ltd.
- Oram, N. D. 1968. Culture change, economic development and migration among the Hula. *Oceania* 38: 243–275.
- Oram, N. D. 1969. Taurama: oral sources for a study of recent Motuan prehistory. In K. S. Inglis (ed.), *The History of Melanesia*: 423–441. Research School of Pacific Studies, Australian National University, Canberra with University of Papua New Guinea, Port Moresby. Reprinted from *Journal of the Papua and New Guinea Society* 2: 79–91 (1968).
- Oram, N. D. 1970. Land and race in Port Moresby. *Journal of the Papua and New Guinea Society* 4: 5–28.
- Oram, N. D. 1971. The London Missionary Society pastorate and the emergence of an educated elite in Papua. *Journal of Pacific History* 6: 115–132.
- Oram, N. D. 1975. Environmental Factors Determining Migration and Site Selection. Paper delivered to the 1975 Waigani Seminar, Port Moresby, Papua New Guinea.
- Oram, N. D. 1976. *Colonial Town to Melanesian City*. Canberra, Australian National University Press.
- Oram, N. D. 1977. Environment, migration and site selection in the Port Moresby coastal area. In J. H. Winslow (ed.), *The Melanesian Environment*: 74–99. Canberra, ANU Press.
- Oram, N. D. 1981. The history of the Motu-speaking and Koitabu-speaking peoples according to their own traditions. In D. Denoon and R. Lacey (eds), *Oral Tradition in Melanesia*: 207–229. Port Moresby, University of Papua New Guinea and Institute of Papua New Guinea Studies.
- Oram, N. D. 1982. Pots for sago: the Hiri trading network. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 1–33. Pacific Research Monograph 8, Research School of Pacific Studies, Australian National University. Canberra, Australian National University.
- Oram, N. D. 1991. Edai Siabo: an ethnographic study of a Papuan myth. In A. Pawley (ed.), *Man and a Half*: 520–35. Auckland, Journal of the Polynesian Society.

- Oram, N. D. n.d.a. Towards a Study of the London Missionary Society in Hula 1875-1968. Mimeo, University of Papua New Guinea, Port Moresby, Papua New Guinea.
- Oram, N. D. n.d.b. Nigel Oram Collection, MS9436, Australian National Library, Canberra.
- Orrell, J. 1977. Kila Kila village, Port Moresby sub-Province, Central Province. *Oral History* 5: 14–30.
- Osborne, P. L., Humphreys, G. S. and Polunin, N. V. C. 1993. Sediment deposition and late Holocene environmental change in a tropical lowland basin: Waigani Lake, Papua New Guinea. *Journal of Biogeography* 20: 599–613.
- O’Shea, M. 1996. *A Guide to the Snakes of Papua New Guinea*. Port Moresby, Independent Publishing.
- Paijmans, K. 1976. *New Guinea Vegetation*. Canberra, Commonwealth Scientific and Industrial Research Organisation and Australian National University Press.
- Pain, C. and Swadling, P. 1980. Sea level changes, coastal landforms and human occupation near Port Moresby. *Science in New Guinea* 7: 57–68.
- Papua New Guinea Church Partnership Program [PNGCPP]. 2006. Annual Program Report July 2005-June 2006, Port Moresby.
- Papua New Guinea Church Partnership Program [PNGCPP]. 2007a. 4th Annual Program Strategy July 2007-June 2008. Port Moresby.
- Papua New Guinea Church Partnership Program [PNGCPP]. 2007b. *Garamut* [Newsletter], 5.
- Papua New Guinea Church Partnership Program [PNGCPP]. 2008. *Garamut* [Newsletter], 6.
- Papua New Guinea Consolidated Legislation [PNGCL]. 1992. National Capital District Commission (Motu-Koitabu Village Development Committees) Regulation 1992, Port Moresby.
- Papua New Guinea Law Reports [PNGLR]. 1973. High Court of Australia: The Administration of the Territory of Papua New Guinea v. Guba and Doriga. *Papuan Villager*. 1931. Sorcery. Volume 3: 81–82.
