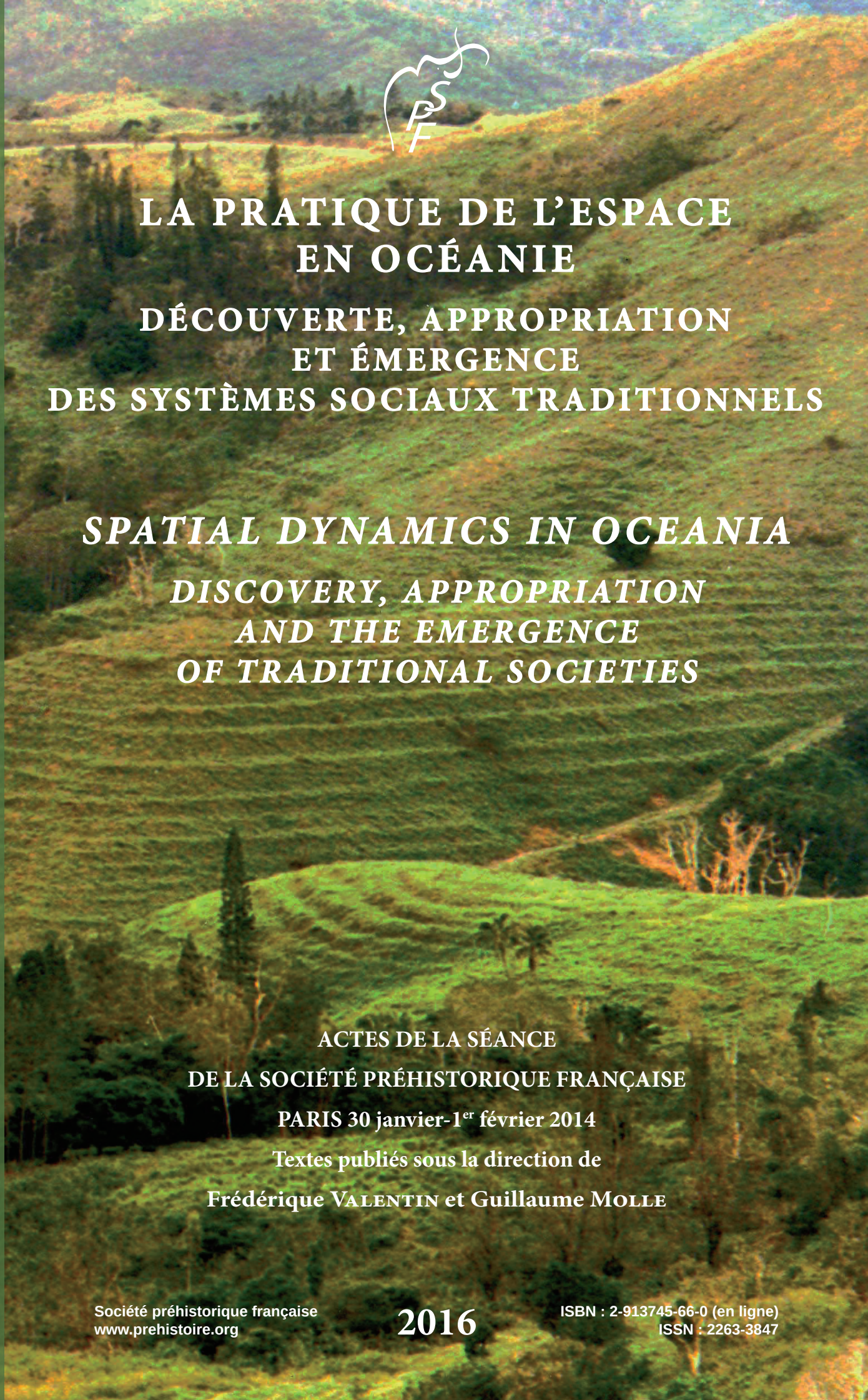
SÉANCES DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE 7



LA PRATIQUE DE L'ESPACE EN OCÉANIE

DÉCOUVERTE, APPROPRIATION ET ÉMERGENCE DES SYSTÈMES SOCIAUX TRADITIONNELS

SPATIAL DYNAMICS IN OCEANIA

DISCOVERY, APPROPRIATION AND THE EMERGENCE OF TRADITIONAL SOCIETIES

ACTES DE LA SÉANCE
DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE
PARIS 30 janvier-1er février 2014

Textes publiés sous la direction de
Frédérique Valentin et Guillaume Molle

Société préhistorique française
www.prehistoire.org

2016

ISBN : 2-913745-66-0 (en ligne)
ISSN : 2263-3847

LA PRATIQUE DE L'ESPACE EN OCÉANIE
DÉCOUVERTE, APPROPRIATION ET ÉMERGENCE DES SYSTÈMES SOCIAUX TRADITIONNELS

SPATIAL DYNAMICS IN OCEANIA
DISCOVERY, APPROPRIATION AND THE EMERGENCE OF TRADITIONAL SOCIETIES

SÉANCES DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE
7

LA PRATIQUE DE L'ESPACE EN OCÉANIE
DÉCOUVERTE, APPROPRIATION ET ÉMERGENCE DES SYSTÈMES SOCIAUX TRADITIONNELS

SPATIAL DYNAMICS IN OCEANIA
DISCOVERY, APPROPRIATION AND THE EMERGENCE OF TRADITIONAL SOCIETIES

ACTES DE LA JOURNÉE DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE
PARIS
30 janvier-1er février 2014

Textes publiés sous la direction de
Frédérique Valentin et Guillaume Molle

Société préhistorique française
Paris
2016

Les « Séances de la Société préhistorique française »
sont des publications en ligne disponibles sur :

www.prehistoire.org

Illustration de couverture : Tarodière du col des Roussettes, Nouvelle-Calédonie (© IANCP, cliché C. Sand).

Responsables des réunions scientifiques de la SPF :
Jacques Jaubert, José Gomez de Soto, Jean-Pierre Fagnart et Cyril Montoya
Directeur de la publication : Jean-Marc Pétillon
Secrétariat de rédaction, maquette et mise en page : Martin Sauvage et Frank Barbery (CNRS, USR 3225, Nanterre)
Correction et vérification : Karolin Mazurié de Keroualin (www.linarkeo.com)
Mise en ligne : Ludovic Mevel

Société préhistorique française
(reconnue d'utilité publique, décret du 28 juillet 1910). Grand Prix de l'Archéologie 1982.
Siège social : 22, rue Saint-Ambroise, 75011 Paris
Tél. : 01 43 57 16 97 – Fax : 01 43 57 73 95 – Mél. : spf@prehistoire.org
Site internet : www.prehistoire.org

Adresse de gestion et de correspondance

Maison de l'archéologie et de l'ethnologie,
Pôle éditorial, boîte 41, 21 allée de l'Université, F-92023 Nanterre cedex
Tél. : 01 46 69 24 44
La Banque Postale Paris 406-44 J

Publié avec le concours du ministère de la Culture et de la Communication (sous-direction de l'Archéologie),
du Centre national de la recherche scientifique,
de l'université Paris I – Panthéon-Sorbonne, de l'université Paris Ouest Nanterre,
de l'université de la Polynésie française (Faa'a), de l'Australian National University (Canberra),
de l'UMR 7041 « Archéologie et sciences de l'Antiquité (ArScAn) » et de son équipe « Ethnologie préhistorique » (Nanterre),
de l'Institut d'archéologie de la Nouvelle-Calédonie et du Pacifique (IANCP, Nouméa)
et du Centre international de recherche archéologique sur la Polynésie (CIRAP, Faa'a).

Dépôt légal : 4e trimestre 2016

ISSN : 2263-3847 – ISBN : 2-913745-66-0 (en ligne)

SOMMAIRE / *CONTENTS*

Frédérique Valentin et Guillaume Molle — Avant-propos / *Foreword* **7**

James L. Flexner and Patrick V. Kirch — Field mapping and Polynesian prehistory: A methodological history and thoughts for the future / *Cartographie de terrain et Préhistoire polynésienne: historique des méthodes et perspectives* **15**

Christophe Sand, André-John Ouetcho, Jacques Bole, David Baret and Yves-Béalo Gony — Traditional Kanak Landscapes: An Assessment of Settlement Pattern Studies in New Caledonia (Southern Melanesia) / *Paysages traditionnels Kanak : études des modalités de l'occupation de l'espace en Nouvelle-Calédonie (Mélanésie du Sud)* **31**

Christian Reepmeyer, Geoffrey Clark, Jolie Liston and Ella Ussher — On the importance of freshwater access in successful island colonization / *De l'importance de l'accès à l'eau douce dans le succès de la colonisation des îles* **49**

Alex E. Morrison and Melinda S. Allen — Marine Prey Vulnerability Versus Resilience to Human Foragers: Insights from Agent Based Modelling / *Vulnérabilité des proies marines* versus *résistance aux prédateurs humains : résultats d'une modélisation multi-agents* **63**

Louis Lagarde and André Ouetcho — Horticultural structures on ultramafic soils: the case of Isle of Pines and other parts of southern Grande Terre (New Caledonia) / *Structures horticoles sur sols ultramafiques : le cas de l'Île des Pins et d'autres régions du sud de la Grande Terre (Nouvelle-Calédonie)* **79**

Annette Kühlem — 'Controlling the Elements': Anthropogenic Landscape Transformation at Ava Ranga Uka A Toroke Hau, Rapa Nui (Easter Island) / *« Contrôler les éléments » : transformations anthropiques du paysage à Ava Ranga Uka A Toroke Hau, Rapa Nui (île de Pâques)* **91**

Nicolas Cauwe et Morgan De Dapper — Rapa Nui (île de Pâques) : nouvelles données sur la gestion de l'espace / *Rapa Nui (Easter Island): New Data on Land Use Patterns* **101**

Caroline Polet — The impact of gender, age, social status and spatial distribution on the ancient Easter Islanders' diet / *L'impact du genre, de l'âge, du statut social et de la répartition spatiale sur l'alimentation des anciens Pascuans* **111**

Guillaume Molle et Éric Conte — Variabilité des espaces dunaires dans l'archipel des Marquises : approche comparative des séquences d'occupation littorale sur l'île de Ua Huka / *Variability of Dune Systems in the Marquesas Archipelago: Comparative Approach of Coastal Occupation Sequences on Ua Huka Island* **125**

Jennifer G. Kahn — Public versus Corporate Ritual in the Prehistoric Society Islands (French Polynesia): a Multi-Scalar Analysis of Religious Practices / *Rituels publics et spécialisés aux îles de la Société (Polynésie française) : une analyse multiscalaire des pratiques religieuses* **141**

Mads Ravn, Stuart Bedford, Matthew Spriggs, Stuart Hawkins, Iarowai Philip and Frédérique Valentin — Pottery spatial patterns at the Lapita site of Teouma, Central Vanuatu: some preliminary refitting results / *Répartition spatiale des poteries du site Lapita de Teouma, Vanuatu central : résultats préliminaires des remontages* **163**

Denis Monnerie — Oceania and the regional relations paradigm: contrasting regional networks and beyond / *De l'Océanie considérée sous l'angle du paradigme des relations régionales : les contrastes entre réseaux régionaux et autres considérations* **177**

Jim Specht — Ancestors for the Present? Exploring Later Prehistory on New Britain, Papua New Guinea / *Des ancêtres pour le présent ? La fin de la Préhistoire sur l'île de Nouvelle-Bretagne, Papouasie-Nouvelle-Guinée* **191**

Aymeric Hermann — Production et échange des lames d'herminette en pierre en Polynésie centrale : les dynamiques techno-économiques dans l'île de Tubuai (archipel des Australes) / *Stone Adze Production and Exchange in Central Polynesia: Techno-Economic Dynamics on Tubuai (Austral Islands)* **205**

Anne Di Piazza — Canoes of Atchin (Vanuatu) Based on John Willoughby Layard's Work / *Les pirogues d'Atchin (Vanuatu) d'après les enquêtes de John Willoughby Layard* **223**

Sophie Chave-Dartoen — Banua, *panua, fenua: an Austronesian conception of the socio-cosmic world / *Banua, *panua, fenua : une conception austronésienne du monde socio-cosmique* **231**

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 7-13
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Avant-propos / *Foreword*

Frédérique Valentin et Guillaume Molle

Les îles du Pacifique sont, pour les plus orientales, parmi les terres les plus isolées du monde (fig. 1). Leur double identité, maritime et terrestre, en fait des espaces physiques, sociaux et cognitifs aux caractéristiques variées et apparemment contraignantes. Pourtant, les descriptions qu'en firent les premiers explorateurs occidentaux prouvent que des sociétés surent s'y adapter et y maintenir des populations nombreuses. L'étude de ces sociétés est dès lors susceptible d'apporter un éclairage particulier à la question plus générale des dynamiques spatiales et de leurs implications sociales et environnementales, dépassant les études classiques de *settlement patterns* initiées en Océanie dans les années 1960 (Green, 1961). C'est ce qu'entend montrer ce volume. Celui-ci réunit seize des contributions présentées à la séance de la Société préhistorique française centrée sur « La pratique de l'espace en Océanie : découverte, appropriation et émergence des systèmes sociaux traditionnels / Spatial Dynamics in Oceania: Discovery, Appropriation and the Emergence of Traditional Societies », qui s'est tenue à Paris du 30 janvier au 1er février 2014.

La publication de cette séance constitue un événement particulier. Elle intervient quarante ans après la publication d'une autre session dédiée à la Préhistoire océanienne, tenue dans le cadre du XXIIe Colloque de l'UISPP, du 13 au 18 septembre 1976 à Nice, sous la direction de J. Garanger (Garanger, 1976). Les phénomènes de peuplement et les reconstitutions des séquences chrono-culturelles y furent au cœur des débats [(1)] reléguant l'espace et sa relation aux sociétés au second plan. Les modes d'occupation de l'espace n'ont été à cette occasion que rapidement évoqués par J. Davidson et considérés comme des marqueurs déterminants pour définir les cultures et distinguer la région d'origine du peuplement de la Polynésie orientale (Davidson, 1976, p. 42). Ils tenaient cependant une place centrale en archéologie océanienne (Green *et al.*, 1967 ; Green et Davidson, 1969 et 1974), malgré le manque de données et de résolution chronologique. Contemporanéité des structures, durée d'utilisation des sites et des structures se devaient en effet d'être affinées alors que les données ethnohistoriques ne pouvaient être associées qu'aux vestiges archéologiques les plus récents (Bellwood, 1979 ; Conte, 2000). R. Green signalait à juste titre dans l'introduction d'un autre symposium tenu en 1983, lors du 15e Pacific Science Congress (Dunedin, Nouvelle-Zélande), que cette approche spatiale des vestiges visibles en surface, très nombreux en Océanie, ouvrait de nouvelles perspectives pour comprendre les organisations sociales et les relations entre l'homme et l'environnement insulaire (Green, 1984). Depuis les années 1980, de nombreuses études ont été réalisées sur ce thème témoignant de l'ampleur des investigations engagées, en particulier en Polynésie (Kirch et Kahn, 2007). Dans les archipels de Polynésie centrale, suite aux travaux pionniers de J. Garanger à la presqu'île de Tahiti (Garanger, 1964 et 1980), les recherches menées dans le cadre du département d'archéologie du Centre polynésien des sciences humaines (devenu par la suite le service de la Culture et du Patrimoine) et par le Centre international de recherche archéologique sur la Polynésie (CIRAP, université de Polynésie française) ont contribué à documenter la variabilité des organisations spatiales des habitats. Si l'attention fut souvent portée aux monuments cérémoniels, il n'en reste pas moins que ces travaux ont largement participé à une meilleure compréhension de l'occupation ancienne de l'espace par les chefferies traditionnelles tant aux îles de la Société (Maric, 2012) qu'aux îles Tuamotu (Conte, 1990) et aux îles Marquises (Ottino Garanger et De Bergh, 1990 ; Chavaillon et Olivier, 2007 ; Conte et Molle, 2012).

Ces études des modes d'occupation de l'espace bénéficient depuis une vingtaine d'années d'un renouvellement des techniques d'enregistrement, grâce à l'avancée notable des technologies géospatiales, et offrent désormais une perception de l'espace anthropisé à grande, voire très grande échelle (Quintus *et al.*, 2015 ; Morrison et O'Connor, 2015). S'intéressant à cette évolution, la contribution de J. Flexner et P. Kirch revient sur la pratique de l'enregistrement spatial des structures en archéo-

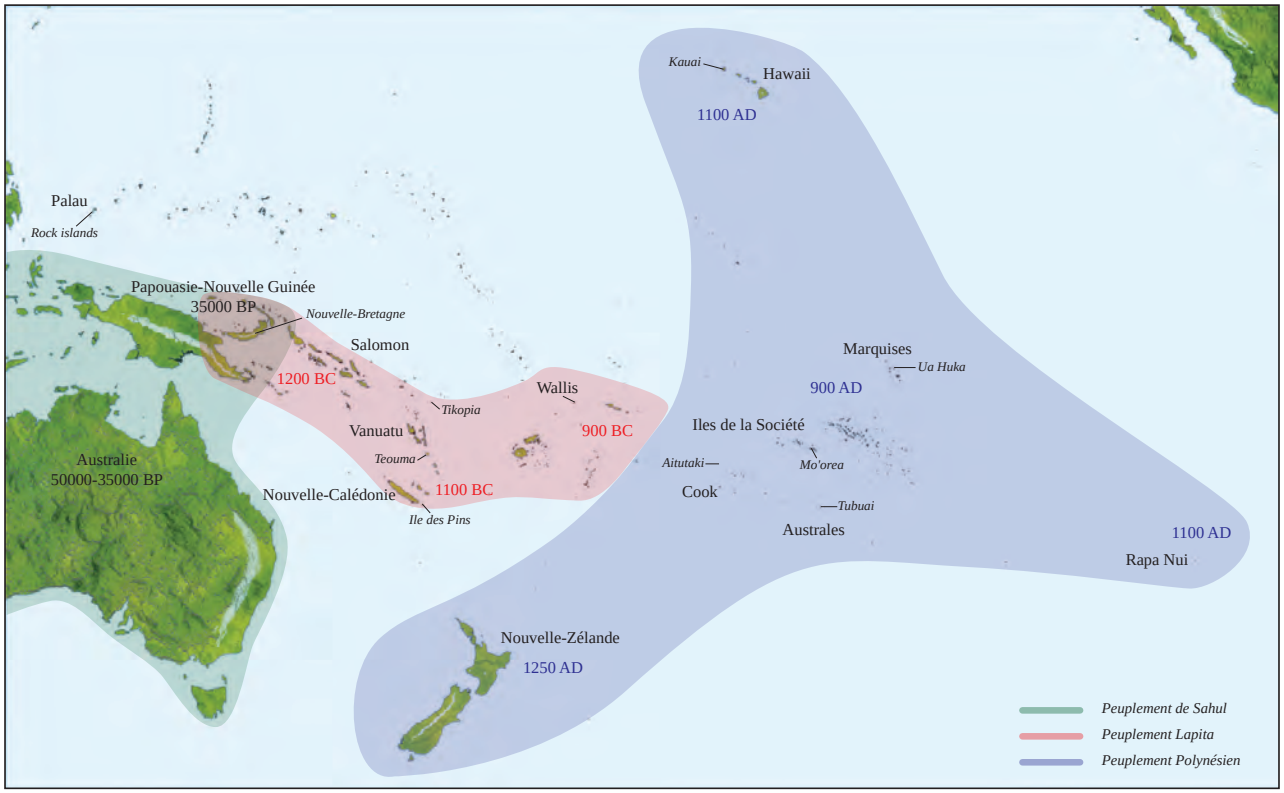


Fig. 1 – Étapes du peuplement du Pacifique et localisation des îles citées dans les contributions.
Fig. 1 – *Stages of settlement of the Pacific and location of the islands cited in the contributions.*

logie océanienne, depuis les premiers croquis réalisés par les illustrateurs associés aux expéditions d'exploration du Pacifique (XVIII[e] siècle) jusqu'aux données LiDAR d'aujourd'hui. Leur analyse historique, s'appuyant sur l'examen de relevés de structures en pierre en Polynésie, témoigne de la manière dont nous sommes passés de l'enregistrement de structures individuelles à celui de structures interconnectées représentant des sites d'habitat inscrits dans un environnement particulier. Les auteurs soulignent malgré tout que les techniques les plus modernes de localisation et d'enregistrement des structures ne remplacent pas mais plutôt complètent les méthodes plus classiques de prospection pédestre et de relevé pierre à pierre. Ils suggèrent même que cette dernière technique pourrait être proche de la manière océanienne de penser l'archéologie d'un espace, reliant les lieux aux savoirs traditionnels sur le passé, transmis de générations en générations. De tels travaux de cartographie sont, en revanche, plus rares et plus récents en Mélanésie, en particulier en Nouvelle-Calédonie où, comme l'indique la contribution de C. Sand et collaborateurs, seul un plan figurant un village dans son environnement a été publié avant la seconde guerre mondiale, les autres illustrations n'étant que des vues idéalisées ou des représentations artistiques. Depuis, l'enregistrement de nombreuses structures et ensembles de structures d'habitat et horticoles (fig. 2) aux formes diverses a été effectué par le département d'archéologie du musée de Nouvelle-Calédonie puis l'Institut d'archéologie de Nouvelle-Calédonie et du Pacifique (IANCP). Les données acquises au fil des ans et répertoriées par les auteurs indiquent un usage intensif de l'espace insulaire à la dernière période pré-européenne et suggèrent une forte densité de population, un habitat sédentaire et des chefferies puissantes. Cette image apparaît très différente, voire à l'opposé, de celle reflétée par les données ethnographiques et ethnohistoriques postérieures au contact et à la colonisation européenne, conduisant les auteurs à s'interroger sur le sens qu'une « archéologie des traditions », telle qu'elle est pratiquée en Polynésie, peut prendre dans la région mélanésienne.

Habitats, structures horticoles/agricoles et zones d'approvisionnement constituent, pour reprendre l'expression de P. Bellwood (Bellwood, 1979, p. 320), « the overall pattern in relation to ecological and social factors ». Le milieu naturel, les conditions environnementales, influencent en effet les modes d'occupation de l'espace insulaire et les choix opérés par les groupes humains. La nature de l'espace éco-géographique et la disponibilité des ressources pourraient dans une certaine mesure avoir guidé le choix des lieux d'implantation des premiers peuplements insulaires, régulièrement situés sur le littoral, à proximité de passes dans le récif, proches du lagon riche en faune marine et de sources d'eau douce (Frimigacci, 1980 ; Lepofsky, 1988 ; Anderson, 1996 ; Kennett *et al.*, 2006). Pourtant, la relation n'est pas aussi simple et directe (Nunn, 2009). Comme le démontre ici la contribution de C. Reepmeyer et collaborateurs, lorsque

Fig. 2 – Tarodière du col des Roussettes, Nouvelle-Calédonie (copyright IANCP, cliché C. Sand).
Fig. 2 – *Taro plantation at the Col des Roussettes pass, New Caledonia (copyright IANCP, photograph C. Sand).*

la situation est contraignante quand l'eau douce superficielle est rare voire absente, des solutions adaptatives sont développées localement pour maintenir des installations durables. Ainsi, les premiers colons des îles Rock (Palau) ont, vers 2800 BP, pallié au manque d'eau en recueillant l'eau saumâtre remontant en bord de plage de la lentille souterraine *(Ghyben-Herzberg)* dans des grandes céramiques. Si cette option et ses variantes ont été utilisées dans de nombreuses îles, il en est d'autres où l'eau souterraine, piégée dans le karst, a été intensivement exploitée comme à Tiga, petite île du groupe des îles Loyauté (Nouvelle-Calédonie, Sand *et al*., 2010). La vulnérabilité des ressources marines, en particulier de la malacofaune qui compose une part non négligeable de l'alimentation des insulaires, constitue un autre type de contrainte. Celle-ci est explorée ici par A. E. Morrison et M. Allen à l'aide de modélisations multi-agents, ou basées sur le comportement des agents, et de comparaison des abondances de trois groupes de mollusques enregistrées dans trois séquences archéologiques relevées à Tikopia (îles Salomon), Aitutaki (îles Cook) et Kauai (îles Hawaii). La nature et la qualité des sols représentent un troisième ensemble de contraintes, des sols de qualité médiocre pouvant faire obstacle à l'expansion et l'intensification de l'horticulture. Toutefois, il apparait là encore que des solutions adaptatives ont été mises en œuvre pour transformer un environnement hostile en un paysage productif. Les travaux sur le sud de Nouvelle Calédonie et l'île des Pins dont rendent compte L. Lagarde et A.-J. Ouétcho, montrent en effet que les importants aménagements horticoles réalisés sur des substrats initialement peu favorables, issus de la dégradation de roches ultramafiques, participent, comme leurs contemporains aux formes différentes, du processus d'intensification horticole caractérisant la fin de la préhistoire calédonienne [(2)].