- Pavlidis, C. and Kennedy, J. 2007. Pre-Lapita horizons in the Admiralty Islands: flaked stone technology from GAC and GFJ. In J. Specht and V. Attenbrow (eds), *Archaeological Studies of the Middle and Late Holocene, Papua New Guinea*: 197–215. Technical Reports of the Australian Museum, No. 20. Sydney, Australian Museum.
- Pawley, A. 2005. The chequered career of the trans New Guinea hypothesis: recent research and its implications. In A. Pawley, R. Attenborough, R. Hide and J. Golson (eds), *Papuan Pasts: Cultural, Linguistic and Biological Histories of Papuan-Speaking Peoples*: 67–107. Australian National University, Pacific Linguistics, 572. Canberra, Australian National University.
- Peel, M. C., Finlayson, B. L. and McMahon, T. A. 2007. Updated world map of the Köppen-Geiger climate classification. *Hydrological Earth Systems Sciences Discussions* 4: 439–473.
- Pernetta, J. C. and Hill, L. 1981. A review of marine resource use in coastal Papua. *Journal de la Société des Océanistes* 37: 175–191.
- Perry, C. T. and Smithers, S. G. 2011. Cycles of coral reef ‘turn-on’, rapid growth and ‘turn-off’ over the past 8500 years: a context for understanding modern ecological states and trajectories. *Global Change Biology* 17: 76–86.
- Petchev, F., Anderson, A., Zondervan, A., Ulm, S. and Hogg, A. 2008. New marine  $\Delta R$  values for the South Pacific Subtropical Gyre region. *Radiocarbon* 50: 373–397.
- Petchev, F., Ulm, S., David, B., McNiven, I. J., Asmussen, B., Tomkins, H., Dolby, N., Aplin, K., Richards, T., Rowe, C., Leavesley, M. and Mandui, H. 2013. High-resolution radiocarbon dating of marine materials in archaeological contexts: radiocarbon marine reservoir variability between *Anadara*, *Gafrarium*, *Batissa*, *Polymesoda* spp. and *Echinoidea* at Caution Bay, southern coastal Papua New Guinea. *Archaeological and Anthropological Sciences* 5: 69–80.
- Petchev, F., Ulm, S., David, B., McNiven, I. J., Asmussen, B., Tomkins, H., Richards, T., Rowe, C., Leavesley, M., Mandui, H. and Stanisic, J. 2012. Radiocarbon marine reservoir variability in herbivores and deposit-feeding gastropods from an open coastline, Papua New Guinea. *Radiocarbon* 54: 967–978.
- Pieters, P. E. 1982. Geology of New Guinea. In J. L. Gressitt (ed.), *Biogeography and Ecology of New Guinea*: 15–38. The Hague, Dr W. Junk Publishers.
- Poiner, I. R. and Catterall, C. P. 1988. The effects of traditional gathering on populations of the marine gastropod *Strombus luhuanus* Linne 1758, in southern Papua New Guinea. *Oecologia* 76: 191–199.
- Poutiers, J. M. 1998a. Bivalves. In K. E. Carpenter and V. H. Niem (eds), *The Living Marine Resources of the Western Central Pacific. Volume 1: Seaweeds, Corals, Bivalves and Gastropods*: 123–361. FAO Species Identification Guide for Fishery Purposes. Rome, Food and Agriculture Organization of the United Nations.
- Poutiers, J. M. 1998b. Gastropods. In K. E. Carpenter and V. H. Niem (eds), *The Living Marine Resources of the Western Central Pacific. Volume 1: Seaweeds, Corals, Bivalves and Gastropods*: 363–648. FAO Species Identification Guide for Fishery Purposes. Rome, Food and Agriculture Organization of the United Nations.
- Prebble, M., Kennedy, J. and Southern, W. 2010. Holocene lowland vegetation change and human ecology in Manus Province, Papua New Guinea. In S. Haberle, J. Stevenson and M. Prebble (eds), *Altered Ecologies: Fire, Climate and Human Influence on Terrestrial Landscapes*: 299–321. Terra Australis 32. Canberra, ANU E Press.

- Prentice, M. L. and Hope, G. S. 2006. Climate of Papua. In A. J. Marshall and B. M. Beehler (eds), *The Ecology of Papua, Part One: 177–195*. The Ecology of Indonesia Series, Volume VI. Hong Kong, Periplus Editions.
- Pretty, G. L. 1967. Report on an Inspection of Certain Archaeological Sites and Field Monuments in the Territory of Papua New Guinea. Report to the Papua and New Guinea Public Museum and Art Gallery.
- Price, A. V. G. 1975. *Traditional Motu Customs*. Port Moresby, Institute of Papua New Guinea Studies.
- Purdy, B. A. and Brooks, H. K. 1971. Thermal alteration of silica minerals: an archaeological approach. *Science* 173: 322–325.
- Pye, E. 2001. *Caring For the Past. Issues in Conservation For Archaeology and Museums*. London, James and James (Science Publications) Ltd.
- Raga, M. N. 2006. *Reef and Mangrove Survey Reports, Barakau Village, Central Province, PNG*. IWP-Pacific Technical Report (International Waters Project), no. 24. Apia, Samoa, Secretariat of the Pacific Regional Environment Programme.
- Rakatani, H. (ed.) 2008. The History of Namura Tribe. Report given to Bruno David by Namura members.
- Reepmeyer, C., Spriggs, M., Bedford, S. and Ambrose, W. 2011. Provenance and technology of lithic artifacts from the Teouma Lapita site, Vanuatu. *Asian Perspectives* 49: 205–225.
- Reeves, J. M., Barrows, T. T., Cohen, T. J., Kiem, A. S., Bostock, H. C., Fitzsimmons, K. F., Jansen, J. D., Kemp, J., Krause, C., Petherick, L., Phipps, S. J. and OZ-INTIMATE Members 2013a. Climate variability over the last 35,000 years recorded in marine and terrestrial archives in the Australian region: an OZ-INTIMATE compilation. *Quaternary Science Reviews* 74: 21–34.
- Reeves, J. M., Bostock, H. C., Ayliffe, L. K., Barrow, T., De Deckker, P., Devriendt, L. S., Dunbar, G. B., Drysdale, R., Fitzsimmons, K. E., Gagan, M. K., Griffiths, M. L., Haberle, S. G., Jansen, J. D., Krause, C., Lewis, S., McGregor, H. V., Mooney, S. D., Moss, P., Nanson, G. C., Purcell, A. and van der Kaars, S. 2013b. Palaeoenvironmental change in tropical Australasia over the last 30,000 years – a synthesis by the OZ-INTIMATE group. *Quaternary Science Reviews* 74: 97–114.
- Reimer, P. J., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Bronk Ramsey, C., Buck, C. E., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hafflidason, H., Hajdas, I., Hatté, C., Heaton, T. J., Hoffmann, D. L., Hogg, A. G., Hughen, K. A., Kaiser, K. F., Kromer, B., Manning, S. W., Niu, M., Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Staff, R. A., Turney, C. S. M., and van der Plicht, J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves, 0–50,000 years cal BP. *Radiocarbon* 55: 1869–1887.
- Reitz, E. J. and Wing, E. S. 2008. *Zooarchaeology*. Cambridge, Cambridge University Press.
- Rhoads, J. W. 1980. *Through a Glass Darkly*. Unpublished PhD thesis, Australian National University.
- Rhoads, J. W. 1982. Prehistoric Papuan exchange systems: the Hiri and its antecedents. In T. E. Dutton (ed.), *The Hiri in History: Further Aspects of Long Distance Motu Trade in Central Papua*: 131–151. Australian National University, Research School of Pacific Studies, Pacific Research Monograph, No. 8. Canberra, Australian National University.
- Rhoads, J. W. 1994. The Popo site. In D. Frankel and J. W. Rhoads (eds), *Archaeology of a Coastal Exchange System: Sites and Ceramics of the Papuan Gulf*: 53–69. Division of Archaeology and Natural History, Research School of Pacific and Asian Studies, Australian National University, Research Papers in Archaeology and Natural History, No. 25. Canberra, Australian National University.