Cependant, « the human organization of space, however, involves more than environmental or ecological considerations. […] Spatial arrangements of ancient settlements provide substantial information on social and political organization of the groups who constructed and occupied the sites » (Kirch, 1985, p. 247). Dépassant les considérations écologiques, le paysage anthropisé est aussi envisagé comme un espace susceptible de révéler les relations économiques, politiques, religieuses et spirituelles qui régissaient autrefois les communautés. Des analyses conduites à l'échelle du site, du territoire ou d'une forme géographique ont ainsi vu le jour, visant à définir les fonctions des ensembles construits ainsi que l'organisation sociopolitique et l'idéologie des groupes. Suivant cette ligne d'analyse, A. Kühlem s'interroge ici sur la fonction des aménagements identifiés sur le site d'Ava Ranga Uka A Toroke Hau (île de Pâques), localisé au centre de l'île sur les bords de la rivière Vaipu. La présence conjointe de structures associées à la maitrise de l'eau, de pavages, de remblais artificiels visant à créer de nouvelles surfaces, de foyers et de palmiers plantés,

invite l'auteure à interpréter cet espace comme un sanctuaire dédié à un culte de l'eau placé sous le contrôle d'élites. Toutefois, la recherche portant sur deux autres localités de l'île de Pâques, présentée par N. Cauwe et M. De Dapper démontre que la prise en compte de la variable temps est importante, offrant une lecture affinée des modalités d'occupation d'un site et d'un territoire. Leur étude stratigraphique, sédimentologique et chronologique sur plusieurs aménagements soulève ainsi la question de la simultanéité d'utilisation de l'ensemble des vestiges visibles en surface ainsi que celle de l'attribution sociale des structures dont la répartition (selon des bandes orientées mer-montagne) était jusqu'à présent interprétée comme correspondant à des territoires structurés en fonction de critères sociaux et occupés de manière synchrone.

Les modalités d'occupation de l'espace pascuan ont également été abordées par le biais de l'analyse de données paléobiologiques relevées sur des restes humains. Étudiant le régime alimentaire de sujets inhumés dans vingt sites répartis dans huit des divisions territoriales traditionnelles identifiée au xxe siècle par K. Routledge (Routledge, 1919 (3)), C. Polet montre que les individus associés à un même territoire avaient une alimentation semblable et qu'il n'existait pas de véritable différence entre les groupes associés à des territoires différents. Seul un site se distingue, le célèbre Ahu Nau Nau édifié sur la dune bordant la baie d'Anakena, qui abrite des défunts à la diète caractérisée par une consommation importante de produits marins indiquant un statut social élevé. À l'instar de la dune d'Anakena, certains systèmes dunaires (à l'interface entre les milieux terrestres et marins), ont joué un rôle particulier dans les trajectoires historiques des groupes océaniens. En se basant sur l'exemple de l'île de Ua Huka aux îles Marquises, la contribution de G. Molle et É. Conte met en évidence des changements diachroniques dans la fonction et les modalités d'occupation des espaces littoraux, depuis les premiers hameaux à la simple fréquentation par des groupes de pêcheurs, des sites de surveillance en période de conflits ou encore de véritables cimetières dans les cas des sites de Hane et Manihina. Les différents usages que firent les Marquisiens des espaces côtiers témoignent d'une constante adaptabilité du lieu de vie aux besoins changeants des groupes, liés à la subsistance, à la défense ou à des croyances religieuses. Dès lors, l'étude diachronique de l'occupation de ces espaces apparait à même d'ouvrir de nouvelles perspectives sur la compréhension des transformations des sociétés sur le long terme.

Les études micro-scalaires des structures d'habitat ont la même ambition, leur objectif premier étant de définir les relations spatiale et temporelle des structures entre elles, au sein et entre plusieurs sites, pour analyser les changements de structure sociale. Pour les périodes les plus récentes de la préhistoire océanienne, les analyses couplent souvent données archéologiques issues de la fouille extensive d'habitations et de l'analyse des éléments de culture matérielle associés et données ethnohistoriques renseignant les fonctions des constructions et les activités qui y sont conduites. La contribution de J. Kahn s'intéresse ici plus spécifiquement à l'architecture religieuse et à son lien avec les différentes composantes de la société des îles de la Société (Polynésie française), documentée à l'aide de données ethnohistoriques. Sa démonstration, qui repose sur l'étude du cas archéologique de la vallée de 'Opuhonu à Moorea, met en avant l'hypothèse selon laquelle les élites locales se sont appropriés, au fil du temps, entre 1350 AD et 1600 AD, certains espaces rituels en faisant évoluer l'architecture, ainsi que les idées et pratiques associées. Dans ce cas de figure, le changement de situation sociopolitique, de relationnel et d'espace social, est manifesté par une restructuration de l'espace matériel. Dans d'autres cas, plus éloignés de la période actuelle, le fonctionnement social du groupe peut être approché directement par le biais de l'analyse de la répartition spatiale des vestiges découverts en fouille, répondant ainsi à des problématiques dont sont familiers les préhistoriens en Europe, à l'image de l'école française de l'équipe « Ethnologie préhistorique » qui développa à partir de 1964 des fouilles extensives et des analyses palethnographiques de sites d'habitat (Julien et Karlin, 2014). Ces études sont peu fréquentes en Océanie mais démontrent bien le potentiel des analyses intra-sites pour définir la fonction du site et les activités qui y étaient pratiquées. À ce titre, le travail de R. Walter sur Anai'o aux îles Cook est un exemple des possibilités d'interprétation qu'ouvre ce champ de la recherche (Walter, 1998). Son analyse de la distribution des vestiges, mettant en évidence des aires de préparation de nourriture et des zones de manufacture d'herminettes et d'hameçons, le conduit notamment à distinguer espaces publics et espaces privés et à envisager une division sexuelle des tâches domestiques. Partant de cette même idée, l'analyse de M. Ravn et collaborateurs montrent ici que la répartition des tessons céramiques observée sur le site Lapita (ca. 3000 BP) de Teouma (Vanuatu) peut résulter d'une activité humaine de nature cérémonielle. Les remontages des céramiques combinés à un SIG leur permettent en effet de conclure que des poteries non seulement complètes mais aussi incomplètes, d'origine locale ou exotique, avaient été déposées près des sépultures et que des fragments d'une même poterie avaient été distribués dans plusieurs tombes, proches ou distantes, témoignant d'un lien voire d'un maillage social entre les défunts, physiquement marqué durant les cérémonies funéraires.

Ces systèmes de relations qui constituent l'espace social océanien fonctionnent à de multiples échelles, locale, translocale et régionale. À l'instar du cycle de la *kula* dans le Nord de la Mélanésie (Malinowski, 1922), du cycle du jade en Mélanésie du Sud (Leenhardt, 1937), ou du système *Sawei* reliant les chefferies de Micronésie centrale (Lessa, 1962), ils peuvent largement dépasser les limites géographiques des îles, donnant à leur isolement terrestre une dimension toute relative. Ces systèmes forment, comme le rappelle ici S. Chave-Dartoen, de vastes et denses réseaux sociaux et rituels. Ceux-ci englobent des concepts, idéologies et modalités de circulation qui varient tant au niveau local que régional. L'étude de cette variabilité et des dynamiques en jeu est l'objet de l'ar-

ticle de D. Monnerie qui s'appuie sur la description et la comparaison de deux réseaux complexes de relations régionales : l'un couvrant le Nord-Ouest des îles Salomon et l'autre l'extrême Nord de la Grande Terre de Nouvelle-Calédonie. Son analyse anthropologique non seulement des objets mais aussi des idées, actions et personnes mobilisées l'amène à penser que le premier correspond à un réseau hétérogène, en « patchwork », alors que le second est beaucoup plus homogène. Il apparait aussi que les réseaux décrits peuvent interagir avec d'autres, conduisant l'auteur à proposer l'idée d'un « paradigme des relations régionales » à l'échelle de l'ensemble de l'Océanie. À cette variabilité des réseaux sociaux fait écho la variabilité culturelle qui caractérise l'aire mélanésienne au moment du contact européen. L'origine de cette variabilité reste néanmoins difficile à appréhender notamment à l'échelle de l'île comme le souligne l'article de J. Specht examinant les différences marquées entre quatre régions de Nouvelle-Bretagne (archipel Bismarck), une île de 600 km de long dont la largeur n'excède pas 80 km.

Ces systèmes de relations et d'interactions, au cœur des dynamiques traditionnelles et contemporaines océaniennes, étaient déjà présents dès les premiers temps de la colonisation humaine des îles. Des structures spatiales liées à la diffusion d'objets, de matières et de savoir-faire sont régulièrement reconstruites à l'aide de données archéologiques alors que le développement, à partir des années 1990, de méthodes d'analyses géochimiques facilite l'identification de la provenance de divers matériaux. Citons à titre d'exemple l'argile utilisée dans la fabrication des céramiques Lapita (Dickinson *et al*., 2013) ou les roches basaltiques employées pour obtenir les lames d'herminette en Polynésie (Weisler, 1997). La contribution d'A. Hermann reprend ce dernier thème et montre, grâce à l'analyse des sources d'approvisionnement en matière lithique, que l'île de Tubuai dans l'archipel des Australes (Polynésie française) participait d'un réseau d'échange, et donc d'un espace social, probablement étendu à la période pré-européenne. Trois des artefacts lithiques découverts sur le site d'Atiahara, occupé entre les XII^e^ et XV^e^ siècles, présentent des compositions géochimiques exogènes, dont une lame d'herminette en basalte d'Eiao, île située à 1 500 km au nord, dans l'archipel des Marquises. Ces indices physiques de transfert de matières sur de longues distances sont à rattacher aux stratégies de navigation déployées de longue date par les Océaniens. Le voyage, les migrations, les embarcations et les savoir-faire en matière de navigation sont autant d'aspects sur lesquels se sont focalisées les discussions et les recherches depuis que les navigateurs européens ont découverts le Pacifique (voir par exemple Finney, 1979 ; Irwin 1992). Dans sa contribution A. Di Piazza analyse la description d'un type d'embarcation du Centre du Vanuatu (Malakula), disparue avant 1914, qu'a donné J. W. Layard dans un manuscrit rédigé au début du XX^e^ siècle. Observant que cette pirogue, dotée d'une plateforme-balancier et gréée avec une voile à livarde, présente des caractéristiques tant polynésienne que micronésienne, l'auteure montre bien qu'à la fin de la Préhistoire, le Centre et le Nord du Vanuatu devaient se trouver au cœur d'un réseau où circulaient idées et savoir-faire incluant des îles polynésiennes, les plus proches étant Anuta et Tikopia. Il semblerait en définitive, si l'on suit le raisonnement reposant sur une analyse anthropologique des termes austronésiens **banua*, **panua*, *fenua* que propose ici S. Chave-Dartoen, que la mobilité soit au fondement des ensembles sociaux océaniens, de leur conceptions des territoires et paysages, et par conséquent de leur définition des espaces physiques, sociaux et cognitifs.

Il nous est agréable de remercier ici les auteurs des articles qui composent ce volume. Nous remercions aussi les relecteurs anonymes, choisis au sein de la communauté scientifique internationale, dont les conseils ont permis de compléter et d'améliorer la qualité des contributions. Les auteurs restent, au final, seuls responsables des idées émises dans leur texte. Un grand merci s'adresse aussi aux autres participants à cette séance de la Société préhistorique française de janvier 2014 qui contribuèrent au succès de cette entreprise, en dynamisant et élargissant les débats. Les soutiens financiers et logistiques indispensables nous ont été principalement accordés par le CIRAP dirigé par É. Conte, l'IANCP dirigé par C. Sand et l'équipe Ethnologie préhistorique de l'UMR 7041 dirigée par P. Bodu que nous remercions ici. Notre gratitude s'étend également à l'université Paris 1-Panthéon-Sorbonne pour l'attribution d'un bonus qualité recherche (BQR) et le prêt de l'auditorium de l'INHA, ainsi qu'à toutes les personnes qui nous ont aidés à organiser la séance, en particulier les étudiants inscrits dans la filière Océanie de l'université Paris 1 – Panthéon-Sorbonne. Nous remercions aussi les collègues du conseil d'administration de la Société préhistorique française, Claude Mordant, Laure Salanova, Jean-Pierre Fagnart, Claire Manen, Martin Sauvage et Cécile Tardif avec qui nous avons pu mener à bien cette manifestation et le volume ici présenté.

NOTES

(1) Il est aujourd'hui admis que le peuplement humain de l'aire océanienne, au sens large du terme, c'est-à-dire englobant aussi le continent australien, s'est effectué en trois grandes étapes fondatrices. L'arrivée des premiers groupes sur le continent Sahul (une vaste région regroupant l'Australie, la Tasmanie et la Papouasie – Nouvelle-Guinée, reliées entre elles par des ponts terrestres lors des baisses du niveau marin) remonterait aux environs de 50000-40000 BP, le premier peuplement des îles orientales proches de la Papouasie – Nouvelle-Guinée participant de ce mouvement. Bien plus tard, aux environs de 1500 BC., les communautés Lapita parlant des langues de la famille austronésienne, s'aventurent plus à l'est, au-delà des îles Salomon à travers le Vanuatu, la Nouvelle-Calédonie et les Fidji jusqu'à Tonga et Samoa. Il faudra ensuite attendre le tournant du Ier millénaire de notre ère pour voir les Polynésiens coloniser rapidement le « triangle » (Hawaii, île de Pâques, Nouvelle-Zélande et les archipels centraux des îles Cook et l'actuelle Polynésie française). À la suite

des premières installations, les groupes vont peu à peu développer des traits spécifiques qui définiront les sociétés traditionnelles redécouvertes par les explorateurs occidentaux à partir du xve siècle signant la fin de la Préhistoire océanienne (Kirch, 2000).

(2) Le processus d'intensification horticole-agricole en lien avec une expansion démographique et une complexification socio-politique est une constante de la fin de la préhistoire des archipels océaniens, en Mélanésie comme en Polynésie ; plusieurs exemples sont cités par P. Kirch (Kirch, 2000).

(3) Il existe plusieurs dénombrements des divisions territoriales de l'île de Pâques, affichant des chiffres différents selon les auteurs (voir Martinsson-Wallin et Wallin, 2014).

RÉFÉRENCES BIBLIOGRAPHIQUES

Anderson A. (1996) – Adaptive Voyaging and Subsistence Strategies in the Early Settlement of East Polynesia, *in* T. Akazawa et E. J. E. Szathmáry (dir.), *Prehistoric Mongoloid Dispersals*, Oxford, Oxford University Press (Oxford Science Publications), p. 359-373.

Bellwood P. (1979) – Settlement Patterns, *in* J. D. Jennings (dir.), *The Prehistory of Polynesia*, Cambridge, Harvard University Press, p. 308-322.

Chavaillon C., Olivier É. (2007) – *Le patrimoine archéologique de l'île de Hiva Oa (archipel des Marquises)*, Tamanu, Service de la culture et du patrimoine (Dossier d'archéologie polynésienne, 5), 179 p.

Conte É. (1990) – *Archéologie des Tuamotu (Polynésie française) : prospection de dix atolls du centre de l'archipel*, Punaauia, Centre polynésien des sciences humaines, 102 p.

Conte É. (2000) – *Archéologie en Polynésie française* : *esquisse d'un bilan critique*, Papeete, Éditions Au Vent des Îles, 302 p.

Conte É., Molle G. (2012) – *Vestiges d'une histoire marquisienne* : *contribution à l'archéologie de Ua Huka*, Faa'a, CIRAP (Les Cahiers du CIRAP, 2), 108 p.

Davidson J. M. (1976) – The Prehistory of Western Polynesia, *in* J. Garanger (dir.), *La préhistoire océanienne, colloque 22*, actes du neuvième congrès de l'UISPP (Nice, 13-18 septembre 1976), Paris, CNRS, p. 27-51.

Dickinson W. R., Bedford S., Spriggs M. (2013) – Petrography of Temper Sands in 112 Reconstructed Lapita Pottery Vessels from Teouma (Efate): Archaeological Implications and Relations to Other Vanuatu Tempers, *Journal of Pacific Archaeology*, 4, 2, p. 1-20.

Finney B. (1979) – Voyaging, *in* J. D. Jennings (dir.), *The Prehistory of Polynesia*, Cambridge, Harvard University Press, p. 323-51.

Frimigacci D. (1980) – Localisation éco-géographique et utilisation de l'espace de quelques sites Lapita de Nouvelle-Calédonie : essai d›interprétation, *Journal de la Société des océanistes*, 36, 66-67, p. 5-11.

Garanger J. (1964) – Recherches archéologiques dans le district de Tautira, Tahiti, Polynésie française, *Journal de la Société des océanistes*, 20, 20, p. 5-22.

Garanger J. (1976) – *La préhistoire océanienne, colloque 22*, actes du neuvième congrès de l'UISPP (Nice, 13-18 septembre 1976), Paris, CNRS, 251 p.

Garanger J. (1980) – Prospections archéologiques de l'îlot Fenuaino et des vallées Aiurua et Vaiote à Tahiti, *Journal de la Société des océanistes*, 36, 66-67, p. 77-104.

Green R. C. (1961) – Moorean Archaeology: A Preliminary Report, *Man*, 61, p. 169-173.

Green R. C (1984) – Settlement Pattern Studies in Oceania: An Introduction to a Symposium, *New Zealand Journal of Archaeology*, 6, p. 59-69.

Green R. C., Davidson J. M. (1969) – *Archaeology in Western Samoa*, I, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 6), 278 p.

Green R. C., Davidson J. M. (1974) – *Archaeology in Western Samoa*, II, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 7), 290 p.

Green R. C, Green K., Rappaport R. A., Rappaport A., DavidsoN J. M. (1967) – *Archaeology on the Island of Mo'orea, French Polynesia*, New York, American Museum of Natural History (Anthropological Papers of the American Museum of Natural History, 51), 230 p.

Irwin G. (1992) – *The Prehistoric Exploration and Colonisation of the Pacific*, Cambridge, Cambridge University Press, 240 p.

Julien M., Karlin C. (2014) – *Un automne à Pincevent. Le campement magdalénien du niveau IV20*, Paris, Société préhistorique française (Mémoire, 57), 639 p.

Kennett D. J., Anderson A., Winterhalder B. (2006) – The Ideal Free Distribution, Food Production and the Colonization of Oceania, *in* D. J. Kennett et B. Winterhalder (dir.), *Behavioral Ecology and the Transition to Agriculture*, Berkeley, University of California Press (Origins of Human Behavior and Culture, 1), p. 265-288.

Kirch P. V. (1985) – *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*, Honolulu, University of Hawaii Press, 360 p.

Kirch P. V. (2000) – *On the Road of the Winds. An Archaeological History of the Pacific Islands before European Contact*, Berkeley, University of California Press, 446 p.

Kirch P. V., Kahn J. G. (2007) – Advances in Polynesian Prehistory: A Review and Assessment of the Past Decade (1993-2004), *Journal of Archaeological Research*, 15, 3, p. 191-238.

Leenhardt M. (1937) – *Gens de la Grande Terre*, Paris, Gallimard (L'espèce humaine, 1), 214 p.

Lepofsky D. (1988) – The Environmental Context of Lapita Settlement Locations, *in* P. V. KIRCH et T. L. HUNT (dir.), *Archaeology of the Lapita Cultural Complex: A Critical Review*, Seattle, Thomas Burke Memorial Washington State Museum (Thomas Burke Memorial Washington State Museum Research Report, 5), p. 33-47.

Lessa W. A. (1962) – An Evaluation of Early Descriptions of Carolinian Culture, *Ethnohistory*, 9, 4, p. 313-403.

Malinowski B., (1922) – *Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagos of Melanesian New Guinea, Londres, Routledge & Kegan Paul, 527 p.*

Maric T. (2012) – *Dynamiques de peuplement et transformations sociopolitiques à Tahiti, îles de la Société*, thèse de doctorat, université Paris 1 – Panthéon-Sorbonne, 376 p. et 443 p.

Martinsson-Wallin H., Wallin P. (2014) – Spatial Perspectives on Ceremonial Complexes: Testing Traditional Land Divisions on Rapa Nui, *in* H. MARTINSSON-WALLIN et T. THOMAS (dir.), *Monuments and People in the Pacific*, Uppsala, Uppsala University (Studies in Global Archaeology, 20), p. 317-342.

Morrison A. E., O'Connor J. T. (2015) – Settlement Pattern Studies in Polynesia: Past Projects, Current Progress, and Future Prospects, *in* E. COCHRANE et T. HUNT (dir.), *The Oxford Handbook of Prehistoric Oceania*, Oxford, Oxford University Press, 18 p. [DOI: 10.1093/oxfordhb/9780199925070.013.024].

Nunn P. D. (2009) – Geographical Influences on Settlement-Location Choices by Initial Colonizers: A Case Study of the Fiji Islands, *Geographical Research*, 47, 3, p. 306-319.

Ottino Garanger P., De Bergh M. N. (1990) – *Hakao'hoka : étude d'une vallée marquisienne*, Montpellier - Papeete, Fonds IRD (Travaux et Documents Microédités, 66), 103 p.

Quintus S., Clark J. T., Day S. S., Schwert D. P. (2015) – Investigating Regional Patterning in Archaeological Remains by Pairing Extensive Survey with a Lidar Dataset: The Case of the Manu'a Group, American Samoa, *Journal of Archaeological Science*, 2, p. 677-687.

Routledge K. (1919) – *The Mystery of Easter Island: The Story of an Expedition*, Londres, Hazell, Watson and Viney, 404 p.

Sand C., Lilley I., Valentin F., Bolé J., Gony B., Baret D. (2010) – Tiga (îles Loyauté). Préhistoire et ethno-archéologie d'une île mélanésienne en marge, *in* F. Valentin et M. Hardy (dir.), *Hommes, milieux et traditions dans le Pacifique sud*, Paris, De Boccard (Travaux de la Maison Archéologie & Ethnologie René-Ginouvès, 9), p. 33-46.

Walter R. (1998) – *Anai'o: The Archaeology of a Fourteenth Century Polynesian Community in the Cook Islands*, Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 22), 115 p.

Weisler M. I. (1997) – *Prehistoric Long-Distance Interaction in Oceania: An Interdisciplinary Approach*, Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 21), 237 p.