- Rhoads, J. and Mackenzie, D. 1991. Stone axe trade in prehistoric Papua: the travels of Python. *Proceedings of the Prehistoric Society* 57: 35–49.
- Rodman, M. 1987. *Masters of Tradition: Consequences of Customary Land Tenure in Longana, Vanuatu*. Vancouver, University of British Columbia Press.
- Romilly, H. 1889. *From My Verandah in New Guinea: Sketches and Traditions*. London, David Nutt.
- Rosenstiel, A. 1953. *The Motu of Papua New Guinea: A Study of Successful Acculturation*. Unpublished PhD thesis, Columbia University.
- Ross, M. D. 1994. Central Papuan culture history: some lexical evidence. In A. K. Pawley and M. D. Ross (eds), *Austronesian Terminologies: Continuity and Change*: 389–479. Australian National University, Pacific Linguistics, Series C, No. 127. Canberra, Australian National University.
- Ross, M. D. 1996. Contact-induced change and the comparative method: case studies from Papua New Guinea. In M. Durie and M. Ross (eds), *The Comparative Method Reviewed: Regularity and Irregularity in Language Change*: 180–217. New York, Oxford University Press.
- Rowe, C. 2007. A palynological investigation of Holocene vegetation change in Torres Strait, seasonal tropics of northern Australia. *Palaeogeography, Palaeoclimatology and Palaeoecology* 251: 83–103.
- Rowe, C. 2015. Late Holocene swamp transition in the Torres Strait, northern tropical Australia. *Quaternary International* 385: 56–68.
- Rowe, C., McNiven, I. J., David, B., Richards, T. and Leavesley, M. 2013. Holocene pollen records from Caution Bay, southern mainland Papua New Guinea. *The Holocene* 23: 1130–1142.
- Rowland, M. J. 1982. Shell middens: weights or numbers? A problem not so easily resolved. *New Zealand Archaeological Association Newsletter* 25: 113–119.

- Rowland, M. J. 1994. Size isn't everything: shells in mounds, middens and natural deposits. *Australian Archaeology* 39: 118–124.
- Rumsey, A. and Niles, D. (eds) 2011. *Sung Tales from the Papua New Guinea Highlands: Studies in Form, Meaning, and Sociocultural Context*. Canberra, ANU E Press.
- Schaffelke, B. and Klumpp, D. W. 1998. Short-term nutrient pulses enhance growth and photosynthesis of the coral reef Macroalgae *Sargassum baccularia*. *Marine Ecology Progress Series* 170: 95–105.
- Schaffelke, B., McCook, L., Klumpp, D. and McKinnon, D. 1996. Seagrasses and seaweeds (Macroalgae) of Exmouth Gulf: their distribution and importance in primary production. AIMS Western Australian Research Activities, 1994–1996. Australian Institute of Marine Science. <http://www.aims.gov.au/pages/research/wa-research/pages/wa9496-13.htm> (15 January 2015).
- Scott, R. M. 1965. Soils of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea*: 129–145. Commonwealth Scientific and Industrial Research Organisation, Land Research Series, No. 14. Melbourne, CSIRO.
- Seligmann, C. G. 1910. *The Melanesians of British New Guinea*. Cambridge, Cambridge University Press.
- Seneca, M. 1976. Pottery in Boera village. *Oral History* 4: 4–8.
- Sheppard, P. J. 1993. Lapita lithics: trade/exchange and technology. A view from the Reefs/Santa Cruz. *Archaeology in Oceania* 28: 121–137.
- Shipman, P., Foster, G. and Schoeninger, M. 1984. Burnt bones and teeth: an experimental study of color, morphology, crystal structure and shrinkage. *Journal of Archaeological Science* 11: 307–325.
- Short, J. W. and Potter, D. G. 1987. *Shells of Queensland and the Great Barrier Reef: Marine Gastropods*. Drummoyne, Golden Press.
- Shulmeister, J. and Lees, B. G. 1995. Pollen evidence from tropical Australia for the onset of an ENSO-dominated climate at c.4000 yr BP. *The Holocene* 5: 10–18.
- Sinclair, R. 1982. Samoans in Papua. In R. Crocombe and M. Crocombe (eds), *Polynesian Missions in Melanesia*: 17–38. Suva, University of the South Pacific.
- Skelly, R. 2014. *From Lapita to the Hiri: Archaeology of the Kouri Lowlands, Gulf of Papua, Papua New Guinea*. Unpublished PhD thesis, Monash University.
- Skelly, R. and David, B. in press. Hiri: *Archaeology of Long-Distance Maritime Trade Along the South Coast of Papua New Guinea*. Honolulu, University of Hawaii Press.
- Skelly, R., David, B., Barker, B., Kuaso, A. and Araho, N. 2010. Migration sites of the Miaro clan (Vailala River Region, Papua New Guinea): tracking Kouri settlement movements through oral tradition sites on ancient landscapes. *The Artefact* 33: 16–29.
- Skelly, R., David, B., Petchey, F. and Leavesley, M. 2014. Tracking ancient beach-lines inland: 2600 year old dentate-stamped ceramics at Hopo, Vailala River region, Papua New Guinea. *Antiquity* 88: 470–487.
- Specht, J. 2007. Small islands in the big picture: the formative period of Lapita in the Bismarck Archipelago. In S. Bedford, C. Sand and S. P. Connaughton (eds), *Oceanic Explorations: Lapita and Western Pacific Settlement*: 51–70. Terra Australis 26. Canberra, ANU E Press.
- Specht, J. 2009. The aceramic to ceramic boundary in the Bismarck Archipelago. In P. J. Sheppard, T. Thomas and G. R. Summerhayes (eds), *Lapita: Ancestors and Descendants*: 11–34. New Zealand Archaeological Association, Monograph 28. Auckland, New Zealand Archaeological Association.
- Specht, R. L. 1981. The use of foliage projective cover. In A. N. Gillison and D. J. Anderson (eds), *Vegetation Classification in Australia*: 10–21. Canberra, Commonwealth Scientific and Industrial Research Organisation and Australian National University Press.
- Specht, R. L. 1983. Foliage projective covers of overstorey and understorey strata of mature vegetation in Australia. *Australian Journal of Ecology* 8: 433–439.
- Speight, J. G. 1965. Geology of the Port Moresby-Kairuku area. In *Lands of the Port Moresby-Kairuku Area, Territory of Papua and New Guinea*: 98–105. Commonwealth Scientific and Industrial Research Organisation, Land Research Series, No. 14. Melbourne, CSIRO.
- Spriggs, M. 2003. Chronology of the Neolithic transition in Island Southeast Asia and the western Pacific: A View from 2003. *Review of Archaeology* 24: 57–80.
- Spriggs, M. and Anderson, A. 1993. Late colonization of east Polynesia. *Antiquity* 67: 200–217.
- Springsteen, F. J. and Leobrera, F. M. 1986. *Shells of the Philippines*. Malate, Carfel Seashell Museum.
- Standish, W. 1999. Papua New Guinea 1999: crisis of governance. Parliament of Australia. <http://www.aph.gov.au/library/pubs/rp/1999-2000/2000rp04.htm> (10 October 2013).
- Stanley, E. R. 1919. Geological expedition across the Owen Stanley Range. In *Papua: Annual Report for the Year 1917-18*: 75–84. Parliament of the Commonwealth of Australia. Melbourne, Albert J. Mullett, Government Printer.
- Steiner, S. C. C. and Williams, S. M., 2006. The density and size distribution of *Diadema antillarum* on Dominica (Lesser Antilles): 2001–2004. *Marine Biology* 149: 1071–1078.
- Stone, O. C. 1876. Description of the country and natives of Port Moresby and neighbourhood New Guinea. *Journal of the Royal Geographical Society* 46: 34–62.

- Stone, O. C. 1880. *A Few Months in New Guinea*. London, Sampson Low, Marston, Searle and Rivington.