Frédérique Valentin
UMR 7041
Maison de l'archéologie et l'ethnologie
21, allée de l'université
92023 Nanterre (France)
frederique.valentin@mae.u-paris10.fr

Guillaume Molle
The Australian National University
AD Hope Building
14, Ellery Crescent
Canberra, ACT 2601 (Australie)
guillaume.molle@anu.edu.au

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 15-30
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Field Mapping and Polynesian Prehistory

A Methodological History and Thoughts for the Future

James L. Flexner and Patrick V. Kirch

Abstract: Archaeologists have long acknowledged that disciplinary history is very important for understanding not only how far we have come, but also for understanding why we do things in certain ways and not others. Further, it is clear that there are different regional bents to the history of archaeology. In the Pacific, much of the surface archaeology is composed of stone architecture, from the massive stone *moai* of Rapa Nui, to more humble stone walls, terraces, and house sites that cover this and many other islands. In Oceania, and especially Polynesia, the development of the 'settlement pattern approach' from the 1960s onwards has been especially influential in regional archaeological history and contemporary practice. The settlement pattern 'turn' in Oceania included a notable visual change with the integration of site plans at various scales as a way of describing archaeological landscapes. Maps obviously have a much longer history in the representation of cultures as well as archaeological sites in Oceania as well. Exploring the history of visual representations of past places, and the techniques through which these images were produced, is an important part of the history of archaeology in the Pacific and elsewhere. In the 21st century, the traditional mapping equipment available to archaeologists (tape and compass, alidade and plane table, theodolite) has been augmented with a host of modern technologies (GPS, 3-dimensional laser scanning, LIDAR, CAD, GIS, and other mapping software). Yet the advent of high-tech mapping solutions does not negate the value of more traditional techniques, and in fact there are many reasons why the old methods persist. While our technology gets faster and more precise, there is still much to recommend approaches that require the mapping of Pacific archaeological landscapes by hand, 'stone-by-stone' when searching for meaning in past settlement patterns. This is especially true in regards to training future generations of Pacific archaeologists, and the increasing consideration of alternative (especially indigenous) epistemologies in Pacific archaeology.

Keywords: history of archaeology, mapping, field methods, Polynesia, settlement pattern archaeology.

Cartographie de terrain et Préhistoire polynésienne: historique des méthodes et perspectives

Résumé : Les archéologues savent combien l'histoire de leur discipline est importante pour estimer le chemin parcouru mais aussi pour comprendre les différents tournants qu'elle a pris, en suivant notamment les particularités chrono-culturelles. Dans le Pacifique, l'archéologie de surface porte essentiellement sur les architectures de pierre, depuis les grands moai de l'île de Pâques aux simples murs, terrasses et habitations rencontrées sur la plupart des îles. En Océanie, et particulièrement en Polynésie, le développement des *settlement patterns* (études de l'organisation spatiale de l'habitat) à partir des années 1960 a largement influencé les pratiques archéologiques dans la région. Cette approche introduisit en effet une nouvelle manière de décrire les paysages archéologiques par l'intégration de plans à différentes échelles. Bien sûr, la cartographie de terrain fut toujours essentielle dans la représentation des sociétés et des sites dans l'ensemble de l'Océanie. Explorer l'histoire des représentations graphiques des lieux anciens, ainsi que des techniques grâce auxquelles elles sont produites, constitue un pan essentiel de l'histoire de l'archéologie. Au xxie siècle, l'équipement classique de cartographie (mètre, compas, alidade et théodolite) s'est enrichi de nouveaux outils modernes (GPS, scanner 3D, LIDAR, DAO, SIG et autres logiciels informatiques). Pourtant, l'arrivée de ces outils ne remet aucunement en question la valeur des méthodes traditionnelles dont l'usage persiste pour plusieurs raisons. Bien que les moyens technologiques désormais à notre disposition ne cessent de se perfectionner, la cartographie manuelle, « pierre par pierre », reste la plus recommandée pour comprendre les modalités d'occupation spatiale. C'est notamment le cas lorsqu'il s'agit de former au terrain les futures générations d'archéologues, mais aussi au regard des nouvelles manières, notamment autochtones, de penser l'archéologie dans le Pacifique.

Mots-clés : histoire de l'archéologie, relevé cartographique, méthodes de terrain, Polynésie, modèles de l'occupation de l'espace.

In a recent article, M. Bowden and D. McOmish (Bowden and McOmish, 2011) outline the history of what they call 'the British tradition' of field archaeology, focusing on the unique approach that English and Scottish surveyors use for the interpretive mapping of earthworks. This is one example of a regional sub-tradition in archaeological practice. Regional methodological histories are valuable for understanding relationships between techniques, interpretations, and broader patterns of thought within different areas of the discipline (e.g. Christenson, 1989; Trigger, 1989; Willey and Sabloff, 1980). Here, we explore some of the legacies and possible future directions for archaeological mapping techniques in Oceania, to see if a look back can give us a sense of where we might be going (e.g. Kirch, 2000, p. 12–41). More specifically, this paper focuses on the history of archaeological maps of stone structures in Polynesia. A brief look at archaeology in Melanesia and Micronesia suggests that there are probably similar patterns in these regions, but further research would certainly refine these observations.(1)

Looking back at a sample of projects over the history of Polynesian archaeology, we can infer the development of a distinctive regional tradition of archaeological cartography, though it is surprising to see the apparently recent vintage of what are familiar techniques and standards for many archaeologists whose fieldwork involves mapping Polynesian archaeological sites. Maps of Polynesian stone structures can be grouped into three basic categories in order to understand the development of archaeological cartography in the region. These are:

– Sketches: beginning with Enlightenment-era visualization techniques, notably explorers' and travelers' accounts, sketches involve the humanistic representation of the landscape in drawn form.

– Schematics: emerging from some of the early scientific explorations of archaeological sites, schematic maps and drawings distill architectural details into a more basic form for the sake of interpretation, usually as simple annotated line drawings.

– Scientific plans: A hallmark of the settlement pattern approach to archaeological landscape recording, though present in earlier phases of Polynesian archaeology as well, scientific plans involve a top-down, relatively spatially precise representation of the archaeological remains of stone structures. Beginning in the 1960s, plans tend to shift from individual sites to broader archaeological landscapes, often integrating archaeological remains with other landscape features such as topography or water sources.

To be sure, these are not mutually exclusive categories that progressed directly one from the other in a linear fashion. There are many maps that feature aspects of all three categories, and there is historical overlap between them as visualization techniques. However, there is a broad tendency for the earliest representations of Polynesian cultural sites, including archaeological remains, to be sketches, followed by more schematic representations during the early and middle parts of the twentieth century, with plans coming to the forefront of mapping practices in the region within the last fifty years or so. The plan map of Polynesian archaeological sites appears to be the dominant technique used from the 1960s onwards, and we argue that this especially has come to define the Polynesian tradition of archaeological cartography.

Thus these categories provide a useful framework for considering the evolution of mapping practices over the last century or more in Polynesia, which can be related to the evolution of archaeological thought in the region. A full review of the sources is not possible here, so a few examples will be used to illustrate the basic properties of each category, and to try to situate the different practices historically. Because we are focusing on stone structures, we will not be discussing earthworks or fortifications, though mapping of such features is certainly an important part of Polynesian archaeology, notably in Samoa and New Zealand (e.g. Best, 1993; Groube, 1970; Irwin, 1985). It does appear that mapping of earthworks follows a similar historical trajectory from impressionistic sketches to measured plans but this would be worth examining in greater detail. In addition, this study is based heavily on Anglophone, and particularly Americanist sources. Future research could beneficially explore the contributions of other national traditions, notably French but also German, Scandinavian, Japanese, and others in the development of archaeological visualization in Oceania.

As part of this discussion, archaeologists need to consider the relationship between cartographic technology and interpretation (e.g. Flexner, 2009; McCoy and Ladefoged, 2009). Archaeologists have always availed themselves of available cartographic methods and instruments. In the mid-twentieth century, the optical alidade and plane table were preferred instruments for site and landscape mapping. However, as aerial photography and photogrammetry emerged after World War II these new techniques rapidly made their way into the archaeologist's tool kit, as did global positioning systems (GPS) and geographic information systems (GIS) in the 1990s. Historical perspectives are particularly important as archaeologists increasingly adopt technology that is unprecedented in terms of precision from a Cartesian perspective, but which is only processed and interpreted at some distance away from our field sites. There is a critical interpretive side to mapping practice that is related to the technologies and techniques that we use in the field, as well as the theoretical frameworks we use (Bender et al., 1997; Tomášková, 2007). Variability in visualization techniques is valuable as it can relate to a diversity of interpretive perspectives, which are crucial to ongoing debates in the discipline.

THE ROOTS OF ARCHAEOLOGICAL MAPPING IN POLYNESIA

Interest in cultural traditions as well as archaeological sites marked many of the early encounters between

Europeans and Polynesians, if only in passing. The Dutch explorer Jakob Roggeveen briefly noted with interest in 1722 the presence of large stone idols that were worshipped by the natives of Easter Island (which they called Rapa Nui; Beaglehole, 1966, p. 182). Lieutenant Webber, who served on the last of Cook's voyages around the world, produced an illustration of a large *luakini heiau* or war temple near Waimea on Kaua'i Island around 1778 (reproduced in Greene, 1993, illustration 82). Early discoveries of Polynesian prehistory even resulted in a few site plans. The draughtsman of Jean-François de La Pérouse's voyage around the world produced a detailed figure of stone structures from Rapa Nui (fig. 1). During the 1838-1842 United States Exploring Expedition, led by Lieutenant Charles Wilkes, a similar plate was produced depicting the temple Ahu a 'Umi on the island of Hawai'i, arguably the first scientific representation of a Hawaiian archaeological site (Kirch, 1985, p. 11). These more formal pictures of Polynesian archaeological sites are fascinating for their representation of an Enlightenment way of seeing, reminiscent of figures from Diderot's *Encyclopédie*: organized, authoritative, and slightly idealized in representing the symmetry and uniformity of construction of these sites. The scientists and surveyors on eighteenth and nineteenth century scientific expeditions were often trained in botanical techniques or the production of sketches with navigational value, and the aesthetic of these early representations would have followed from the formalism of these traditions.

A tradition of humanistic representations of Polynesian archaeological sites involves sketches that attempt to represent what a given site looked like at a given moment to a particular observer. Sketches have a legacy dating back to eighteenth and nineteenth century European visits to Polynesia, where scientists, missionaries, or traders might record unique or interesting cultural features as part of their travels. Louis-Antoine de Bougainville, James Cook, and the other Enlightenment explorers and their scientist passengers, such as Joseph Banks and Johann and Georg Forster, regularly recorded, collected, and often sketched cultural 'curiosities' throughout the Pacific, sometimes including temples, houses, and other features of cultural landscapes (Beaglehole, 1966, p. 195–324; Kirch, 1985, p. 3, 10 and 2000, p. 12–14). The missionary William Ellis (Ellis, 1833, p. 262, 266) provides a few sketches along with his description of the enormous temple at Atehuru in the Society Islands. Missionaries may have sketched 'heathen' sites as part of their documentation of what they wrongly presumed to be the disappearance of indigenous religion as Christianity expanded in Oceania. Images of ruins such as these could be interpreted as slightly romantic in nature, conforming

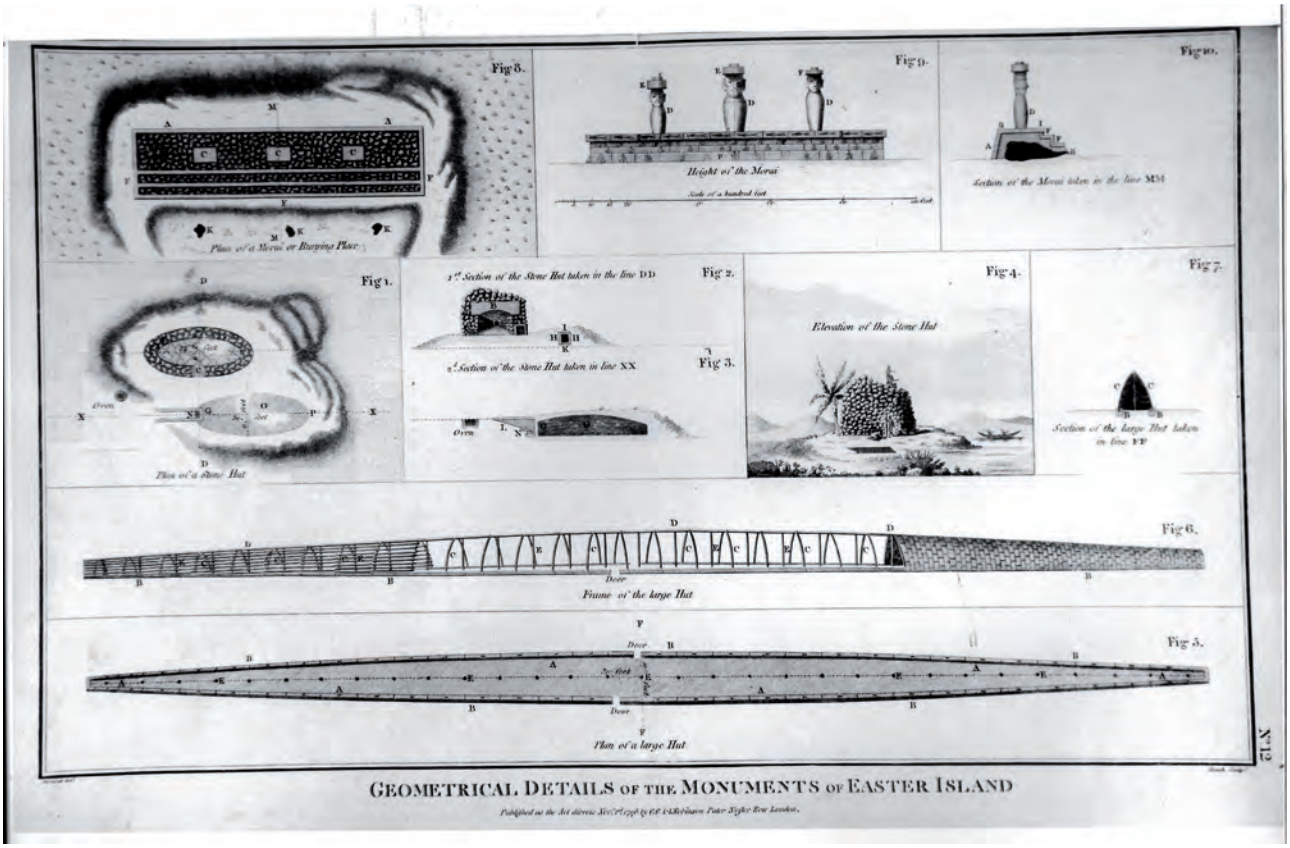


Fig. 1 – Plate of Easter Island stone structures produced from La Pérouse's voyage through the Pacific, engraved in 1798 (collection of P. V. Kirch).

***Fig. 1** – Planche illustrant des structures en pierre de l'île de Pâcques, produite par l'expédition de La Pérouse à travers le Pacifique, gravure de 1798 (collection de P. V. Kirch).*

to a prominent aesthetic of the time. It was not until over a century later that the first archaeological research—in a truly modern sense—began. It is among the first systematic archaeological studies in the early 1900s that we can trace out the first lines of cartographic practice in Polynesian archaeology.

Katherine Routledge's visit to Rapa Nui in the early twentieth century represents in many ways a transition from the piecemeal observations of travelers to more systematic, scientific observations of archaeological remains. The figures produced from the Routledge's expedition reflect this, consisting of a number of sketches (e.g. Routledge, 1919, fig. 42; fig. 47; fig. 60; fig. 60A) that record some of the first detailed observations of the quarry sites where Rapa Nui's iconic megalithic sculptures *(moai)* were produced. This transition is found in schematic perspectival drawings of stone platforms (ahu; e.g. Routledge, 1919, fig. 36; fig. 40), and in Routledge's systematic mapping of the quarry sites at Rano Raraku (fig. 2). In this early work, the lone plan-view map of an archaeological feature that appears is diagrammatic, an idealized sketch of a canoe-shaped house not unlike that produced during Jean-François de La Pérouse's voyage over a century earlier (Routledge, 1919, fig. 85).

A landmark study in the history of Polynesian archaeology was John F. G. Stokes' survey of temple sites *(heiau)* on the island of Hawai'i from 1906-1908 (Stokes, 1991), and of temples on Moloka'i in 1909 (Stokes, ms.). John F. G. Stokes is widely credited as being the first 'modern' archaeologist of Polynesia, ahead of his time in such respects as recognizing the importance of stratigraphy (Kirch, 1985, p. 10–13 and 2000, p. 21). The Hawaiian *heiau* survey was explicitly designed to test an hypothesis arising from the oral traditions collected by Abraham Fornander: that an earlier, open platform type of temple foundation was later replaced by temples with walled enclosures, following the arrival of the priest Pā'ao from Tahiti. This project was notable in that John F. G. Stokes set out to systematically document every known *heiau* site on these islands using the knowledge of local informants, both native Hawaiians and sugar cane planters. Where the stone foundations of the heiau were well-preserved, John F. G. Stokes used a transit to map the stonework, later drawing and inking in plan and cross-section maps of the architecture. At the same time, a large format view camera was used to take photographic plates of the standing architecture; the glass plate negatives are still preserved in the Bishop Museum archives. In some maps the walls and terrace facings are depicted by lines

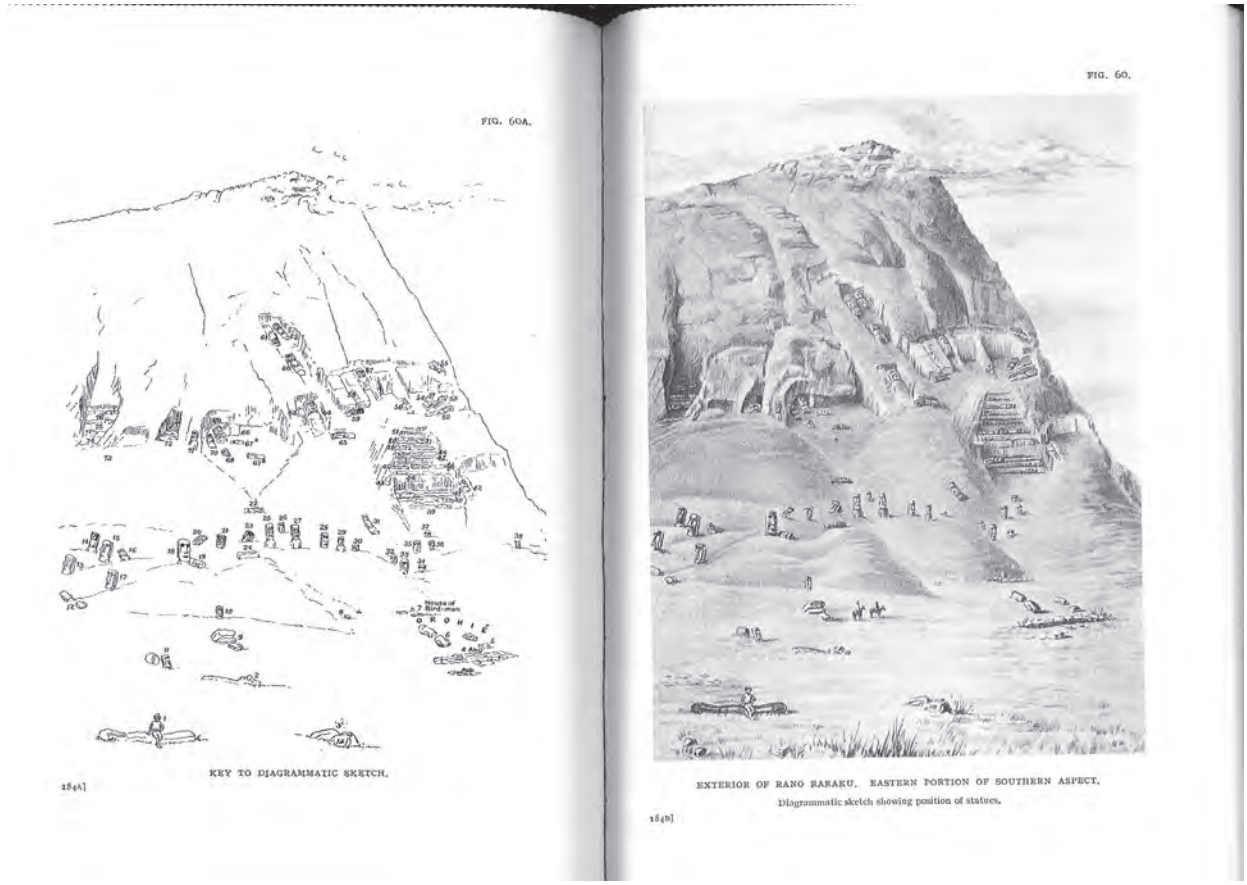


Fig. 2 – Diagramatic sketch of a portion of the Rano Raraku quarry site on Rapa Nui, produced during the Routledge expedition (after Routledge, 1919, fig. 60A).

***Fig. 2** – Croquis schématique d'une partie de la carrière de Rano Raraku sur Rapa Nui, dessiné pendant l'expédition Routledge (d'après Routledge, 1919, fig. 60A).*

while in others individual stones are inked in. John F. G. Stokes also precisely situated the temples in geographic space by using his transit to take bearings to key trigonometric stations established by the Hawaiian Government Survey. In total, over forty examples of Hawaiian religious architecture were carefully mapped during John F. G. Stokes' fieldwork on Hawai'i Island, and dozens more on Moloka'i. John F. G. Stokes had a remarkably modern eye for mapping Hawaiian surface architecture, producing detailed plans as well as schematics of *heiau* sites (fig. 3). He ultimately decided that it was impossible to prove the hypothesis of a change in form of *heiau* architecture from the archaeological remains given the great variability he encountered in the Hawaiian temples.

The research carried out by John F. G. Stokes is notable for the history of Polynesian archaeology for several reasons. First, he used local knowledge, both from historical sources (primarily Hawaiian traditions that had been written down in the nineteenth century, see Kamakau, 1976; Malo, 1951) and living native Hawaiian informants. Archaeologists continue to use the traditions of Polynesians as an interpretive tool for understanding stone structures, though this approach has waxed and waned over the history of the discipline in the region (e.g. Dye, 1989 and 1991; Kirch, 2010). Second, as noted above, John F. G. Stokes used realistic and accurate maps of stone structures to test an explicit hypothesis about the Polynesian past. In many ways, this prefaces the kind

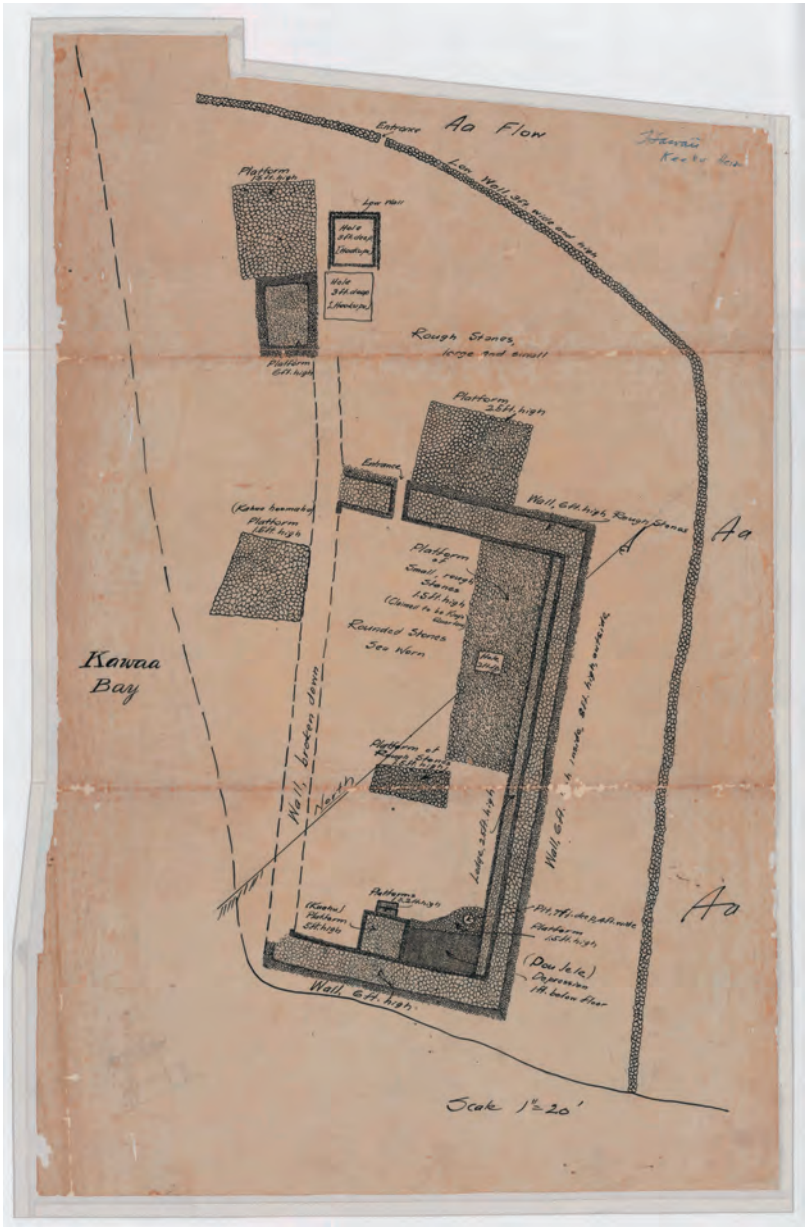


Fig. 3 – Plan map of Ke'eku *Heiau*, Hawai'i island (original map by J. F. G. Stokes; reproduced with permission of the Bernice Pauahi Bishop Museum, scan SP 202437).
Fig. 3 *– Plan de Ke'eku Heiau, Hawai'i (carte originale dessinée par J. F. G. Stokes, reproduite avec l'autorisation du Bernice Pauahi Bishop Museum, scan SP 202437).*

of back-and-forth between hypothesis and map that has been a hallmark of the later settlement pattern approach. Third, John F. G. Stokes likely was the first to regularly use the then-new technology of photography as a visualization tool to augment his maps of these historical sites. While not specifically the focus of this paper, it would be worthwhile to examine the role of photography in changing ways of looking at archaeological sites in Polynesia, and more generally in field archaeology (e.g. Dorrell, 1994, p. 1–7; Feyler, 1987).

FROM SITE SURVEYS TO SETTLEMENT PATTERNS

From the 1920s to 1960s, the scope of research in Polynesian archaeology expanded exponentially. One outcome of the First Pan-Pacific Scientific Conference held in Honolulu in 1920 was the recognition of 'the problem of Polynesian origins' as a major scientific issue. Bishop Museum director Herbert Gregory obtained financial support to launch the Bayard Dominick Expeditions to several Polynesian archipelagoes, each field team integrating archaeology, ethnography, physical anthropology, and in some cases ethnobotany to systematically obtain data with which to tackle the Polynesian origins problem. The archaeologists included John F. G. Stokes on the Austral islands expedition, Ralph Linton on the Marquesan expedition, Will Carleton McKern on the Tongan expedition, and Kenneth Emory on the Hawaiian field team. With the exception of Will Carleton McKern in Tonga, no subsurface excavations were undertaken, with a result being a focus on documenting the diversity of stone monuments in each archipelago (Kirch, 2000, p. 20–24).[(2)] Will Carleton McKern's maps of Tongan *langi* are typical of those produced by the Bayard Dominick field teams: schematic in nature, with solid lines representing the stone retaining walls of these terraced structures (e.g. McKern, 1929, p. 16, 36, and 38–40), though he does provide some detailed sketches of specific stones deemed particularly interesting from a few of these sites (e.g. McKern, 1929, p. 16 and 38). Will Carleton McKern's most detailed map, though still executed in the schematic style, came from the 'King's Village' of Lapaha (fig. 4; McKern, 1929, p. 92–101). His work was groundbreaking in many ways, but in the pre-radiocarbon era, he failed to recognize the significant antiquity of the human settlement of Tonga, which has been revealed by subsequent investigations (e.g. Burley and Dickinson, 2010; Burley et al., 2012). This resulted in a limited view of Tongan prehistory, as recognizing time depth is a critical first step towards analyzing historical dynamism.

Kenneth Emory, who initially focused on the Hawaiian archipelago, would later rise to become one of the most prominent Polynesian archaeologists of the twentieth century. An initial survey of stone structures within Haleakalā crater on Maui island (Emory, 1921) was soon followed by a more extensive reconnaissance of the island of Lāna'i (Emory, 1924). As is typical of most early archaeologists, Kenneth Emory does not inform us about the methods he used to make his maps, but his Lāna'i survey includes sketch plans of *heiau* (Hawaiian temples) that appear to have been made with compass and tape. Especially notable is the larger scale map of the village site of Kaunolu (Emory 1924, plate II), printed as a separate fold-out. This may be the first map of an entire settlement complex in Polynesia, foreshadowing Roger Green's later settlement pattern surveys by nearly forty years. Kenneth Emory also worked in the schematic mode, although his work (e.g. Emory, 1928 and 1934) is notable in that it often included perspective as well as plan drawings (e.g. Kirch, 1985, p. 96–97; Kirch and Green, 2001, p. 253). Following on the earlier work of John F. G. Stokes, he was especially interested in the possibility of documenting temporal changes in the form of Polynesian monumental architecture; his perspective drawings especially represented ideal types that could be used to document migration and local cultural evolution among different Polynesian societies. These were influential in developing some of the early models for Polynesian migration, though like John F. G. Stokes before him, Kenneth Emory ultimately found the variability of monumental architecture to be too great to clearly answer questions about origins.

Throughout the 1920s and 1930s surface surveys of monumental architecture continued to be made, under the auspices of the Bishop Museum, in Hawai'i (Bennett, 1931; McAllister, 1933a and 1933b), the Society islands (Emory, 1933), the Equatorial islands (Emory, 1934b), the Tuamotu archipelago (Emory, 1934a), and the Mangareva islands (Emory, 1939). In virtually all of the work, the single stone monument (usually a heiau or a marae) was the focus, rather than groups of sites or settlement complexes. One exception were the small, uninhabited islands of Nihoa and Necker (Mokumanamana), where Kenneth Emory (Emory, 1928) conducted what could be considered intensive and systematic surveys of the entire archaeological landscapes. Site mapping continued to be done by simple compass-and-tape, or just by sketching with estimated measurements. Moreover, unlike John F. G. Stokes who had employed a transit to determine precise geographic coordinates for sites, later archaeologists in the Bishop Museum tradition mostly 'guesstimated' site locations on island maps.

A native Hawaiian man named Henry Enoka Palenapa Kekahuna, who worked as Kenneth Emory's research assistant, produced a remarkable set of mid-twentieth century Polynesian archaeological maps (copies of these maps are now available online, Bishop Museum, 2013). Henry Kekahuna had a sensitive eye for detail, and the plan maps that he produced in the 1950s were in many ways an indicator of things to come for the state of the art in Polynesian archaeology. Notably, Henry Kekahuna often recorded important ethnobotanical observations on his plans, prefacing the ongoing interest in environmental archaeology in the region. Like John F. G. Stokes before him, and many Hawaiian archaeologists since, Henry Kekahuna also tied architectural details on his maps to his knowledge of Hawaiian traditions, either concerning

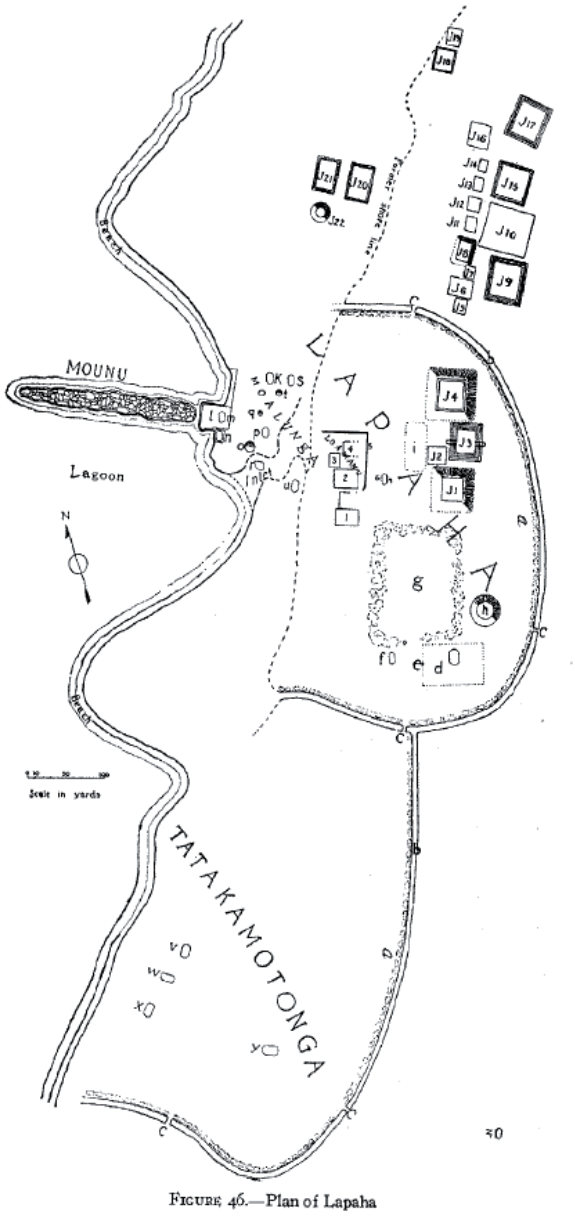


Fig. 4 – Schematic plan of the site of Lapaha, Tonga (from McKern, 1919, p. 95).
Fig. 4 *– Plan schématique du site de Lapaha, Tonga (d'après McKern, 1919, p. 95).*

specific sites, or more general relationships between religious and cultural beliefs and architectural form.

By mid-century, archaeologists began to shift towards a more holistic examination of cultural change through time, including tracking relationships between culture process, environmental change, and demography. Robert Suggs (Suggs, 1961), working in the Marquesas, was interested in developing a cultural sequence for the islands. Despite his broader research goals, Robert Suggs' maps of village sites *(tohua)* still focused on limited clusters of stone structures or individual monuments. Further, it seems he was more concerned with contextualizing his excavation work through maps, rather than recognizing mapping as a potential interpretive tool for understanding the past (e.g. Suggs, 1961, p. 33). Nonetheless, Robert Suggs was an innovator in that he began to champion a more evolutionary approach to Polynesian archaeology (Kirch, 2000, p. 31-32). Similar transitions in visualization are apparent in the maps produced as part of the Norwegian expedition to Rapa Nui and Eastern Polynesia in 1955-1956. While Thor Heyerdahl's theories of Polynesian origins in South America remain completely incorrect, the detailed plan maps of site complexes from the island continue to provide an important source of information for visualizing a range of stone structures from Rapa Nui's prehistory (Heyerdahl and Ferdon, 1961 and 1965).

The 1960s witnessed the beginning of a paradigm shift in the mapping of archaeological sites throughout Polynesia, related to the application of the 'settlement pattern approach' in the region. Settlement pattern archaeology was pioneered by Gordon Willey (e.g. Willey, 1968) in the Virú valley of Peru. At Harvard University in the

1950s, Gordon Willey emphasized the importance of a settlement pattern approach to his graduate students, including Roger Curtis Green (Kirch, 2000, p. 32). When D. Oliver suggested that he change his research area from the American Southwest to Polynesia, Roger Green conducted the first settlement pattern survey in the ‘Opunohu valley of Mo‘orea, in the Society islands (Green et al., 1967). Roger Green shifted survey-based fieldwork from a focus on individual monumental structures to the recording and documentation of all classes of sites within a particular study area. Especially important was the relationship of architecture, including domestic, agricultural, and ritual features to social and ecological relationships and community structure as reflected in settlement space. This shift to an explicitly settlement pattern approach was accompanied by changes in the mapping techniques employed. Roger Green used a plane table and peep-sight alidade to map site complexes in the 'Opunohu valley. Subsequent settlement pattern work in Polynesia often employed a plane table with telescopic alidade, a method that had been developed primarily for topographic and geologic mapping in the United States from the 1920s on.

The difference between the earlier, site-based surveys of selected monuments and the new, comprehensive settlement-pattern approach is well illustrated by comparing Kenneth Emory's work in the 'Opunohu valley of Mo'orea in the 1920s with that of Roger Green in 1960. Kenneth Emory recorded three marae and a cluster of house sites in the valley, producing stylized, outline plans of the structures (Emory, 1933, p. 105–107, fig. 69–72). In striking contrast, Roger Green recorded no less than three hundred four structures, including round-ended and rectangular house curbings, house terraces, a diversity of marae and shrines, and specialized structures such as archery platforms and assembly platforms (Green et al., 1967, table 13). Not included in this count were numerous areas of agricultural terracing which Roger Green noted but did not attempt to map or record in detail.

Roger Green’s work on settlement pattern archaeology in Polynesia had a massive influence on the cartographic representation of Polynesian stone structures. One of the keys to the settlement pattern approach is the top-down representation of these sites through maps that attempt to represent structures in the landscape on a stone by stone basis as precisely and realistically as possible. There may be schematic elements to these maps, but generally these scientific plans involve line drawings of stone walls, pavings, and other features that attempt to point out the individual elements and construction techniques of a given structure or settlement. This type of map is prominent in Roger Green and colleagues’ early monographs on settlement pattern archaeology in Polynesia (e.g. Green et al., 1967; Green and Davidson, 1969 and 1974), though they appear alongside more schematic maps and some sketches of sites, especially in volume 1 of *Archaeology in Western Samoa* (Green and Davidson, 1969, p. 73, 82, and 84).

As with earlier work, the maps produced through the settlement pattern approach were used to test hypotheses about the past in Polynesia. What the settlement pattern approach involved, however, was a shift away from the kinds of ‘culture history’ questions relating to migration and origins to more ‘processual’ questions about human populations, human-environment interactions, and cultural evolution. We argue that visualization is key here. Archaeological maps, specifically large-scale plan maps integrating a variety of features led to a move away from site-based surveys, to surveys of whole landscapes. The maps produced of stone architecture and its relationship to natural features in the landscape, such as topography and fresh water sources, as well as the relationships of archaeological features to one another, are critical for understanding the kinds of human interactions from which we can start to build our larger models of Polynesian societies. These models can then be brought to bear on even broader anthropological questions.

Roger Green made a huge impact on Hawaiian archaeology during his relatively brief tenure at the Bishop Museum and University of Hawai‘i (1965-70). During this period he initiated or had a major role to play in three projects, all of which applied a settlement pattern approach: the Makaha Valley Project (Green, 1980), the Lapakahi Project (Tuggle and Griffin, 1973), and the Halawa Valley Project (Kirch and Kelly, 1975). In Makaha, plane table mapping was employed to define large complexes of dryland agricultural features integrated with habitation features such as the previously unknown ‘C-shape shelter’ (Green, 1980), as well as to map interior valley irrigation complexes (Yen et al., 1972). In Halawa, Moloka‘i, an inland zone called Kapana was mapped in detail with plane table and alidade (Kirch and Kelly, 1975; here: fig. 5), depicting an array of house sites, *heiau*, and both irrigated and dryland agricultural systems. At Lapakahi on Hawai‘i island, the focus was on a previously undefined kind of extensive dryland agricultural ‘field system’ which extended across a large swath of the Kohala peninsula. There, Paul Rosendahl used plane table mapping to record the intricate network of field embankments and cross-cutting trails, along with habitation and ritual sites (Rosendahl, 1994). Paul Rosendahl's map enabled Patrick Kirch (Kirch, 1984) to propose a temporal model for the intensification of the field system over time, a topic later researched in much greater detail by Michael Graves and Thegn Ladefoged (Ladefoged and Graves, 2006; Ladefoged et al., 1996 and 2003). Lapakahi also saw the first application in Hawai‘i of yet another mapping technology, that of aerial photography and photogrammetry, used by Newman to map part of the vast Leeward Kohala Field System (Newman, 1972).

The new settlement pattern approach was enthusiastically adopted by William Mulloy, who had been involved with the earlier Norwegian Expedition, for a comprehensive survey of Easter Island, an initial phase of which was carried out by P. McCoy (McCoy, 1976) for his doctoral dissertation. Using a then-new set of 1:10,000 scale topographic maps of the island provided by the Chilean Air Force, P. McCoy divided his survey area around the volcanic cone of Rano Kao into five quadrangles, each roughly 4 square kilometers in area (McCoy, 1976, p. 12,

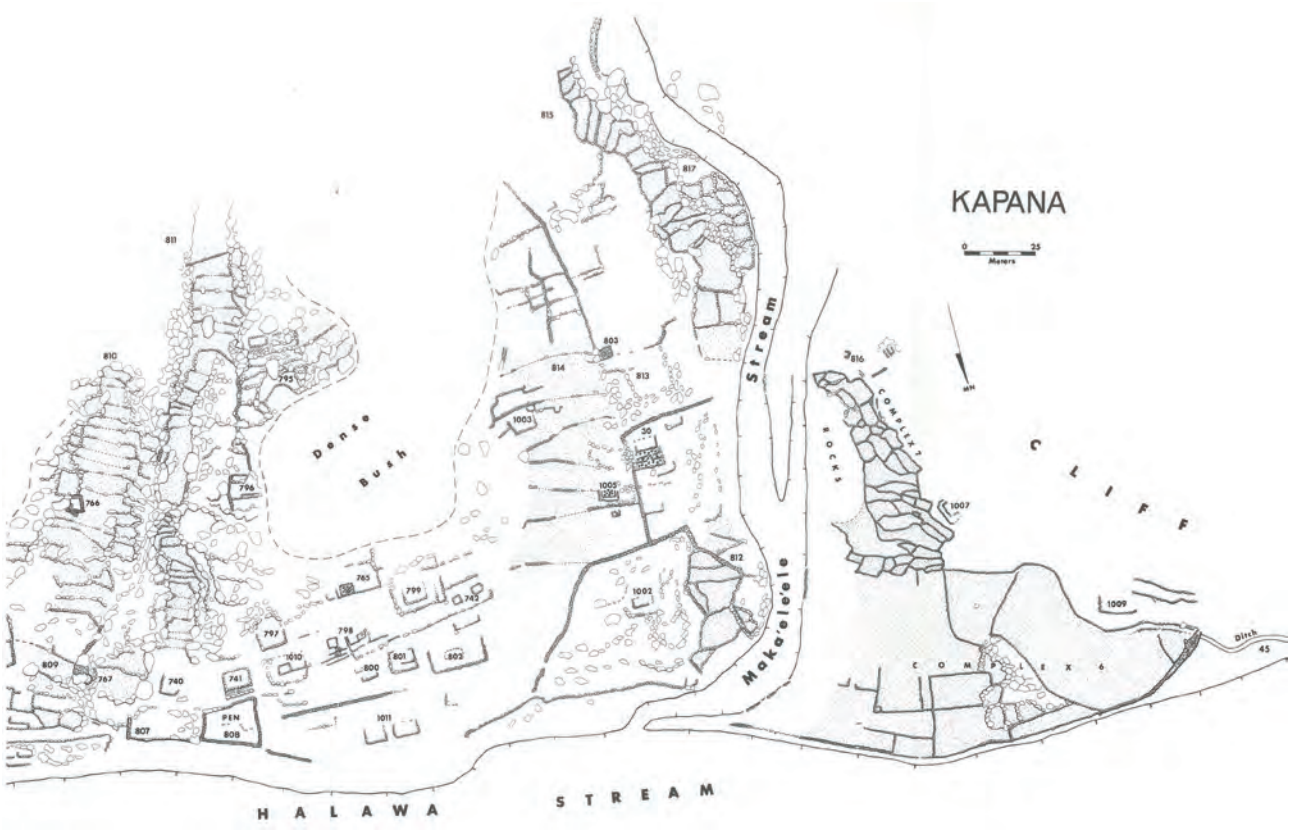


Fig. 5 – Part of the settlement pattern map of Kapana, Halawa (from Kirch and Kelly, 1975).
***Fig. 5** – Extrait du plan d'occupation de Kapana, Halawa (d'après Kirch et Kelly, 1975).*

fig. 4). According to P. McCoy, "the entire landscape was systematically and carefully searched for any evidence of prehistoric human activity" (McCoy, 1976, p. 11). Eight and one-half months of fieldwork yielded 1,738 individual sites which were mapped onto the quadrangle sheets. P. McCoy's analysis of these data not only produced maps of the landscape with schematic representations of individual kinds of features, but also graphical representations of site density over the landscape (McCoy, 1976, p. 131). This kind of statistical representation of settlement patterns drew explicitly on spatial models developed by The New Geographers such as P. Haggett and R. J. Chorley (Haggett and Chorley, 1968).

Scientific plans of archaeological landscapes have come to dominate the cartography of stone structures in Polynesia, as is clear in the maps of subsequent settlement pattern studies throughout the region from the 1970s through the present (for Hawaiian examples see Earle, 1978; Green, 1980; Kirch and Kelly, 1975; Kirch, 1992; Ladefoged et al., 1987; Rosendahl, 1994). In the last few decades, we might define a 'Berkeley' school of archaeological mapping in Polynesia, from Patrick Kirch's influence on a more recent generation of settlement pattern archaeologists. This is especially apparent in the continuing use of telescopic alidade and plane table maps, which feature in much of his students' research (e.g. Flexner, 2010; Kahn, 2005; McCoy, 2006; Millerstrom, 2006; Van Gilder, 2005; Weisler and Kirch, 1985).

DRAWING, SPACE AND TECHNOLOGY FOR THE OCEANIC PAST

Since the pioneering work carried out by Roger Green and his contemporaries, there have been significant developments in cartographic technology (McCoy and Ladefoged, 2009), perhaps none more influential than the development of high-precision GPS (Global Positioning System) technologies for recording archaeological features. Using GPS, archaeologists can record structures on the landscape quickly and relatively precisely, facilitating research on large survey areas. Likewise, 3-D laser scanning allows for the collection of massive amounts of spatial data in recording archaeological features in the landscape (e.g. Mulrooney et al., 2005). Simultaneously, the technology for translating data collected in the field into publishable information has also changed, not only in the almost ubiquitous use of GIS (Geographic Information Systems) but also in the widespread use of vector graphics programs like Adobe Illustrator. This has further contributed to the homogenization of the kinds of images

produced of Polynesian archaeological sites. This is not necessarily a bad thing, as certain forms of standardization can help make archaeological maps more legible from one researcher to the next. However, we need to be careful about limiting the possibilities for visualizing different types of data, especially as they relate to our interpretations of past landscapes.

New cartographic techniques have allowed for the accumulation of an unprecedented amount of new data, as projects using GPS and GIS can now account for thousands of individual features. This has been truly useful for settlement pattern archaeology in Polynesia, expanding the scope and scale of modeling for past landscapes. Recent work in the Hawaiian islands has been particularly fruitful. In the district of Kohala, on the north of Hawai'i island, settlement pattern data from GPS surveys as well as LiDAR (light direction and ranging), not to mention tape-and-compass mapping and plane table survey, has been instrumental in building models of agricultural expansion, intensification, innovation and change in Hawaiian prehistory (e.g. Ladefoged et al. 1996, 2003 and 2011; Ladefoged and Graves, 2006; McCoy and Graves, 2010). Data from archaeological surveys from around Hawai'i has been extrapolated to GIS-based models of agricultural development for the Hawaiian archipelago as a whole, including prediction of agricultural field systems in as-yet unsurveyed areas (e.g. Ladefoged et al., 2009). In the Kohala surveys, telescopic alidade and plane table continue to be used to record and interpret significant architectural details, notably on domestic sites (Field et al., 2010). In Hawaiian historical archaeology, James Flexner (Flexner, 2010 and 2012) has combined plane table mapping with GIS analysis to examine the 'village-like' layout of the landscape of the 19th century Hawaiian leprosy institution at Kalawao, Moloka'i (fig. 6).