- Strahan, D. and Unruh, J. 2002. Conservation of ceramic artifacts on archaeological sites. Field Notes – Practical Guides for Archaeological Conservation and Site Preservation, No. 12. Japanese Institute of Anatolian Archaeology. [http://www.jiaa-kaman.org/images/fn/pdf/fieldnotes\\_no\\_12.pdf](http://www.jiaa-kaman.org/images/fn/pdf/fieldnotes_no_12.pdf) (1 June 2014).
- Stuart, I. 1970. *Port Moresby: Yesterday and Today*. Sydney, Pacific Publications.
- Sturman, A. and Tapper, N. 2001. *The Weather and Climate of Australia and New Zealand*. Melbourne, Oxford University Press.
- Sullivan, M. E. and Sassoon, M. 1987. Prehistoric occupation of Loloata Island Papua New Guinea. *Australian Archaeology* 24: 1–9.
- Summerhayes, G. R. 2009. Obsidian network patterns in Melanesia – sources, characterisation and distribution. *Indo-Pacific Prehistory Association Bulletin* 29: 109–123.
- Summerhayes, G. R. and Allen, J. 2007. Lapita writ small? Revisiting the Austronesian colonisation of the Papuan south coast. In S. Bedford, C. Sand and S. P. Connaughton (eds), *Oceanic Explorations: Lapita and Western Pacific Settlement*: 97–122. Terra Australis 26. Canberra, ANU E Press.
- Sunshine State Stories 2011. Papua New Guinea climate, temperatures and weather review. <http://www.sunshinestatestories.com/interesting-stuff/papua-new-guinea-climate-temperatures-weather-review> (18 May 2011).
- Swadling, P. 1976. Was there a Hiatus in Human Settlement 1000 Years Ago in the Port Moresby Area? Unpublished manuscript, Papua New Guinea National Museum and Art Gallery, Port Moresby.
- Swadling, P. 1977a. A review of the traditional and archaeological evidence for early Motu, Koita and Koiari settlements along the central south Papua coast. *Oral History* 5: 37–57.
- Swadling, P. 1977b. Depletion of shellfish in the traditional gathering beds of Pari. In J. H. Winslow (ed.), *The Melanesian Environment*: 182–187. Canberra, Australian National University Press.
- Swadling, P. 1980. Decorative features and sources of selected potsherds from archaeological sites in the Gulf and Central Provinces. *Oral History* 8: 101–125.
- Swadling, P. 1981. The settlement history of the Motu and Koita speaking people of the Central Province, Papua New Guinea. In D. Denoon and R. Lacey (eds), *Oral Tradition in Melanesia*: 240–251. Port Moresby, University of Papua New Guinea and Institute of Papua New Guinea Studies.
- Swadling, P. 1994. Changing shellfish resources and their exploitation for food and artifact production in Papua New Guinea. *Man and Culture in Oceania* 10: 127–150.
- Swadling, P. and Kaiku, O. 1980. Radiocarbon date from a fireplace in the clay surface of an eroded village site in the Papa salt pans, Central Province. *Oral History* 8: 86.
- Symons, J. 2003. Obsidian artefacts and land-use in the mid-Holocene of the Willaumez Peninsula, Papua New Guinea. *Australian Archaeology* 57: 128–134.
- Szabó, K. 2008. Shell as a raw material: mechanical properties and working techniques in the Indo-West Pacific. *Archaeofauna* 17: 125–138.
- Szabó, K. 2009. Molluscan remains from Fiji. In G. Clark and A. Anderson (eds), *The Early Prehistory of Fiji*: 183–211. Terra Australis 31. Canberra, ANU E Press.
- Szabó, K. 2013. Identifying worked shell: a consideration of methodological issues with particular reference to Pleistocene contexts. In G. Bailey, K. Hardy and A. Camara (eds), *Shell Energy: Mollusc Shells as Coastal Resources*: 277–286. Oxford, Oxbow Books.
- Taborin, Y. 1993. *La Parure en Coquillage au Paléolithique*. CNRS éditions, *Supplément à Gallia Préhistoire*, n°29. Paris, CNRS.