From the perspective of cartographic visualization, a critical reappraisal of the images we produce is warranted as more recent digital visualization techniques come to dominate the kinds of maps produced in the field. The goal is not to claim that one particular technique is the 'best' one for representing one site type or another. Rather, in light of the Polynesian tradition of plan mapping outlined above, we should consider what our maps are doing for our interpretations of settlement patterns, and to consider how we might use some of the more traditional techniques alongside more recent digital ones. Settlement pattern archaeology remains a major interest for Polynesian archaeologists. The kinds of line maps produced in a GPS survey, the point clouds produced in laser scanning and LiDAR, and the projection of features in GIS are increasingly common media for representing settlement patterns and stone structures. But, alidade and plane table and tape and compass still have much to contribute to our visualization of Polynesian archaeological features. The kind of stone-by-stone representation necessitated in the analog style of mapping may not be as fast as GPS, or as precise as laser scanning, but it involves an interpretive process that may be lost among the more recently developed techniques (e.g. Flexner, 2009).

The kinds of scientific plans developed as part of the Polynesian tradition of settlement pattern archaeology can be used for many contemporary research purposes. One key issue is that the kind of stone-by-stone maps produced on paper in the field (or in the near future possibly on digital tablets) can be converted fairly quickly to schematic line drawings, but the opposite is not true. Especially in the training of students, we must be wary of falling into the trap of "assuming that the ability to push buttons makes a surveyor" (Howard, 2007, p. 4), allowing the technology to dictate the thought process in the survey. In documenting archaeological sites, we should try to keep in mind what we are recording, and why. It is from this perspective that we should recognize that a basic GPS or LiDAR survey should not provide our only map of a landscape. We must also assemble at least a sample of detailed maps of stone structures in order to understand the settlement pattern. This is true whether we are attempting to get a more humanistic sense of everyday life in past places or if, for example, we were attempting to quantify the amount of labor that went in to constructing a given structure or field system. In the latter case, a more accurate model would take into account things like sizes of stone and construction methods (stacked, piled, core-filled, etc.), something more suited to the kind of recording done with a plane table or tape and compass map, possibly alongside detailed photography or photogrammetry.

At the other end of the spectrum, laser scanning can provide a remarkably detailed picture of a given structure or set of structures through a point cloud consisting of many millions of individual coordinates. In this case, a good deal of interpretation is necessary to distill the important information to translate the raw data of a scan into the useful data of a map. This is not a matter of 'dumbing down' the data, but of actually taking the time to figure out which are the important components of a feature for our interpretations. One interesting possibility for this kind of data would be to reintroduce the perspectival view into Polynesian archaeology, since laser scans are well suited to this kind of manipulation. But in plan or perspective view, the archaeologist is still tasked with determining the relevant details to pick out in order to add meaning to the map. Digital photography has likewise made it especially easy to produce quick visual recordings of archaeological features. The increasing availability of aerial photography, either kite photography or through the use of small drones, will only increase our ability to capture archaeological remains in great detail from above.

Satellite imagery has great potential for exploring Polynesian landscapes from a broad perspective, as has been shown for Rapa Nui rock gardens (Ladefoged et al., 2013). The same goes for LiDAR surveys, which can give us great overviews of large swathes of often rugged and overgrown terrain, but which provide only a distant view of individual features. Applications of LiDAR are likely to make a huge impact on archaeological surveys in Polynesia, and are beginning to become more widespread in the region, especially where archaeologists can take advantage of publicly available datasets, as is the case in

Fig. 6 – GIS map of archaeological features at Kalawao, Moloka'i Island (left) and plane table map of the area highlighted in red (right).
***Fig. 6** – Carte SIG des structures archéologiques à Kalawao, île de Moloka'i (à gauche) et carte dessinée à la main de la zone marquée en rouge (à droite).*

American Samoa (Quintus et al., 2015). Such techniques will certainly be useful for future survey work, but we will still need to point out relevant aspects of the landscape, carefully interpret the features, control for scale, and target excavations appropriately. With this in mind, well-established analogue mapping and survey techniques carried out in detail and on-site will remain useful well into the future. No matter what visualization techniques we use, at some point we still have to take the time to draw out our interpretations in a way that makes clear to ourselves and other archaeologists just how archaeological landscapes were built, used, and transformed through time.

If we are interested in the diachronic dimensions of the palimpsest of archaeological landscapes in Polynesia, it is crucial that we as archaeologists actually interpret the layering of surface as well as subsurface features in order to understand the way that human beings modified their environments in different islands over time, which is never an easy task (e.g. Dye, 2009). Archaeologists have found that detailed mapping of surface features must often be accompanied by careful excavation work, itself involving carefully measured plans and stratigraphic profiles, to better understand site chronologies. The sorts of spatial puzzles that frustrated the ambitions of John F. G. Stokes, Kenneth Emory, and others earlier in the twentieth century were limited at least in part by a lack of reliable dating techniques. While the research paradigms have changed, precise spatial and chronological controls are still absolutely paramount for interpreting Polynesian prehistory. Recent studies have shown the great advances that can be made in settlement pattern archaeology using a variety of mapping techniques, targeted excavations, and state of the art chronometric dating techniques to better understand monumental landscapes in Polynesia (Kahn, 2013; Kahn and Kirch, 2014; Kolb, 2006; Kirch and Sharp, 2005; Martinsson-Wallin, 2014; Martinsson-Wallin et al., 2007; McCoy et al., 2011; Weisler et al., 2006). Many of these studies use techniques such as LiDAR or laser scanning alongside more traditional settlement pattern plans to visualize these sites, which are highly significant for understanding the ways that ideology functioned in Polynesian societies (Clark et al., 2008; Kahn and Kirch, 2011).

In short, the new technologies available to Polynesian archaeologists represent a wealth of potential for developing the mapping tradition in our region. However, we should not forget the value of the already well-established techniques for visualizing and interpreting past places. Digital recording is fine, but it is not a replacement for the level of interpretation that is only possible for the human mind.

CONCLUSIONS

Polynesian archaeology has advanced by leaps and bounds in the past two decades (Kirch and Kahn, 2007), and Polynesian archaeologists are researching a far greater variety of questions, using a greater array of techniques and theoretical perspectives than ever before. The regional history of the discipline, however, provides fruitful ground for thinking about contemporary research for those who are willing to take the time to explore the available resources. While not the first history of archaeological work in Polynesia, the above narrative is a first attempt to examine the trajectory of work in the region from the perspective of visualization techniques, specifically mapping. There is, obviously, much more research that could be done on this topic. As mentioned above, an in-depth exploration of the history of archaeological mapping in Melanesia and Micronesia would be worthwhile to understand how and why these phenomena might vary across Oceania. Within Polynesia, what kinds of sub-regional traditions might we identify? For example, is there variability between Western Polynesia and Eastern Polynesia in site visualization techniques? What about the relationship between 'anglophone', 'francophone' and other national traditions in Polynesian archaeology? Were there different tendencies in site visualization among archaeologists trained in different academic traditions? What kinds of conversations, if any, took place between different schools of thought, and how did these influence mapping techniques? How did this impact theorizing about the Polynesian past in different scholarly traditions? Beyond mapping, what can we learn about the history of other techniques, such as photography or stratigraphic recording (excavation plan and profile drawings)? How does visualization relate to other methodological developments in the region (for example, stratigraphic excavation methods, material recovery techniques, or laboratory analyses)? As seen above, these are not simply questions of disciplinary or regional descriptive chronicle, but potential lines of critical inquiry for thinking through the assumptions we make about our fieldwork and methodologies, and thus about our broader interpretations regarding the past.

As a closing thought, C. Ballard (Ballard, 2013), using sketches from turn-of-the-century ethnographic field notes, has pointed out the relatively underexplored value of drawings as a 'dialogic' tool, that is, a tool that can facilitate discussion, interpretation, and re-evaluation of the images produced in scientific research. Archaeologists are quickly recognizing that nuanced, relevant perspectives must involve the voices of indigenous people, among other stakeholder communities, and the Pacific is no exception (e.g. Allen et al., 2002; Crosby, 2002; Kawelu, 2007). As part of an increasing concern with doing collaborative research among Pacific islander communities, it should be noted that our field drawings are often one of our best tools for engaging local people with the materials that interest us as archaeologists, while simultaneously gauging the research interests and goals of the communities with which we work (Flexner, 2014). In the next century of archaeological research in Oceania, indigenous mapping (Chapin et al., 2005) may come to define many new aspects of visualization in field methodology as more and more Pacific islanders are trained and become leaders in archaeological practice (e.g. Kawelu, 2007; Kirch 2000, p. 39–40; Martinsson-Wallin, 2011; Mills and Kawelu, 2013).

Here again, there is a technological element to this dynamic, as paper drawings are something tangible that can be examined and revised in the field, versus the 'black box' of the total station or laser scanner, which has to be post-processed, often in a laboratory thousands of kilometers away. Of course, much of this is changing as computer-based visualization technologies become increasingly mobile. It should be clear that we are not proposing some sort of Luddite return to paper-based drawings only. Rather, archaeologists need to consider the possibility of contributing to the next century of archaeological work in the region using both the most current digital cartographic techniques, and the more traditional sketches, schematics, and plans that have done so much to advance our knowledge of spatial dynamics in Oceanic prehistory.

Acknowledgements: James Flexner would like to thank Frédérique Valentin and Guillaume Molle for the invitation to present a version of this paper at the Spatial Dynamics in Oceania conference in Paris. Travel to Paris was funded by an Early Career Researcher Travel Award from The Australian National University. An earlier version of this paper was also presented at the Rapa Nui Conference in Santa Rosa in 2012. Thoughts on this topic come from many joyful hours spent field mapping on different Pacific Islands, and we must thank our collaborators, fieldworkers, students, and friends in local communities throughout the region. Aymeric Hermann provided the translation of the abstract into French. We thank two anonymous reviewers for their comments on this paper.

NOTES

(1) At the Spatial Dynamics in Oceania meeting in Paris, Christophe Sand raised the hypothesis that early archaeological maps would be quite rare in Melanesia, because of misguided assumptions based on ethnography that the 'simpler' cultures in this region did not significantly modify the landscape, something subsequent archaeological investigations disprove quite definitively (see Field, 1998; Sand, 1995 and 1996; Sand and Ouétcho, 1993; Spriggs, 1997 and 2008; Walter et al., 2004).

(2) It is possible that from the mid-twentieth century onwards, this assumption continued to play into a contrast between an emphasis on early, pottery-bearing sites in the western Pacific (especially Melanesia, which is the source of the distinctive Lapita ceramic tradition) and stone architecture and settlement patterns in central and eastern Polynesia.

BIBLIOGRAPHICAL REFERENCES

Allen H., Johns D., Phillips C., Day K., O'brien T., Mutunga N. (2002) – Wahi Ngaro (The Lost Portion): Strengthening Relationships between People and Wetlands in North Taranaki, New Zealand, *World Archaeology*, 34, 2, p. 315–29.

Ballard C. (2013) – The Return of the Past: On Drawing and Dialogic History, *The Asia Pacific Journal of Anthropology*, 14, 2, p. 136–48.

Beaglehole J. C. (1966) – *The Exploration of the Pacific*, Palo Alto, Stanford University Press, 346 p.

Bender B., Hamilton S., Tilley C. (1997) – Leskernick: Stone Worlds, Alternative Narratives, Nested Landscapes, *Proceedings of the Prehistoric Society*, 63, p. 147–78.

Bennett W. C. (1931) – *Archaeology of Kauai*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 80), 156 p.

Best S. B. (1993) – At the Halls of the Mountain Kings. Fijian and Samoan Fortifications: Comparison and Analysis, *Journal of the Polynesian Society*, 102, 4, p. 385–448.

Bishop Museum (2013) The Maps of Henry E. P. Kekahuna, Institute of Museum and Library Services, http://50.62.139.14/Kekahuna/kekahuna.php?b=about [online].

Bowden M., Mcomish D. (2011) – A British Tradition? Mapping the Archaeological Landscape, *Landscapes*, 12, 2, p. 20–40.

Burley D. V., Dickinson W. R. (2010) – Among Polynesia's First Pots, *Journal of Archaeological Science*, 37, 5, p. 1020–26.

Burley D. V., Weisler M. I., Zhao J. X. (2012) – High Precision U/Th Dating of First Polynesian Settlement, *PLoS One*, 7, 11, 6 p., DOI: 10.1371/journal.pone.0048769 [online].

Chapin M., Lamb Z., Threlkeld B. (2005) – Mapping Indigenous Lands, *Annual Review of Anthropology*, 34, p. 619–638.

Christenson A. L. (1989) – *Tracing Archaeology's Past: The Historiography of Archaeology*, Carbondale, Southern Illinois University Press (Publications in Archaeology Series), 264 p.

Clark G., Burley D. V., Murray T. (2008) – Monumentality and the Development of the Tongan Maritime Chiefdom, *Antiquity*, 82, 318, p. 994–1008.

Crosby A. (2002) – Archaeology and Vanua Development in Fiji, *World Archaeology*, 34, 2, p. 363–378.

Dening G. (1992) – *Mr. Bligh's Bad Language: Passion, Power and Theatre on the Bounty*, Cambridge, Cambridge University Press (Canto Original Series), 460 p.

Di Piazza A., Pearthree E. (2007) – A New Reading of Tupaia's Chart, *Journal of the Polynesian Society*, 116, 3, p. 321–340.

Dorrell P. G. (1994) – *Photography in Archaeology and Conservation. Second Edition*, Cambridge, Cambridge University Press (Cambridge Manuals in Archaeology), 284 p.

Dye T. S. (1989) – *Tales of Two Cultures: Traditional Historical and Archaeological Interpretations of Hawaiian Prehistory*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Occasional Papers, 29), p. 3–22.

Dye T. S. (1991) – A Reputation Unmade: J. F. G. Stokes's Career in Hawaiian Archaeology, in J. F. G. Stokes (ed.), *Heiau of the Island of Hawai'i: A Historic Survey of Native Hawaiian Temple Sites*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin in Anthropology, 2), p. 3–20.

Dye T. S. (2010) – Traditional Hawaiian Surface Architecture: Absolute and Relative Dating, in T. S. Dye (ed.), *Research Designs in Hawaiian Archaeology: Agriculture, Astronomy, Architecture*, Honolulu, Society for Hawaiian Archaeology, p. 93–155.

Earle T. K. (1978) – *Economic and Social Organization of a Complex Chiefdom: The Halelea District, Kaua'i, Hawaii*, Ann Arbor, University of Michigan Press, 205 p.

Ellis W. (1833) – *Polynesian Researches, During a Residence of Nearly Eight Years in the Society and Sandwich Islands*, New York, J. & J. Harper, 338 p.

Emory K. P. (1921) – *An Archaeological Survey of Haleakala*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Occasional Papers, 7), p. 237–59.

Emory K. P. (1924) – *The Island of Lanai: A Survey of Native Culture*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 12), 129 p.

Emory K. P. (1928) – *Archaeology of Nihoa and Necker Islands*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 53; Tanager Expedition Publication, 5), 124 p.

Emory K. P. (1933) – *Stone Remains in the Society Islands*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 116), 182 p.

Emory K. P. (1934a) – *Tuamotuan Stone Structures*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 118), 78 p.

Emory K. P. (1934b) – *Archaeology of the Pacific Equatorial Islands*, Honolulu, Bernice Pauahi Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 123), 43 p.

Emory K. P. (1939) – *Archaeology of Mangareva and Neighboring Atolls*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 163), 76 p.

Feyler G. (1987) – Contribution à l'histoire des origines de la photographie archéologique: 1839-1880, *Mélanges de l'École française de Rome, Antiquité*, 99, 2, p. 1019–47.

Field J. S. (1998) – Natural and Constructed Defenses in Fijian Fortifications, *Asian Perspectives*, 37, 1, p. 32–58.

Field J. S., Kirch P. V., Kawelu K. L., Ladefoged T. N. (2010) – Households and Hierarchy: Domestic Modes of Production in Leeward Kohala, Hawai'i Island, *The Journal of Island and Coastal Archaeology*, 5, 1, p. 52–85.

Flexner J. L. (2009) – Where is Reflexive Map-Making in Archaeological Research? Towards a Place-Based

Approach, *Archaeological Review from Cambridge*, 24, 1, p. 7–21.

Flexner J. L. (2010) – *Archaeology of the Recent Past at Kalawao: Landscape, Place, and Power in a Hawaiian Hansen's Disease Settlement*, doctoral thesis, University of California, Berkeley, 336 p.

Flexner J. L. (2012) – An Institution that was a Village: Archaeology and Social Life in the Hansen's Disease Settlement at Kalawao, Moloka'i, Hawaii, *International Journal of Historical Archaeology*, 16, 1, p. 135–163.

Flexner J. L. (2014) – Mapping Local Perspectives in the Historical Archaeology of Vanuatu Mission Landscapes, *Asian Perspectives*, 53, 1, p. 2–28.

Green R. C. (1980) – *Makaha before 1880 AD*, Honolulu, Department of Anthropology and Bishop Museum Press (Pacific Anthropological Records, 31; Makaha Valley Historical Project, 5), 90 p.

Green R. C., Davidson J. M. (1969) – *Archaeology in Western Samoa*, volume I, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 6), 278 p.

Green R. C., Davidson J. M. (1974) – *Archaeology in Western Samoa*, volume II, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 7), 290 p.

Green R. C., Green K., Rappaport R. A., Rappaport A., Davidson J. M. (1967) – *Archaeology on the Island of Mo'orea, French Polynesia*, New York, American Museum of Natural History (Anthropological Papers of the American Museum of Natural History, 51), 230 p.

Greene L. W. (1993) – *A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai'i Island*, Denver, United States Department of the Interior, 579 p.

Groube L. (1970) – The Origin and Development of Earthwork Fortification in the Pacific, in R. C. Green and M. Kelly (eds.), *Studies in Oceanic Culture History*, Honolulu, Bishop Museum Press (Pacific Anthropological Records, 11), p. 133–164.

Haggett P., Chorley R. J. (1968) – Models, Paradigms, and the New Geography, in R. J. Chorley and P. Haggett (eds.), *Socio-Economic Models in Geography*, London, Methuen & Co. (Routledge Revivals), p. 19–41.

Heyerdahl T., Ferdon E. N. (1961) – *Archaeology of Easter Island, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, volume 1, London, George Allen and Unwin (Monographs of the School of American Research and the Museum of New Mexico, 24, 1), 559 p.

Heyerdahl T., Ferdon E. N. (1965) – *Miscellaneous Papers, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, volume 2, London, George Allen and Unwin (Monographs of the School of American Research and the Kon-Tiki Museum, Oslo, Norway, 24, 2), 512 p.

Howard P. (2007) – *Archaeological Surveying and Mapping: Recording and Depicting the Landscape*, New York, Routledge, 300 p.

Irwin G. (1985) – *Land, Pā, and Polity: A Study Based on the Maori Fortifications of Pouto*, Auckland, New Zealand Archaeological Association (Monographs of the New Zealand Archaeological Association, 15), 118 p.

Kahn J. G. (2005) – *Household and Community Organization in the Late Prehistoric Society Islands (French Polynesia)*, doctoral thesis, University of California, Berkeley, 573 p.

Kahn J. G. (2013) – Temple Renovations, Aggregate Marae, and Ritual Centers: The ScMo-15 Complex, Lower Amehiti District, 'Opunohu Valley, Mo'orea (Society Islands), *Rapa Nui Journal*, 27, 2, p. 33–49.

Kahn J. G., Kirch P. V. (2011) – Monumentality and the Materialization of Ideology in Eastern Polynesia, *Archaeology in Oceania*, 46, 3, p. 93–104.

Kahn J. G., Kirch P. V. (2014) – *Monumentality and Ritual Materialization in the Society Islands: The Archaeology of a Major Ceremonial Complex in the 'Opunohu Valley, Mo'orea*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletins in Anthropology, 13), 267 p.

Kamakau S. M. (1976) – *The Works of the People of Old: Na Hana a ka Po'e Kahiko*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publication, 61), 178 p.

Kamakau S. M. (1991) – *Tales and Traditions of the People of Old: Nā Mo'olelo a ka Po'e Kahiko*, Honolulu, Bishop Museum Press, 196 p.

Kawelu K. L. (2007) – *A Sociopolitical History of Hawaiian Archaeology: Kuleana and Commitment*, doctoral thesis, University of California, Berkeley, 290 p.

Kirch P. V. (1984) – *The Evolution of the Polynesian Chiefdoms*, Cambridge, Cambridge University Press, 314 p.

Kirch P. V. (1985) – *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*, Honolulu, University of Hawaii Press, 360 p.

Kirch P. V. (1992) – *The Archaeology of History*, Chicago, University of Chicago Press (Anahulu: The Anthropology of History in the Kingdom of Hawaii, 2), 216 p.

Kirch P. V. (2000) – *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*, Berkeley, University of California Press, 446 p.

Kirch P. V. (2010) – *How Chiefs Became Kings: Divine Kingship and the Rise of Archaic States in Ancient Hawai'i*, Berkeley and Los Angeles, University of California Press, 288 p.

Kirch P. V., Green R. C. (2001) – *Hawaiki, Ancestral Polynesia. An Essay in Historical Anthropology*, Cambridge, Cambridge University Press, 375 p.

Kirch P. V., Kahn J. G. (2007) – Advances in Polynesian Prehistory: A Review and Assessment of the Past Decade (1993–2004), *Journal of Archaeological Research*, 15, 3, p. 191–238.

Kirch P. V., Kelly M. (1975) – *Prehistory and Ecology of a Windward Hawaiian Valley: Halawa Valley, Molokai*, Honolulu, Bishop Museum Press (Pacific Anthropological Records, 24), 207 p.

Kirch P. V., Sharp W. (2005) – Coral 230Th Dating of the Imposition of a Ritual Control Hierarchy in Precontact Hawaii, *Science*, 307, 5706, p. 102–104.

Kolb M. J. (2006) – The Origins of Monumental Architecture in Ancient Hawai'i, *Current Anthropology*, 47, 4, p. 657–665.

Ladefoged T. N., Flaws A., Stevenson C. M. (2013) – The Distribution of Rock Gardens on Rapa Nui (Easter Island) as Determined from Satellite Imagery, *Journal of Archaeological Science*, 40, p. 1203–12.

Ladefoged T. N., Graves M. (2006) – The Formation of Hawaiian Territories, in I. Lilley (ed.), *Archaeology of Oceania: Australia and the Pacific Islands*, Oxford, Blackwell (Blackwell Studies in Global Archaeology), p. 259–83.

Ladefoged T. N., Graves M. W., Jennings R. P. (1996) – Dryland Agricultural Expansion and Intensification in Kohala, Hawai'i Island, *Antiquity*, 70, 270, p. 861–80.

Ladefoged T. N., Graves M. W., Mccoy M. D. (2003) – Archaeological Evidence for Agricultural Development in Kohala, Island of Hawaii, *Journal of Archaeological Science*, 30, p. 923–40.

Ladefoged T. N., Kirch P. V., Gon S. M., Chadwick O. A., Hartshorn A. S., Vitousek P. M. (2009) – Opportunities and Constraints for Intensive Agriculture in the Hawaiian Archipelago prior to European Contact, *Journal of Archaeological Science*, 36, p. 2374–83.