- Tau, K. H. 1976. Porebada village, Port Moresby sub-Province, Central Province. *Oral History* 4: 5–6.
- Tauberschmidt, G. 1995. *Sinaugoro Dictionary*. Dictionaries in Papua New Guinea, Volume 15. Ukarumpa, Papua New Guinea, Summer Institute of Linguistics.
- Taylor, A. J. 1970. *Syntax and Phonology of Motu (Papua): A Transformational Approach*. Unpublished PhD thesis, Australian National University.
- Taylor, A. J. 1977. Missionary lingue franche: Motu. In S. A. Wurm (ed.), *New Guinea Area Languages and Language Study Vol. 3: Language, Culture, Society and the Modern World*: 881–891. Australian National University, Pacific Linguistics, C40. Canberra, Australian National University.
- Tebano, T. and Paulay, G. 2000. Variable recruitment and changing environments create a fluctuating resource: the biology of *Anadara uropigmelana* (Bivalvia: Arcidae) on Tarawa Atoll. *Atoll Research Bulletin* No. 488. Washington DC, National Museum of Natural History, Smithsonian Institution. [http://www.sil.si.edu/digitalcollections/atollresearchbulletin/ARB\\_RecordSingle.cfm?issue=488](http://www.sil.si.edu/digitalcollections/atollresearchbulletin/ARB_RecordSingle.cfm?issue=488) (15 January 2015).
- Thompson, T. J. U., Islam, M., Piduru, K. and Marcel, A. 2011. An investigation into the internal and external variables acting on crystallinity index using Fourier transform infrared spectroscopy on unaltered and burned bone. *Palaeogeography, Palaeoclimatology, Palaeoecology* 299: 168–174.
- Thomson, N. P. 1975. The dialects of Magi. In *Papers in New Guinea Linguistics* 18: 37–90. Australian National University, Pacific Linguistics, Series A, No. 40. Canberra, Australian National University.
- Torrence, R. 2011. Finding the right question: learning from stone tools on the Willaumez Peninsula, Papua New Guinea. *Archaeology in Oceania* 46: 29–41.

- Tschegg, C. 2009. Post-depositional surface whitening of ceramic artifacts: alteration mechanisms and consequences. *Journal of Archaeological Science* 36: 2155–2161.
- Turner, W. 1878. The ethnology of the Motu. *Journal of the Anthropological Institute of Great Britain and Ireland* 7: 470–499.
- Uberoi, J. P. S. 1962. *Politics of the Kula Ring: An Analysis of the Findings of Bronislaw Malinowski*. Manchester, Manchester University Press.
- Ulm, S., Barham, A. J., David, B., Jacobsen, G., McNiven, I. J., Petchey, F. and Rowland, M. J. 2007. Marine carbon reservoir variability in Torres Strait: preliminary results of AMS dating of live collected shell specimens. Abstracts from XVII INQUA Congress (Cairns, Australia, 28 July–3 August 2007). *Quaternary International* 167–168: 426.
- UNESCO. 2001. *Partners in Coastal Development: the Motu Koitabu People of Papua New Guinea*. Coastal Region and Small Island Papers, No. 10. Paris, UNESCO.
- Unsworth, R. K., Bell, J. J. and Smith, D. J. 2007. Tidal fish connectivity of reef and sea grass habitats in the Indo-Pacific. *Journal of The Marine Biological Association of the United Kingdom* 87: 1287–1296.
- Vanderwal, R. L. 1973. *Prehistoric Studies in Central Coastal Papua*. Unpublished PhD thesis, Australian National University.
- Vanderwal, R. L. 1976. Tradition, history and potting: a Papuan example of changing settlement and economy. *Oral History* 4: 2–15.
- Vanderwal, R. L. 1978. Exchange in prehistoric coastal Papua. In J. Specht and J. P. White (eds), *Trade and Exchange in Oceania and Australia*: 416–428. Special issue of *Mankind*, 11(3). Sydney, Australian Museum and the Anthropological Society of New South Wales.
- Vandiver, P. 2001. The role of materials research in ceramics and archaeology. *Annual Review of Materials Research* 31: 373–385.