Ladefoged T. N., Mccoy M. D., Asner G. P., Kirch P. V., Poulsen C. P., Chadwick O. A., Vitousek P. M. (2011) – Agricultural Potential and Actualized Development in Hawai'i: an Airborne LiDAR Survey of the Leeward Kohala Field System (Hawai'i Island), *Journal of Archaeological Science*, 38, p. 3605–19.

Ladefoged T. N., Somers G. F., Lane-Hamasaki M. M. (1987) – *A Settlement Pattern Analysis of a Portion of Hawaii Volcanoes National Park: Archeology at Hawaii Volcanoes National Park*, Tuscon, Western Archeological and Conservation Center (Western Archeological and Conservation Center Publications in Anthropology, 44), 161 p.

Malo D. (1951) – *Hawaiian Antiquities: Mo'olelo Hawai'i*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publication, 2), 278 p.

Martinsson-Wallin H. (2011) – The Complexity of an Archaeological Site in Samoa. The Past in the Present, in J. Liston, G. R. Clark and D. Alexander (eds.), *Pacific Island Heritage: Archaeology, Identity, and Community*, Canberra, ANU E Press (Terra Australis, 35), p. 101–114.

Martinsson-Wallin H. (2014) – Archaeological Investigations in Independent Samoa: 'Tala Eli' of Laupule Mound and beyond, in H. Martinsson-Wallin and T. Thomas (ed.), *Monuments and People in the Pacific, Uppsala,* Uppsala University (Studies in Global Archaeology, 20), p. 245–272.

Martinsson-Wallin H., Wallin P., Clark G. (2007) – The Excavation of Pulemelei Site 2002-2004, *Archaeology in Oceania*, 42, 1 (supplement), p. 41–59.

Mcallister J. G. (1933a) – *Archaeology of Oahu*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 104), 201 p.

Mcallister J. G. (1933b) – *Archaeology of Kahoolawe*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 115), 61 p.

Mccoy M. D. (2006) – *Landscape, Social Memory, and Society: An Ethnohistoric-Archaeological Study of Three Hawaiian Communities*, doctoral thesis, University of California, Berkeley, 392 p.

Mccoy M. D., Asner G. P., Graves M. (2011) – Airborne Lidar Survey of Irrigated Agricultural Landscapes: an Application of the Slope Contrast Method, *Journal of Archaeological Science*, 38, p. 2141–54.

Mccoy M. D., Graves M. (2010) – The Role of Agricultural Innovation in Pacific Islands: A Case Study from Hawai'i Island, *World Archaeology*, 42, 1, p. 90–107.

Mccoy M. D., Ladefoged T. N. (2009) – New Developments in the Use of Spatial Technology in Archaeology, *Journal of Archaeological Research*, 17, p. 263–95.

Mccoy M. D., Ladefoged T. N., Graves M. W., Stephen J. W. (2011) – Strategies for Constructing Religious Authority in Ancient Hawai'i, *Antiquity*, 85, p. 927–41.

Mccoy P. C. (1976) – *Easter Island Settlement Patterns in the Late Prehistoric and Protohistoric Periods*, New York, Easter Island Committee, International Fund for Monuments (Easter Island Committee, International Fund for Monuments Bulletin, 5), 164 p.

Mckern W. C. (1929) – *Archaeology of Tonga*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 60; Bayard Dominick Expedition Publication, 15), 123 p.

Millerstrom S. (2006) – Ritual and Domestic Architecture, Sacred Places, and Images: Archaeology in the Marquesas Archipelago, French Polynesia, in I. Lilley (ed.), *Archaeology of Oceania: Australia and the Pacific Islands*, Oxford, Blackwell (Blackwell Studies in Global Archaeology), p. 284–301.

Mills P., Kawelu K. L. (2013) – Decolonizing Heritage Management in Hawai'i, *Advances in Anthropology*, 3, 3, p. 127–32.

Mulrooney M. A., Ladefoged T. N., Gibb R., Mccurdy D. (2005) – Eight Million Points Per Day: Archaeological Implications of Laser Scanning and Three-Dimensional Modeling of Pu'ukoholā Heiau, Hawai'i Island, *Hawaiian Archaeology*, 10, p. 18–28.

Newman T. S. (1972) – Two Early Hawaiian Field Systems on Hawaii Island, *Journal of the Polynesian Society*, 81, 1, p. 87–89.

Quintus S., Clark J. T., Day S. S., Schwert D. P. (2015) – Investigating Regional Patterning in Archaeological Remains by Pairing Extensive Survey with a Lidar Dataset: The Case of the Manu'a Group, American Samoa, *Journal of Archaeological Science*, 2, p. 677–87.

Rosendahl P. H. (1994) – Aboriginal Hawaiian Structural Remains and Settlement Patterns in the Upland Agricultural Zone at Lapakahi, Island of Hawai`i, *Hawaiian Archaeology*, 3, p. 14–70.

Routledge K. (1919) – *The Mystery of Easter Island: The Story of an Expedition*, London, Hazell, Watson and Viney, 404 p.

Salmond A. (2009) – *Aphrodite's Island: The European Discovery of Tahiti*, Berkeley, University of California Press, 544 p.

Sand C. (1995) – *« Le temps d'avant » : La Préhistoire de la Nouvelle Calédonie : contribution à l'étude des modalités d'adaptation et d'évolution des sociétés océaniennes dans un archipel du Sud de la Mélanésie*, Paris, L'Harmattan, 356 p.

Sand C. (1996) – Structural Remains as Markers of Complex Societies in Southern Melanesia during Prehistory: The case of the Monumental Forts of Mare Island (New Caledonia), *Bulletin of the Indo-Pacific Prehistory Association*, 15, 2, p. 37–44.

Sand C., Ouétcho A.-J. (1993) – Three Thousand Years of Settlement in the South of New Caledonia: Some Recent Results from the Region of Païta, *New Zealand Journal of Archaeology*, 15, p. 107–30.

Spriggs M. (1997) – *The Island Melanesians*, Cambridge, Blackwell, 326 p.

Spriggs M. (2008) – Ethnographic Parallels and the Denial of History, *World Archaeology*, 40, 4, p. 538–52.

Stokes J. F. G. (1991) – *Heiau of the Island of Hawai'i: A Historic Survey of Native Hawaiian Temple Sites*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin in Anthropology, 2), 208 p.

Suggs R. C. (1961) – *The Archaeology of Nuku Hiva, Marquesas Islands, French Polynesi*a, New York, American Museum of Natural History (Anthropological Papers of the American Museum of Natural History, 49, 1), 205 p.

Tomášková S. (2007) – Mapping a Future: Archaeology, Feminism, and Scientific Practice, *Journal of Archaeological Method and Theory*, 14, 3, p. 264–84.

Trigger B. G. (1989) – *A History of Archaeological Thought*, Cambridge, Cambridge University Press, 500 p.

Tuggle H. D., Griffin P. B. (1973) – *Lapakahi, Hawaii: Archaeological Studies*, Honolulu, University of Hawaii Press (Asian and Pacific Archaeology Series, 5), 351 p.

Van Gilder C. L. (2005) – *Families on the Land: Archaeology and Identity in Kahikinui, Maui*, doctoral thesis, University of California, Berkeley, 288 p.

Walter R., Thomas T., Sheppard P. J. (2004) – Cult Assemblages and Ritual practice in Roviana Lagoon, Solomon Islands, *World Archaeology*, 36, 1, p. 142–57.

Weisler M. I., Kirch P. V. (1985) – The Structure of Settlement Space in a Polynesian Chiefdom: Kawela, Molokai, Hawaiian Islands, *New Zealand Journal of Archaeology*, 7, p. 129–58.

Weisler M. I., Collerson K. D., Feng Y. X., Zhao J. X., Yu K. F. (2006) – Thorium-230 Coral Chronology of a Late Prehistoric Hawaiian Chiefdom, *Journal of Archaeological Science*, 33, 2, p. 273–82.

Willey G. R. (1968) – Settlement Archaeology: An Appraisal, in K. C. Chang (ed.), *Settlement Archaeology*, Palo Alto, National Press Books, p. 208–26.

Willey G. R., Sabloff J. A. (1980) – *A History of American Archaeology*, New York, W. H. Freeman & Co., 384 p.

Yen D. E., Kirch P. V., Rosendahl P., Riley T. (1972) – Prehistoric Agriculture in the Upper Makaha Valley, Oahu, in E. J. Ladd and D. E. Yen (ed.), *Makaha Valley Historical Project: Interim Report no. 3*, Honolulu, Bishop Museum Press (Pacific Anthropological Records, 18), p. 59–94.

James L. Flexner
School of Philosophical and Historical Inquiry
Quadrangle Building (A14)
The University of Sydney
Sydney NSW 2006 (Australia)
james.flexner@sydney.edu.au

Patrick V. Kirch
Department of Anthropology,
232 Kroeber Hall,
University of California,
Berkeley, CA 94720 (USA)
kirch@berkeley.edu

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 31-48
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Traditional Kanak Landscapes

An Assessment of Settlement Pattern Studies in New Caledonia (Southern Melanesia)

Christophe Sand, André-John Ouétcho, Jacques Bolé, David Baret and Yves-Béalo Gony

Abstract: Settlement pattern studies of traditional Melanesian landscapes have been and still remain an under-represented research topic. This paper reviews the question for New Caledonia. The first part will highlight the near absence of mapping field-studies on traditional pre-contact Kanak landscapes until the early 1990s, before presenting the major change in this regard identifiable during the past twenty-five years. As part of a larger research program focusing explicitly on the 'Traditional Kanak Cultural Complex' from an archaeological perspective, the objectives were to highlight the type of settlement patterns still identifiable on the Grande Terre Island, the large mountainous island of the archipelago. The first focus was put on household mapping and the related horticultural features present around Kanak hamlet sites. This has shown an unexpected diversity of settlement shapes and sizes. These field projects also highlighted the dense nature of the former landscape occupation.
These first results permitted a critical assessment of the orthodox historical scenario of low Kanak population densities in New Caledonia at first European contact. In order to expand our understanding of traditional Kanak landscapes, more recent research projects have started to map the density of some of these occupations on Grande Terre on a wider scale. The recording of structures over large areas illustrates the complexity of traditional Kanak settlement patterns. Excavation on some of these sites allows us for the first time to highlight the construction chronology of these traditional Southern Melanesian landscapes, developed specifically during the second millennium AD. The analysis below discusses the main reasons that have until recently limited landscape studies in island Melanesia, one being the strong focus of three generations of Melanesianist archaeologists on ceramics and cultural chronologies. Our mappings also question the ethnographic interpretation, which relies on late nineteenth century and early twentieth century observations that were made at a time when most of the indigenous population had already disappeared owing to introduced diseases. This paper highlights the extent to which recent archaeological results challenge the orthodox model proposed by ethnographers for traditional indigenous Kanak societies. Rather than the sparsely populated island described in the late nineteenth century, archaeological surveys have revealed the massive scale of landscape use during the pre contact period. We can only conclude that landscape archaeology has much to offer for a better understanding of the diverse cultural chronologies of island Melanesia.

Keywords: Settlement patterns, island Melanesia, New Caledonia, Traditional Kanak Cultural Complex, ethnography, house mounds, horticultural features, epidemics.

Paysages traditionnels Kanak : études des modalités de l'occupation de l'espace en Nouvelle-Calédonie (Mélanésie du Sud)

Résumé : Les études des occupations de l'espace traditionnel mélanésien ont été et restent rares, en particulier au vu des nombreux travaux menés sur ce sujet en Polynésie et en Micronésie. Cet article propose d'aborder ce thème en focalisant l'attention sur la Nouvelle-Calédonie, l'archipel méridional du croissant mélanésien. La première partie souligne l'absence quasi complète, avant le début des années 1990, de cartographies de terrain ayant eu pour objectif d'inventorier les formes d'occupation de l'espace développées par les Kanak pendant la période de pré-contact. Le désintérêt pour ce sujet s'explique par la focalisation massive des études sur le volet ethnographique des sociétés traditionnelles kanak. L'article présente ensuite les grandes évolutions qui ont marqué les vingt-cinq dernières années, principalement liées à des projets de terrain développés par des équipes locales. Dans le cadre d'un programme de recherches plus large dont le but est d'étudier les différentes caractéristiques de « l'ensemble culturel traditionnel kanak » dans une perspective archéologique, l'objectif était de suivre un modèle d'étude de *settlement pattern* emprunté aux travaux menés en Polynésie. L'attention s'est principalement portée sur les traces anciennes d'occupation de l'espace encore identifiables dans les paysages de la Grande

Terre, l'île principale de l'archipel. La première phase de l'étude s'est attachée à caractériser les formes d'aménagements des habitats en hameaux et des types de structures horticoles réalisées autour des lieux de vie. La cartographie de nombreux sites a mis au jour une diversité insoupçonnée de formes et de tailles de hameaux, bien plus complexes dans leur organisation au sol que ce qui avait pu être déduit des études ethnographiques. Les inventaires ont également révélé la densité de ces anciens sites dans le paysage. Cette densité s'illustre dans certaines régions par des successions de regroupements de tertres de cases surélevés tous les 100-200 m de distance sur certaines lignes de crête des hautes vallées.
Ces premiers résultats de terrain ont forcé à mener une analyse critique des interprétations proposées par les travaux ethnographiques sur les anciennes sociétés kanak, censées être caractérisées par une faible démographie. Ce travail a fait apparaître un manque de relation directe avec les données issues des études archéologiques de terrain. Afin de pouvoir illustrer de façon plus claire l'importance spatiale des anciennes occupations kanak, les programmes développés récemment ont commencé à s'attacher à cartographier dans différentes régions de la Grande Terre, des ensembles d'habitat et de cultures horticoles sur de grandes surfaces. Ceci a été réalisé dans un premier temps en travaillant sur les données observables grâces aux photographies aériennes des espaces non-boisés. Dans un deuxième temps, les vestiges visibles au sol dans plusieurs sites-clé de la zone nord-est de la Grande Terre ont été cartographiés de façon extensive. Dans les vallées de la Tipindjé et de la Tiwaka, l'extension spatiale des traces d'habitat et de cultures horticoles était telle, que la cartographie des sites étudiés n'a pu être menée. Une cartographie complète a néanmoins pu être menée à son terme dans les parties planes de deux petites vallées de la tribu de Wérap, en moyenne vallée de la Hienghène.
La cartographie de structures anciennes sur des grandes étendues, permet d'illustrer la complexité des anciens modes d'occupation de l'espace kanak. Les fouilles menées sur certains sites nous permettent pour la première fois de mettre en lumière l'existence d'une chronologie d'édification de ces structures caractéristiques du sud de la Mélanésie, en démontrant que celle-ci est limitée au deuxième millénaire apr. J.-C. L'analyse des données permet d'identifier les principales raisons qui ont jusqu'à récemment limité les études archéologiques sur l'occupation de l'espace dans les îles de la Mélanésie. La première est certainement la focalisation quasi exclusive de trois générations d'archéologues travaillant dans cette région, sur des études liées à la céramique et à la définition de chronologies culturelles. De façon significative, un contexte archéologique similaire était présent en Micronésie, sans que ceci n'ait empêché le développement depuis longtemps de programmes de recherches focalisés explicitement sur les occupations traditionnelles de l'espace. Cette différence dans la définition d'axes d'études archéologiques, s'explique par la forte influence des travaux ethnographiques en Mélanésie, qui ont en particulier caractérisé les groupes kanak comme ayant toujours été peu nombreux et organisés en systèmes politiques simples.
Les cartographies de sites kanak anciens viennent aujourd'hui questionner cette interprétation, qui s'est construite sur des données obtenues à la fin du XIX^e^ siècle et au début du XX^e^ siècle, à une période où la majorité des groupes autochtones avaient déjà disparu, emportés lors d'épidémies engendrées par toute une série de maladies introduites par les européens. Cet article souligne à quel point les données archéologiques acquises récemment viennent remettre en question le modèle ethnographique orthodoxe caractérisant les sociétés traditionnelles kanak anciennes. Contrairement à l'image couramment acceptée de populations peu nombreuses et vivant en groupes dispersés, véhiculée par les descriptions de la fin du XIX^e^ siècle, les inventaires archéologiques ont mis en lumière une densité massive des occupations de l'espace durant les siècles ayant précédé les premiers contacts avec les Européens. Les études ont montré que les processus d'intensification et de densification sont tout particulièrement observables pour les ensembles horticoles et les regroupements de tertres d'habitat surélevés. Ces données démontrent tout l'intérêt des études archéologiques réalisées sur les anciennes occupations traditionnelles des espaces insulaires du Pacifique sud-ouest. Le développement souhaité de cette problématique dans les années à venir devrait permettre une caractérisation des diverses chronologies culturelles de la Mélanésie insulaire plus conforme aux réalités historiques passées.

Mots-clés : occupation de l'espace, Mélanésie insulaire, Nouvelle-Calédonie, « ensemble culturel traditionnel kanak », ethnographie, tertres de cases, structures horticoles, épidémies.

Landscape archaeology has been one of the central research themes developed since the start of the discipline to better understand the ways former pre-historic and historic civilizations interacted with their environment. Large-scale mapping of former towns, forts, agricultural settings and religious sites is routine in archaeology, as essential for the understanding of the past as excavation. In the Pacific, this has led from the first period of contacts, and more professionally from the end of the nineteenth century onward, to a record of the complexity of some of the significant indigenous sites of the region. Starting with the most emblematic remains such as the Moai of Rapanui (e.g. Routledge, 1919) or the megalithic complex of Nan Madol in Pohnpei (e.g. Hambruch, 1911), the record of archaeological landscapes has grown to encompass a more diverse array of site-types, such as fortifications, shrines and traditional villages. By the middle of the twentieth century, a number of field studies permitted, at least for part of Polynesia and to a lesser degree Micronesia, the production of a first set of large-scale maps, prompting analysis of former landscape uses and comparisons with the ethnographic record.

Surprisingly, the only region in Oceania where no comparable programs were undertaken is Melanesia. Although the southwestern Pacific had been identified early on as having 'megalithic remains' (Riesenfeld, 1950)—a site-type conducive to mapping—and had in at least some archipelagoes developed impressive wooden building traditions, ethnographers and amateur archaeologists did not venture to really tackle this topic. When professional archaeology finally developed in Melanesia after World War II, the main focus was on early settlement and ceramic sequences (Golson, 1959). Until the 1990s, the Melanesian crescent did not see the boost in landscape studies (Green, 1961) that characterized Polynesia and Micronesia as well as Fiji. To draw attention to

a case where the late development of landscape archaeology in the region has produced rich results over the last two decades, this paper will present an assessment of New Caledonia, the southernmost archipelago of island Melanesia (fig. 1). After providing a general background of ethnographic data on the traditional Kanak societies of New Caledonia and their uses of landscapes, the paper will outline the results of the very few studies that dealt with Kanak landscapes before the 1990s. A second part will then detail the horticultural and house-hold/hamlet-focused research programs conducted over the last twenty years, before ending with the presentation of large-scale mapping programs undertaken in recent years.

GEOGRAPHICAL AND ETHNOGRAPHIC BACKGROUND

New Caledonia is located at the southern limit of the tropics, being crossed by the Tropic of Capricorn. Two distinct landmasses with different geological histories, positioned on a north-west/south-east axis, characterize the archipelago. The western part is a continental fragment of Gondwanaland, separated from Australia about 80 million years ago, before diving into the ocean. When it rose again, this landmass pulled with it part of the ocean floor, rich in different metals like nickel, chrome and iron. The progressive weathering of this upper acidic metamorphic crust prompted, by adaptation, the development of a unique biota that makes New Caledonia one of the main hotspots of biodiversity in the world. Today the metamorphic crust covers about 30% of Grande Terre, the 400 km-long (N–S) and 50 km-wide (E–W) main island of the archipelago, divided down its long axis by a mountain range reaching up to 1648 m above sea level, creating a wet climate on the narrow windward east coast and a dry climate on the broader leeward west coast. Grande Terre is surrounded by a 1,600 km long coral reef, protecting most of the coasts of the main island as well as its smaller satellites (e.g. Isle of Pines, Belep) from direct impact of the ocean. This is not the case of the second

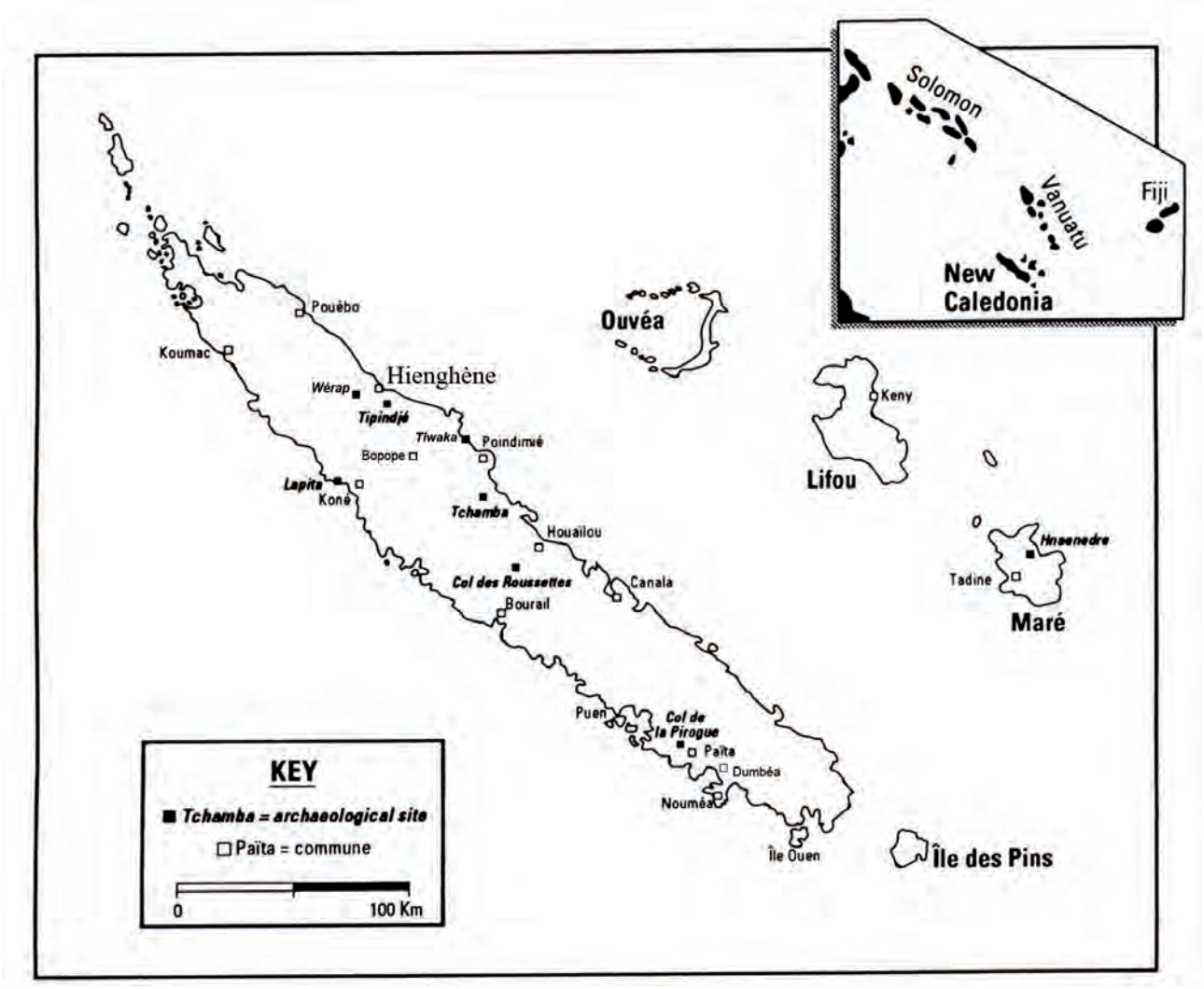


Fig. 1 – Map of New Caledonia, showing the location of the main archaeological sites discussed in the paper.
Fig. 1 *– Carte de la Nouvelle-Calédonie avec la localisation des principaux sites archéologiques discutés dans l'article.*

part of the archipelago, the Loyalty islands to the east of Grande Terre, which are terraced uplifted coral platforms built up on volcanic summits. The two largest islands, Lifou (1,200 km^2) and Maré (640 km^2), reach 104 m and 123 m above sea level respectively. Only Ouvea in the north of the Loyalties has an extensive protective lagoon, owing to its semi-atoll shape.

The archipelago was first settled by Lapita navigators about 3000 years ago (Sand, 2010). Over the succeeding millennia, population growth and socio-cultural dynamics led to the occupation of most of the habitable environments. This gave rise, at around AD 1000, to the advent of a specific 'Traditional Kanak Cultural Complex' (Sand et al., 2003). As in every other agricultural society in the world, Kanak traditions and beliefs saw the landscape as a central element in cultural identity. The origin point of a clan is symbolized in Kanak myths by the first house-mound built by the oldest ancestor. Successions of generations are recorded in traditions not merely through genealogies, but through the clans' itinerary as materialized by the position of the different house mounds which the clan leaders settled over the centuries (Bensa and Rivierre, 1982). Around the chiefly or head house-mound were built other habitation mounds forming hamlets, habitation and cooking houses being mostly organized around a central path. This hamlet center was the main ceremonial locus for everyday or routine exchanges and encounters (Boulay, 1990; here: fig. 2). When a large meeting was called, Kanak chiefdoms organized the building of an independent hamlet for the festivities that was not permanently in use.

Exchanges centered around the presentation of traditional money and crops, with yam *(Dioscorea* sp.*)* as the male/dry symbol and taro *(Colocasia esculenta)* as the female/wet symbol. Root crops, as well as bananas and sugarcane, were planted in complex raised mound structures for dryland production and in different types of marshy land or artificially-irrigated terraces for wetland production. These extensive planting-grounds scattered in the landscape, did not have to be protected from pig *(Sus scrofa)* destruction, as pigs were not present in New Caledonia until very late in the cultural sequence. Rituals were mostly performed in isolated places, as Kanak traditions did not develop centralized religious practices (Leenhardt, 1930). Collective burial sites were restricted to the chiefly elite, with skulls aligned in rock shelters and bones piled in caves. In some regions, some individuals were mummified prior to placement in rock shelters. Commoners appear to have been simply buried in the ground (Valentin and Sand, 2001). At the margin of the settlements and planting-grounds, large forests were managed for firewood and more importantly for the access to timber for house construction, elite houses especially needing a central post that could be over 30 m long. The presence of large forests is explained by a supposed low population density in New Caledonia at first European contact, only about 40,000 Kanaks being estimated to live on Grande Terre (16,370 km^2) at the end of the eighteenth century (Kasarherou, 1992).

EARLY STUDIES ON KANAK LANDSCAPES

The diversity of cultural traditions that characterized former Kanak societies, with chiefdoms divided into about thirty languages groups and numerous dialects, specific house forms and a diversity of material culture depending on the region considered, was studied by ethnographers from the end of the nineteenth century (Glaumont, 1888; Lambert, 1900). The vast majority of these studies relied on oral traditions and recording of myths and genealogies, in a context of harsh colonial violence, despoliation of traditional lands to settle farmers or convicts, and Christianization (Terrier, 2012). This meant that by the beginning of the twentieth century, some of the old Kanak ways of occupying the landscape had vanished, forcing the French colonial administration in the 1930s to finance traditional 'memory houses' to maintain the existence of a few large Kanak chiefly buildings. The depopulation that had hit the indigenous groups of the archipelago at that time (Rallu, 1990; Kasarherou, 1992)—associated to the strongly synchronic approach of most ethnographers, mainly missionaries and pastors from Christian churches—did not allow any clear under-

Fig. 2 – Proposed reconstruction of a Kanak hamlet organized around a central path (modified from Boulay, 1990, p. 54).
***Fig. 2** – Proposition d'une reconstruction d'un village kanak organisé autour d'une allée centrale (modifié d'après Boulay, 1990, p. 54).*

standing of how Kanak landscapes would have looked and operated a century before.

It is thus unsurprising that no one during this early period ventured to map the large abandoned chiefly hamlets—easily spotted by the presence of alignments of coconut and Araucaria trees—or made detailed recordings of the huge taro terracing systems in indefinite fallow that could be observed on many hillsides. Written comments and descriptions are rare in the publications of that time (e.g. Glaumont, 1897; Leenhardt, 1930). The best sources to gain a sense of former Kanak landscapes remain the colonial maps produced during the process of settling former convicts in some of the regions of Grande Terre's west coast. The maps precisely position 'old planting grounds' or 'remains of indigenous settlements' in places that have since been transformed into modern villages or towns. Looking at the ethnographic literature, one can only conclude that while the landscape was—and is still claimed to be—at the core of Kanak identity, understanding the subtle indigenous layout and use of the environment was not a central concern of early European ethnographers. In all, only one map—discussed below—presenting a real Kanak site was published amongst all the ethnographic books and scientific papers before World War II, all the others illustrating this subject with an idealized view of a Kanak settlement (e.g. Lambert, 1900, fig. 21).

Significantly, the most emblematic early ethnographer of Kanak culture, protestant missionary Maurice Leenhardt, approached the question of Kanak landscapes not by mapping sites, but through the direct use of Kanak drawings. It appears that the very first 'scientific' drawing of the layout of a Kanak settlement, representing a feasting village in the Nindiah plain (central east coast of Grande Terre; see Guiart, 1997, p. 134), was made for the missionary by a Kanak elder named Boesou (Bwesou Eurijisi). Boesou had organized the meeting as a customary leader, probably around 1900. He presented in a sketch the position of the different house-mounds, the raised paths linking them, as well as the different types of planting grounds built around the feasting village (Leenhardt, 1930, fig. 6; here: fig. 3). Relying on the sketch, Maurice Leenhardt published an artist's rendering of the Nindiah site (Leenhardt, 1930, fig. 7). To propose artistic reconstructions of the customary scenes, Maurice Leenhardt used as a basis, representations of exchange ceremonies and dancing on central paths incised on Kanak bamboos (Leenhardt, 1930, fig. 32 to fig. 37).

After World War II, archaeological mapping of traditional indigenous sites started to become normal professional practice in Polynesia and Micronesia (Kirch, 2000, p. 12–41). Nevertheless, when preparing to leave for his six-month expedition to New Caledonia in early 1952, American archaeologist Edward Gifford did not consider adding this topic to his research goals. All in all, his survey of fifty-three archaeological sites with Richard Shutler Jr. only comprises five abandoned Kanak habitation sites, each described in only a few words (Gifford and Shutler, 1956, p. 99–100; Sand and Kirch, 2002, fig. 2.1). Eight years later, Jack Golson's team began working on Isle of Pines and produced the very first scientific archaeological map for New Caledonia, locating numerous enigmatic tumuli present on the island's central plateau. Jack Golson also mapped a small, abandoned Kanak hamlet near Moindou town, where some test-excavations were opened (Golson, pers. com. 1996). Missionary and ethnographer Marie-Joseph Dubois made a first general map of two megalithic structures on Maré Island, identified as predating the traditional Kanak period (Dubois, 1970). The ethnographer Jean Guiart offered a sketch of the former chiefdom setting of Gadji on Isle of Pines (Guiart, 1963, p. 239). Although one of his research goals was to study traditional Kanak sites as part of a general synthesis on New Caledonia's prehistory, Daniel Frimigacci only included one detailed site-map of a ritual site at the foot of Meori Mountain in his thesis manuscript (Frimigacci, 1975, fig. 101), although in the same volume he presented a large number of stratigraphic profiles. This was also the case a decade later for Jean-Christophe Galipaud's thesis, which was mainly focused on ceramic chronology, although one site map of a traditional Kanak settlement was included (Galipaud, 1988, fig. 60). In his study of Kanak houses, the ethnographer Roger Boulay only published an idealized image of a traditional Kanak hamlet, with no connection to any real site (Boulay, 1990, p. 54).

In the meantime, traditional Kanak landscapes had attracted new scientific interest, linked at least partly to a strong political claim for land-rights. Battling for the return of alienated lands back into indigenous hands, Kanak leaders promoted a structured discourse on the links between Pacific islanders and their ancestral properties (Tjibaou, 1976; Tjibaou et al., 1976; Bensa, 1981). This prompted geographers to study in more detail what could still be recorded of the traditional uses of Grande Terre's landscapes, mainly in terms of horticulture. A program of aerial photography analysis was put in place, generating a series of maps positioning the main agricultural systems that could be located in the plains and hills of Grande Terre (Bensa, 1981, map 18). The geographer François Doumenge mapped for his thesis a series of modern Kanak hamlets but only offered sketches of the traditional settings (Doumenge, 1982, fig. 22–23). An extensive phase of recording of Kanak land claims produced other maps, locating former villages and planting grounds (Frimigacci, pers. com. 1986). However none of these data were generated in a manner that facilitated detailed archaeological analysis (see Roux, 1990). For example, the aerial photography study only recorded planting surfaces, never the number of raised mounds or terraces, or their individual length and width.

THE FIRST PHASE OF KANAK LANDSCAPES ARCHAEOLOGY

One of the main ideas behind the creation of a local Department of Archaeology at the New Caledonia

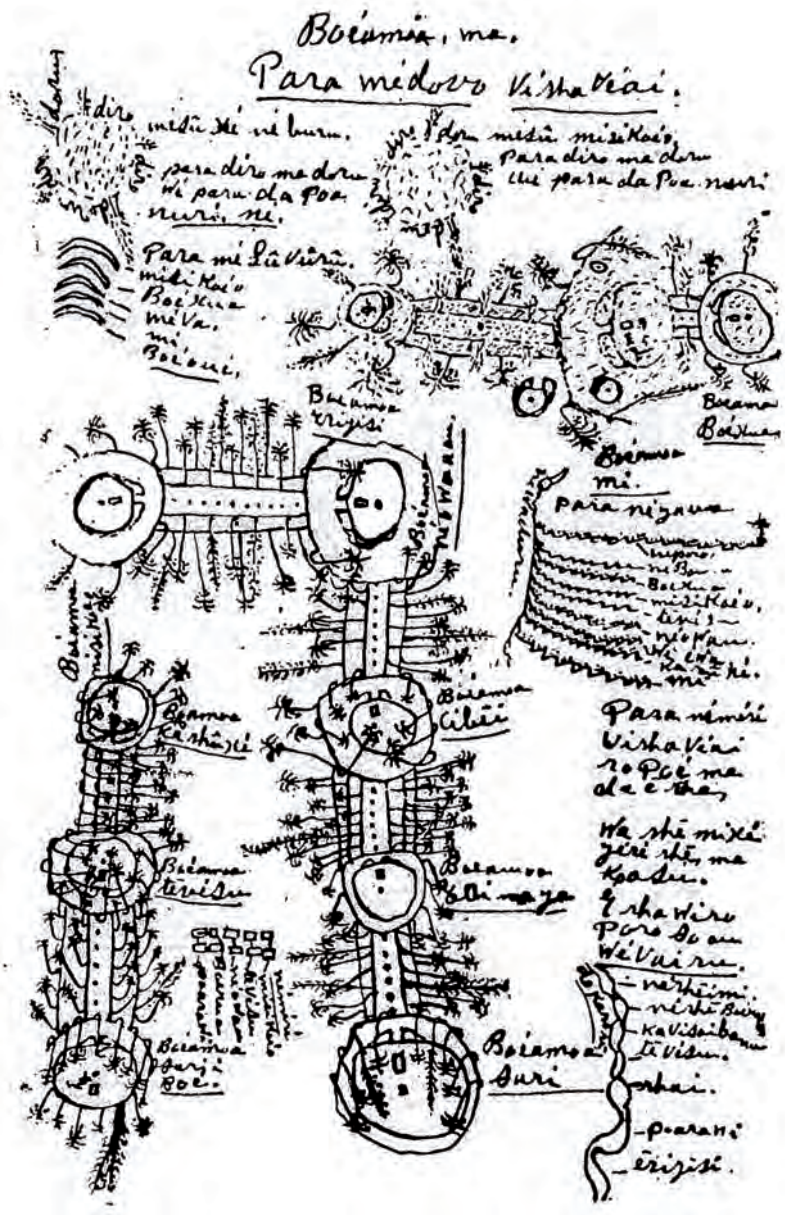


Fig. 3 – The sketch of the Nindiah feasting village drawn by Bwesou Eurijisi (from Leenhardt, 1930, fig. 6).
***Fig. 3** – Plan du village dans la plaine de Nindiah à l'occasion d'un grand pilou dessiné par Bwesou Eurijisi (d'après Leenhardt, 1930, fig. 6).*

Museum at the beginning of the 1990s was to build the first firm basis upon which the multiple potential aspects of traditional Kanak societies could be studied through archaeology. Strongly influenced by Polynesian archaeology as a general model, the team focused mainly on field surveys, on Grande Terre as well as in the Loyalty Islands (cf. Sand, 1995). In the south of Grande Terre, where colonial impact has been strongest and where extensive Kanak settlements are difficult to find (but see Sand and Ouétcho, 1992, fig. 1), the focus was set on detailed recording and mapping of former planting grounds. This was especially the case in Païta and Dumbea (fig. 4), just north of the capital Noumea, where over 1,000 hectares of abandoned taro-terraces were recorded and partly mapped (Sand, 1994). Over half of these structures were not visible on aerial photographs, showing the imperative for pedestrian surveys under the forest cover but also in open environments. The study revealed a complex and painstaking building-process on often steep hillsides, entailing robust retaining walls as well as the excavation of deep water-channels sometimes several kilometers long, to bring water to higher-altitude platforms. The dating of some of these terraces in favorable locations showed the start of the horticultural intensification process in the second half of the first millennium AD. The highest and most remote terraces, built artificially by bringing fertile soil directly on bare rock, were only dated to the last three centuries before European contact (Sand, 1994, p. 59–63; Sand,

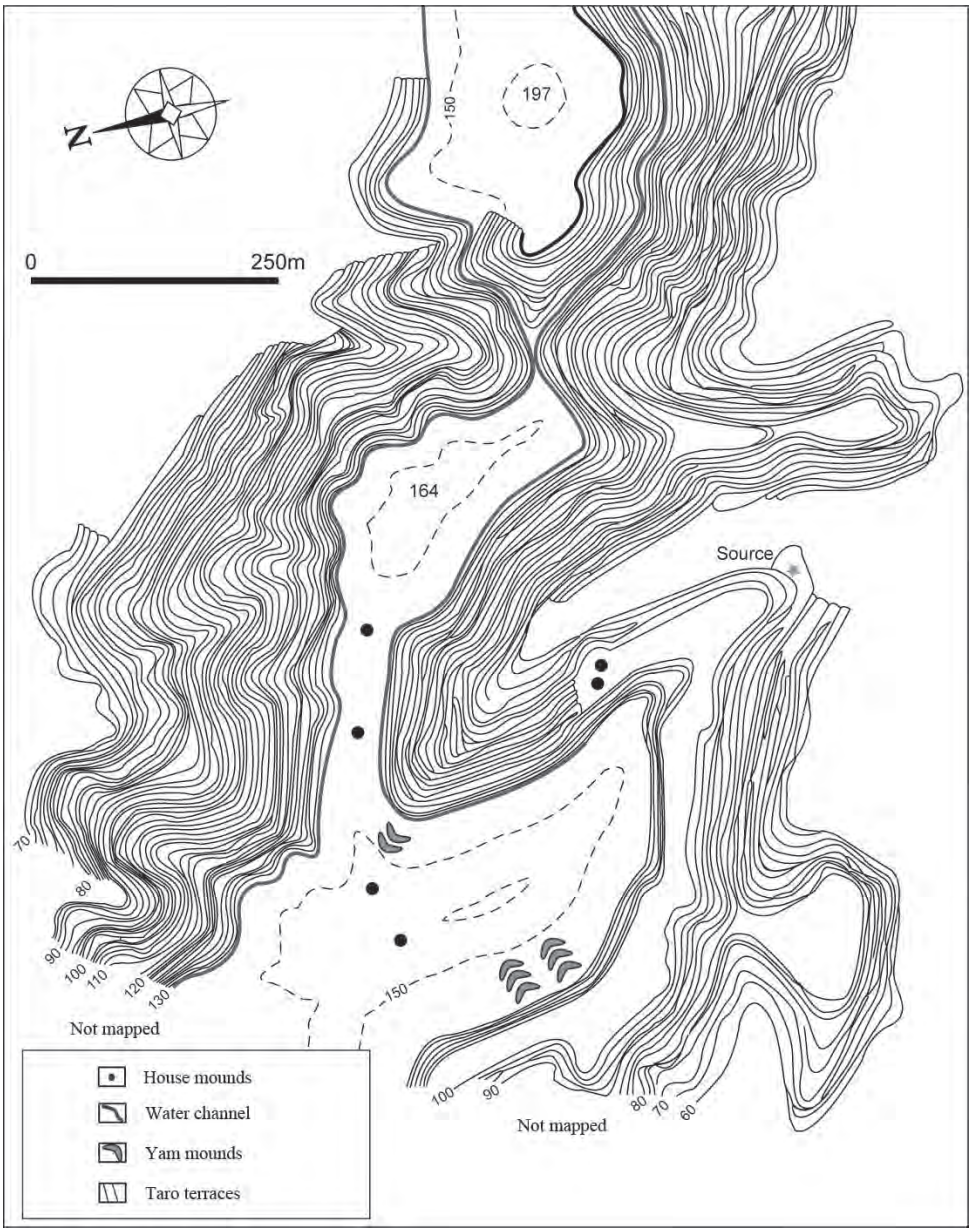


Fig. 4 – Example of abandoned terraced taro-planting area at Mont Koghi (Dumbea).
Fig. 4 *– Exemple d'une tarodière en terrasses abandonnées au Mont Koghi (Dumbéa).*

2012). Spatial analysis showed that the planting grounds surveyed and some of their associated old settlements and burial sites were all located on hillsides difficult of access for machinery, thus protecting them from modern destruction. This observation raised questions about the extent of Kanak planting-grounds present in the past in the large alluvial plains of Dumbea, Païta and Tontouta, destroyed by the use of these flatlands for over 150 years for colonial farming and cattle-raising. This archaeological study was the first to use field maps and landscape analysis to question the supposed low Kanak population density at the time of first European contact (Sand, 1995, p. 218–231).

Aside from extensive planting-grounds, another major type of site of the 'Traditional Kanak Cultural Complex' is composed of former settlements, marked on the ground by alignments of raised house mounds of a rounded form (fig. 5). Although being one of the central symbols in Kanak discourse, it was only in 1992 that the first archaeological program concerned exclusively with detailed mapping of some of these former hamlets was pursued (Sand and Ouétcho, 1993; Sand, 1997 and 2002a). Concentrated in the isolated central mountain region of the Bopope tribe in the northern part of Grande Terre, the program allowed us in a few weeks to map over thirty individual sites, with hamlets comprising from five up to thirty individual house-mounds, often surrounded by large horticultural structures (fig. 6). In some areas, a new nexus of habitations was present every 100–200 m, illustrating a significant density of sites, especially for a mountainous region. The mapping process identified a

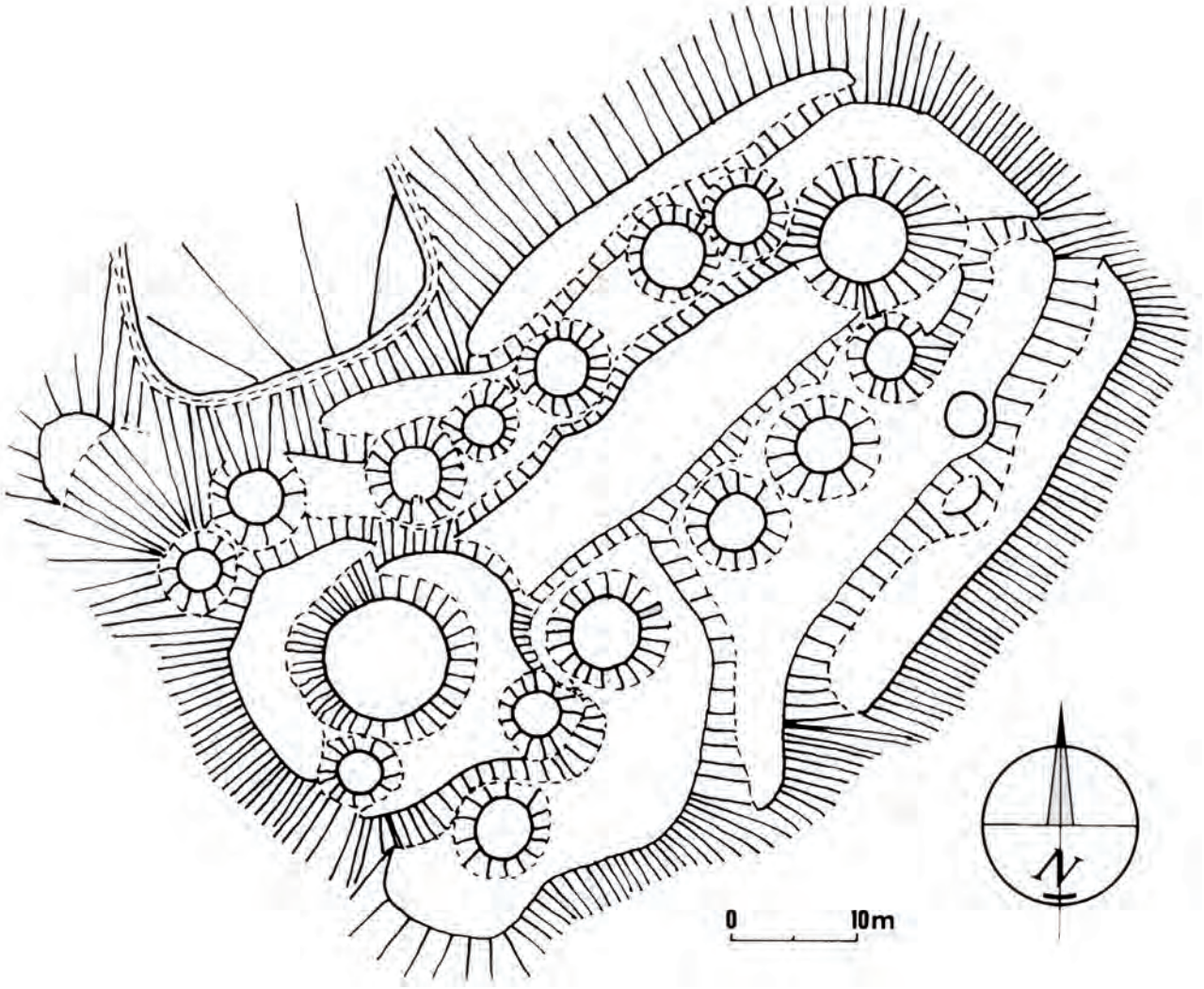


Fig. 5 – Example of site ETO018 of Tipalèt, featuring the classic ethnographic Kanak hamlet pattern around a central path (upper Bopope region).
***Fig. 5** – Exemple du site ETO018 de Tipalèt, présentant le modèle d'un village classique kanak d'après les données ethnographiques, organisé autour d'une allée centrale (partie supérieure de la région de Bopope).*

large diversity of individual site-plans, intricately linked to the local topography. This demonstrated that the typical ethnographic hamlet model reconstructed through Kanak oral traditions, with a clearly marked straight central path and neatly positioned house-mounds on each side, was only an idealized image of a far more diverse traditional settlement pattern, something that could only be identified through *in situ* mapping of real hamlets (Sand, 2002a, fig. 8).