- Van Dyck, S. and Strahan, R. 2008. *The Mammals of Australia*. Sydney, Reed New Holland.
- Van Heekeren, D. 2011. ‘Singing it local’: the appropriation of Christianity in the Vula’a villages of Papua New Guinea. *Asia Pacific Journal of Anthropology* 12: 44–59.
- Vasey, D. E. 1982. Subsistence potential of the pre-colonial Port Moresby area, with reference to the Hiri trade. *Archaeology in Oceania* 17: 132–142.
- Vuki, V. C. and Price, I. R. 1994. Seasonal changes in the *Sargassum* populations on a fringing coral reef, Magnetic Island, Great Barrier Reef region, Australia. *Aquatic Botany* 48: 153–166.
- Wacker Chemie AG 2006. Lasting protection for building fabric with Silres BS Silicon masonry protection agents, Wacker Chemie AG. [http://www.wacker.com/cms/media/publications/downloads/6187\\_EN.pdf](http://www.wacker.com/cms/media/publications/downloads/6187_EN.pdf) (1 June 2014).
- Walker, D. 1966. Vegetation of the Lake Ipea region, New Guinea highlands: forest, grassland and garden. *Journal of Ecology* 54: 445–456.
- Walker, J. and Gillison, A. N. 1982. Australian savannas. In B. J. Huntley and B. H. Walker (eds), *Ecology of Tropical Savannas*: 5–24. Ecological Studies Volume 42. New York, Springer-Verlag Publishing.
- Wari, R. 2004. Pari women get K81,000 from US Government. The National, 16 November 2004. <http://www.thenational.com.pg/1116/nation21.htm> (10 October 2013).
- Weiner, J. 2002. The work of inscription in Foi poetry. In B. David and M. Wilson (eds), *Inscribed Landscapes: Marking and Making Place*: 270–283. Honolulu, University of Hawai’i Press.
- Weiner, J. 2013. The incorporated what group: ethnographic, economic and ideological perspectives on customary land ownership in contemporary Papua New Guinea. *Anthropological Forum* 23: 94–106.
- Westcott, D. A., Setter, M., Bradford, M. G., McKeown, A. and Setter, S. 2008. Cassowary dispersal of the invasive pond apple in a tropical rainforest: the contribution of subordinate dispersal modes in invasion. *Diversity and Dispersal* 14: 432–439.
- Whittow, J. 2000. *Dictionary of Physical Geography*. London, Penguin Books.
- Wilson, B. R. 2002. *A Handbook to Australian Seashells on Seashores East to West and North to South*. French’s Forest, NSW, Reed Books.
- Wilson, B. R. and Gillett, K. 1988. *A Field Guide to Australian Shells: Prosobranch Gastropods*. French’s Forest, NSW, Reed Books.
- Womersley, H. B. S. 1987. *The Marine Benthic Flora of South Australia Part II*. Adelaide, SA Government Printer.
- Woodroffe, C. D. 2000. Deltaic and estuarine environments and their late Quaternary dynamics on the Sunda and Sahul shelves. *Journal of Asian Earth Sciences* 18: 393–413.
- WoRMS Editorial Board. 2014. World register of marine species. <http://www.marinespecies.org> (28 May 2014).
- Worthing, M. A. 1980. South Papuan coastal sources of potsherds from the Gulf area of PNG. *Oral History* 8: 87–100.
- Woxvold, I. A. 2008. Assessment and impact analysis of terrestrial biodiversity at the LNG Facilities Site, Central Province, Papua New Guinea. Final Report to Coffey Natural Systems. Appendix 12 in CNS 2009, PNG LNG Project. Environmental Impact Statement. [http://www.pnglng.com/downloads/eis\\_appendix12.pdf](http://www.pnglng.com/downloads/eis_appendix12.pdf) (27 January 2015).
- Zuschin, M., Stachowitsch, M. and Stanton, R. J. 2003. Patterns and processes of shell fragmentation in modern and ancient marine environments. *Earth-Science Reviews* 63: 33–82.