Expanding on this first inland study, a series of maps was produced through the detailed recording of individual features visible on aerial photographs of some still well-preserved large alluvial plains. They highlighted a high density of agricultural features developed on fertile soils, completely surrounding large hamlets. This is for example the case in part of the river plain of Tiwaka Valley, on the northeast coast of Grande Terre, where the mapping of about 35 hectares revealed a complex array of long, raised yam fields (Sand and Ouétcho, 1993, fig. 48; Sand, 1995, p. 184–185; here: fig. 7). Put end to end, these planting structures—about 5–8 m wide and 1 m high—would total 17 km in length. Similar densities of planting mounds can be observed under the forest cover of a number of alluvial plains that have not been flattened by modern agriculture (Sand, 2012; Sand et al., 2008; Sand and Baret, in press). Large horticultural landscapes and associated hamlets are also still present in some of tribal Kanak reservations on the west coast, such as the floodplains of Koumac on the northwest coast (Guillaud and Forestier, 1996). All these data strongly attest to the existence of a marked intensification of landscape use during the 'Traditional Kanak Cultural Complex'. Indigenous population collapse during the 19th century was so devastating and colonial land dispossession so rapid that this dense pre-contact type of settlement pattern had mostly vanished when early ethnographers started to give attention to Kanak traditions.

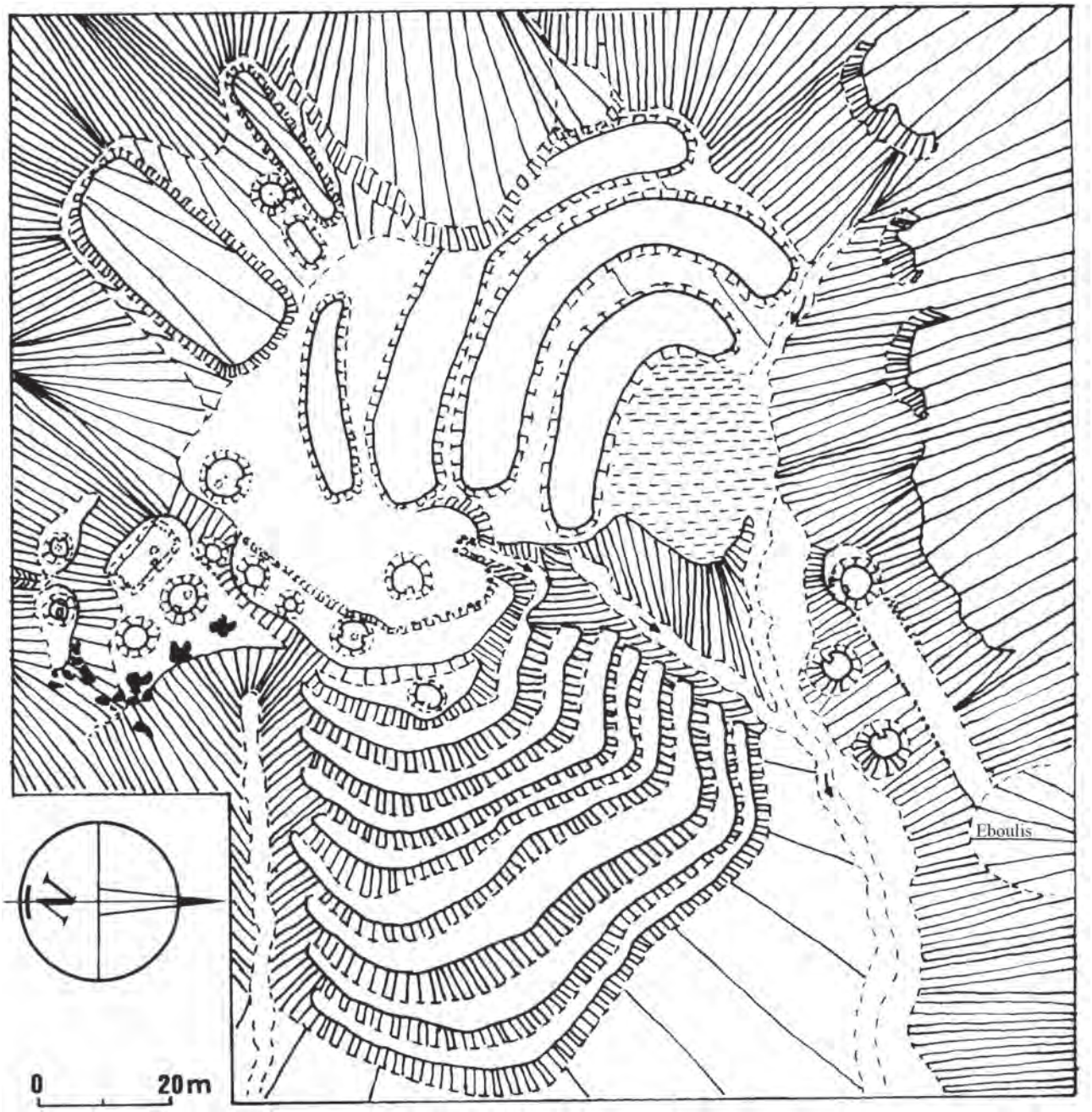


Fig. 6 – A typical settlement pattern in the upper mountainous Bopope region, with house-mounds, taro terraces and long raised yam mounds (site ETO045 of Kadèn).
***Fig. 6** – Modèle d'un village typique dans la partie supérieure montagneuse de Bopope, avec des tertres d'habitat, des terrasses destinées à la culture du taro et de longs billons aménagés pour la culture de l'igname (site ETO045 de Kadèn).*

GETTING TO THE BIG PICTURE: MAPPING VALLEYS

Over the last decade, opportunities have been taken to expand from mapping projects restricted to site-specific sizes, to fulfill for the first time extensive (or near-complete) valley-scale recordings. Time constraints mean the first attempts at large scale mapping were dissatisfying, as the unexpectedly huge extent of the sites under study meant full recording of the landscape was not possible. This was for example the case for a series of sites of Pombei in the upper Tiwaka Valley (northeast coast), where only a portion of the extensive habitation and cultivation areas was mapped as part of a multi-topic project (Sand, 2007; Dotte, 2010; here: fig. 8). Another case was in the upper valley of the Hienghene River (northeast coast) around the Tendo tribal area, where we had planned to map a complex terrace-system associated with important traditional hamlets at the request of the tribe (Sand et al., 2005; Bolé et al., 2005). The survey by foot undertaken on the terrace complex showed that it extended without

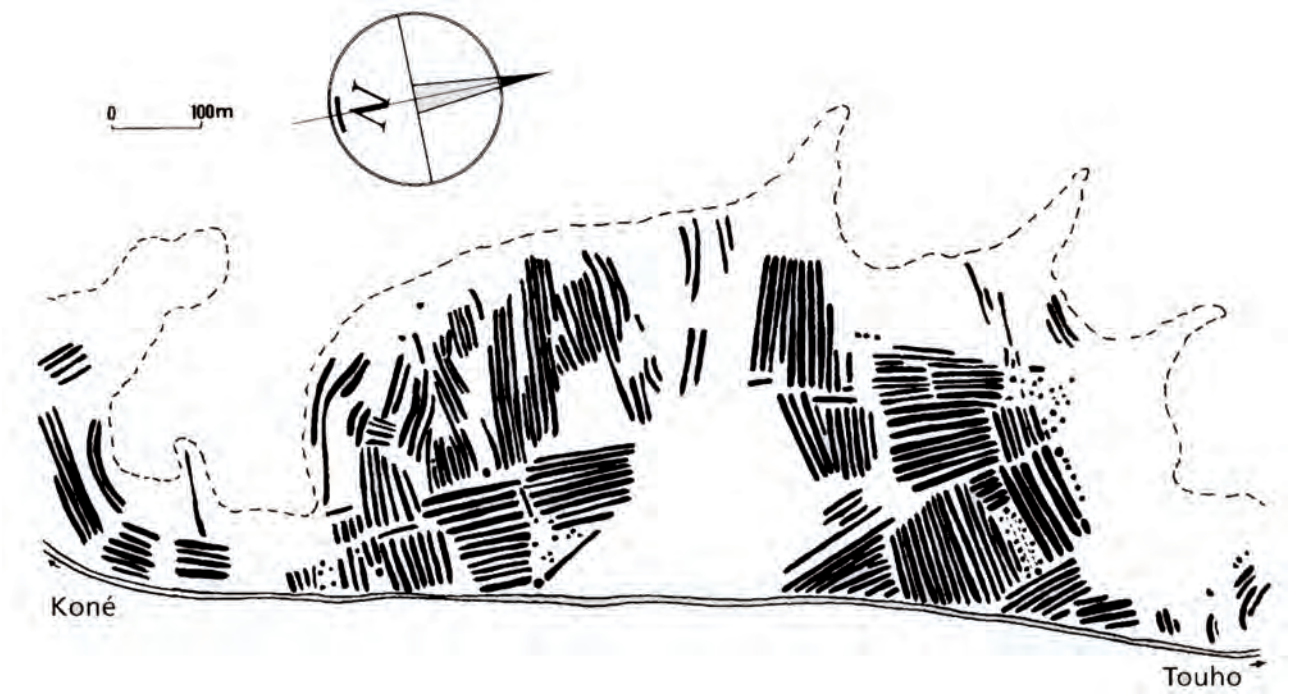


Fig. 7 – Map of the lower Tiwaka valley from aerial photography, showing the density of features.
***Fig. 7** – Carte de la basse vallée de Tiwaka d'après une photo aérienne montrant la densité des structures.*

any clear break for over half a day's walk under the forest cover, and would have needed months to map completely. The partial mapping of some of the sites showed the existence of a complex building process of terraces on steep slopes, some walls measuring over 2 m high for a planting space less than 1 m wide. A set of large mounds, associated in oral traditions with high chiefly lines, was mapped, with some mounds reaching 20 m in diameter and over 4 m high, in hamlets comprising from ten to fifteen individual house mounds (Sand et al., 2005).

A more successful project of the same kind has been finalized in one of the flood-plains of the abandoned central part of the valley of Tipindje river, on the northeast coast of Grande Terre. This region was occupied by Kanak clans until 1917, when the entire population was removed from the valley at the end of an indigenous revolt (Gony et al., 2011). The structure-by-structure recording over a surface of 240,000 m^2 has identified the presence of 113 individual raised yam-mounds, alongside 165 house mounds, mainly organized in hamlet clusters (fig. 9). The mapping has stopped at the foot of the valley sides, but surface surveys have shown the presence of a dense network of features (mounds, terraces etc.) all along the hill-slopes up to the ridge, itself being densely marked by successions of house mounds. This intensified landscape use is also visible on the other side of the riverbank, spreading over long distances. In the small valley system of the Werap tribal area, opening towards the Hienghene River just north of Tipindje, the presence of steep hillsides created a clear natural limit to expansion and therefore constrained human occupation to a sizable surface in terms of archaeological mapping. About 500,000 m^2 of the two parallel valley floors of Werap have been completely mapped, showing the presence of a complex settlement pattern under the forest cover (Gony et al., 2012; here: fig. 10). What is probably the most impressive characteristic is the discovery that the whole length of all the streambanks and small creeks was walled, extending for kilometers.

Similar walling has been observed during surveys along a number of streams and riverbanks on the northeast coast of Grande Terre (fig. 11), but the Werap features are the first to be mapped. Unsurprisingly, the alluvial flatlands were mostly used as planting grounds, with the presence of long raised yam fields. Territorial divisions between families were still marked by long flat stones planted in the ground. It appears that as soon as the terrain became steeper, Kanaks constructed different sorts of artificial platforms bound by retaining stone walls. It is on these platforms that most of the raised house mounds have been identified. At the back of the two valleys, the hillsides were completely worked into artificial terraces for wet taro plantations. Some terraces are over 2 m high and less than 1 m wide, indicating a significant collective labor input to obtain relatively small cultivation surfaces. Artificial basins to retain and manage the flow of stream water have also been identified during mapping, as well as a few unique sites that have been recognized by local inhabitants as ceremonial locations, some still being used. The first results of an extensive dating project underway in this area shows major occupation during the last few centuries before European contact.

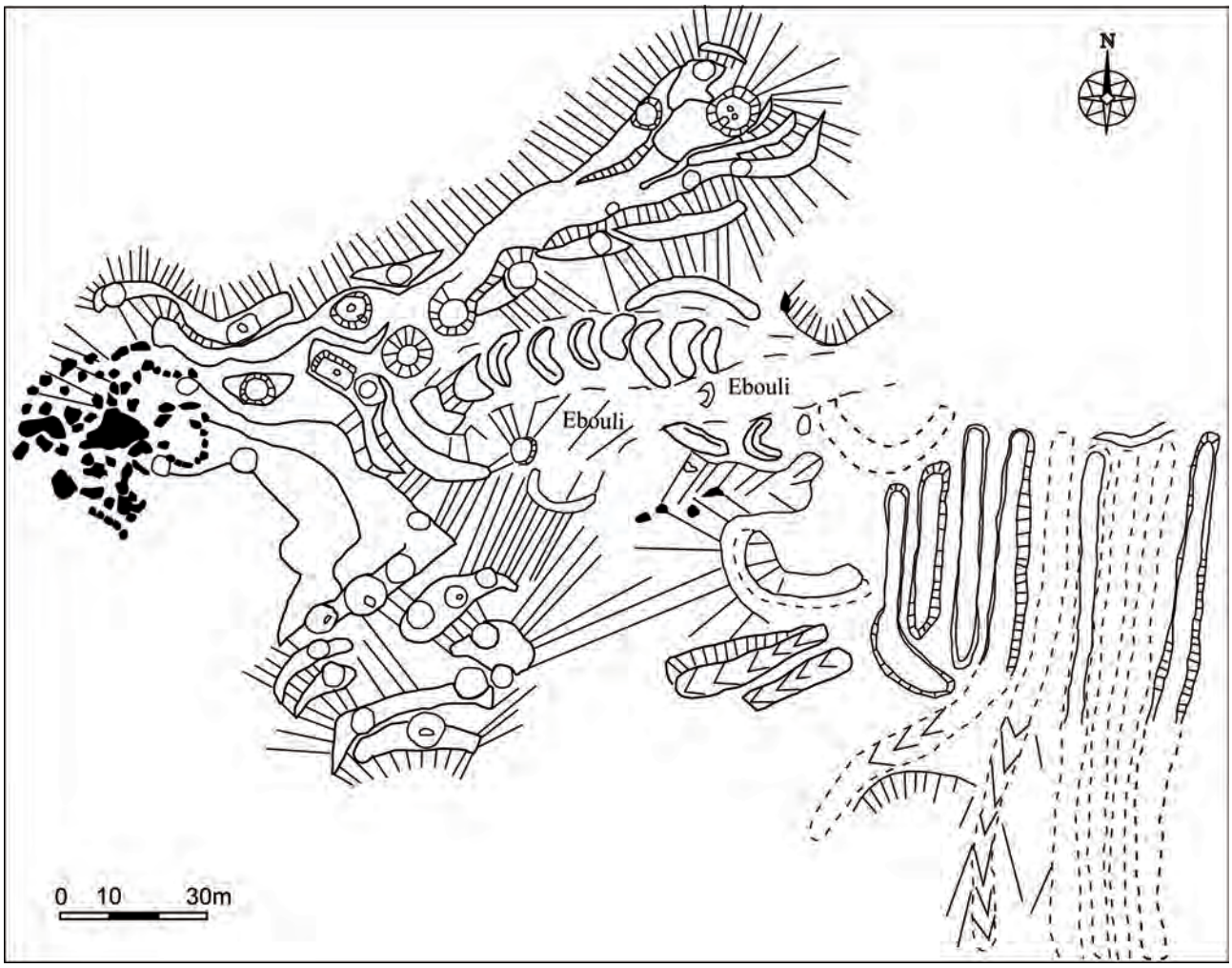


Fig. 8 – Partial mapping of the Pwadaunu site in the upper Pombei region.
Fig. 8 *– Cartographie partielle du site de Pwadaunu dans la partie supérieure de la région de Pombei.*

ANALYSIS

In New Caledonia, as in the rest of the Melanesian crescent, landscape archaeology is a recent research topic. Most of the few site-maps published by early archaeologists, ethnographers and geographers were not made with detailed settlement pattern studies in mind. Indeed, compared to Micronesia and especially Polynesia, the southwestern Pacific (with the exception of Fiji) has still seen only a handful of projects dedicated explicitly to landscape archaeology (see Terrell, 1976; Spriggs, 1981; Walter and Sheppard, 2000). Two main reasons can be put forward to explain this evident discrepancy. The first is that for a long time (and still in some respects today), most research programs in Melanesia—be they large institutional projects or more modest PhD studies—continue to focus by and large on ceramics and cultural chronologies (Bedford, 2006; Felgate, 2003; Garling, 2007). Lapita studies and early settlement issues form a large part of this pottery-focused interest, at the expense of the more recent past.

However, restricting the explanation solely to this reason appears too limited, as a similar long history with pottery chronologies—although without Pleistocene and early Holocene occupations, such as in Near Oceania—is present in the northwestern Pacific, where extensive settlement pattern studies have been conducted for decades (Spoehr, 1957; Osborne, 1966; Cordy, 1993; Liston, 2013). We believe that for island Melanesia, a second reason explaining the recent development of settlement pattern studies is the belief strongly imbedded in the 19th and 20th century anthropological community, that traditional Melanesian societies in the past were demographically less numerous than Polynesian and Micronesian chiefdoms (McArthur, 1968; Rallu, 1990). As a supposed consequence, these groups were characterized by traditions of scattered occupations and only weak political hierarchies (see Sahlins, 1963), with settlements isolated from each other and no centralized political authority.

This vision of dispersed Melanesian settlements is explained by the widespread reliance of previous generations of Pacific historians on missionary and early ethnographic sources created at a time when no-one was really

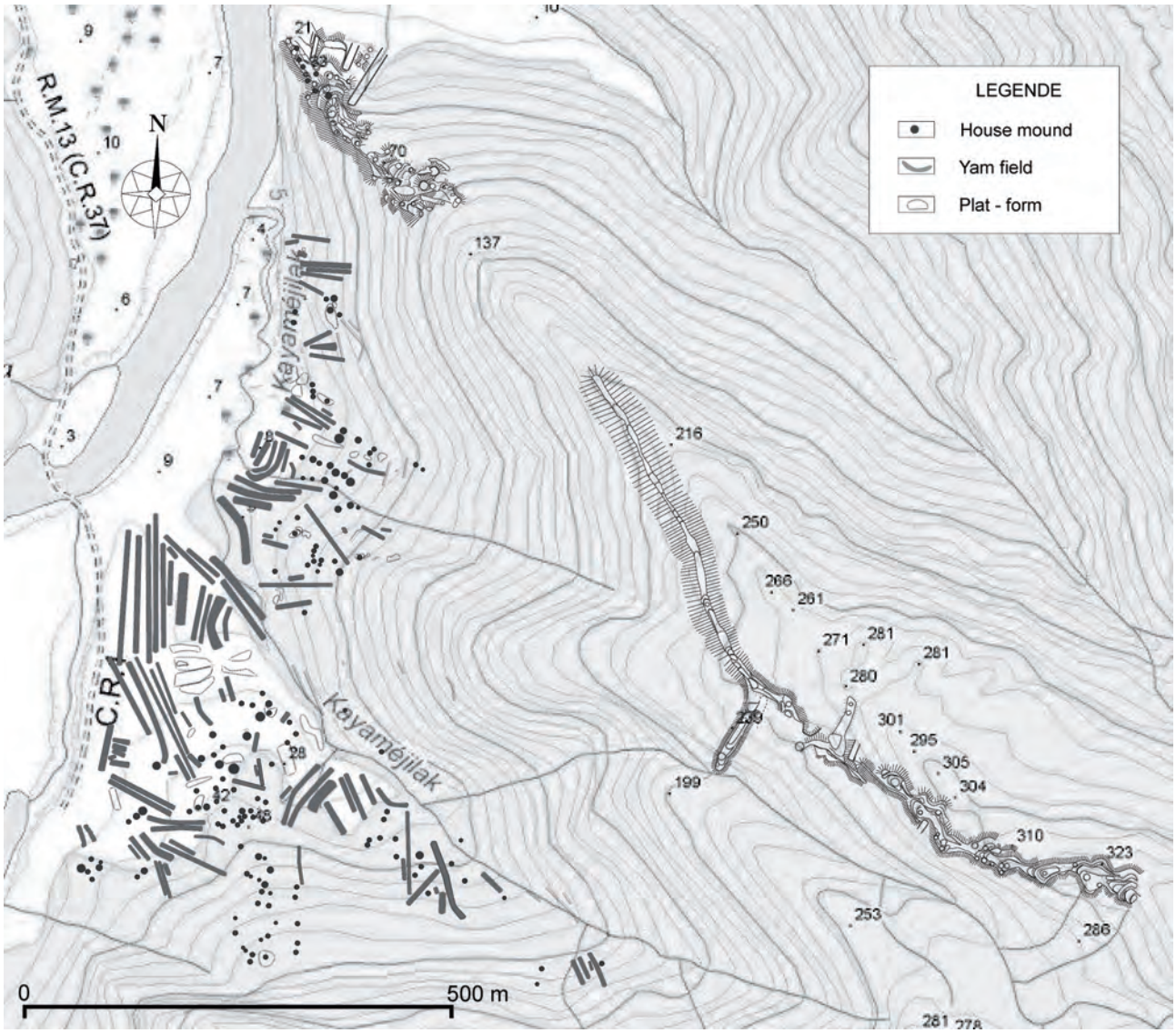


Fig. 9 – Map of the flat areas of the Thehaat site, in the central part of Tipindje valley (the slopes remain to be mapped).
Fig. 9 *– Carte des zones planes du site de Thehaat dans la partie centrale de la vallée de Tipindjé (les pentes restent à cartographier).*

aware of the deadly impact on Melanesian demography of the contact-period introduction of European diseases. Missionary diaries are full of references to episodes of epidemics witnessed on a regular basis during their sojourns in the islands. However, the social consequences of a century of catastrophic population decline were not really taken into consideration in ethnographic studies. Ethnographers concluded that the dispersed habitats and weakly-hierarchical political traditions that they observed and recorded were accurate reflections of centuries-old customs (Sand, 2000 and 2002b). In this theoretical frame, there was no room for densely-populated landscapes, complex pre-contact political systems based on marked hierarchical differences, or large-scale processes of economic intensification over time (see Guiart, 1992 for an example, and Saussol, 1979, fig. 3 for an illustration of sparse mid-nineteenth century Kanak landscape densities).

Although the question of demographic numbers in Melanesian populations during the entire period of human settlement—and especially at first contact—remains to be better studied, archaeological data everywhere in the southwestern Pacific today point to the need for a significant re-evaluation of figures (Kirch and Rallu, 2007). In New Caledonia, this was started in the 1990s, pushed by the unexpected first results of our settlement pattern studies, which showed the existence of dramatically intensified landscape uses (Sand, 1995; Sand et al., 2000). Two decades later, a proposition that initially was only hypothetical has for archaeologists become a certainty: at the time of the first encounter with the crew of Captain James Cook in 1774, the Kanak population as a whole was far more numerous than the 50,000 or so people historically accepted (Sand et al., 2007). Starting from this general point, field surveys have above all shown the composite nature of Kanak settlement patterns, adapted in each case to

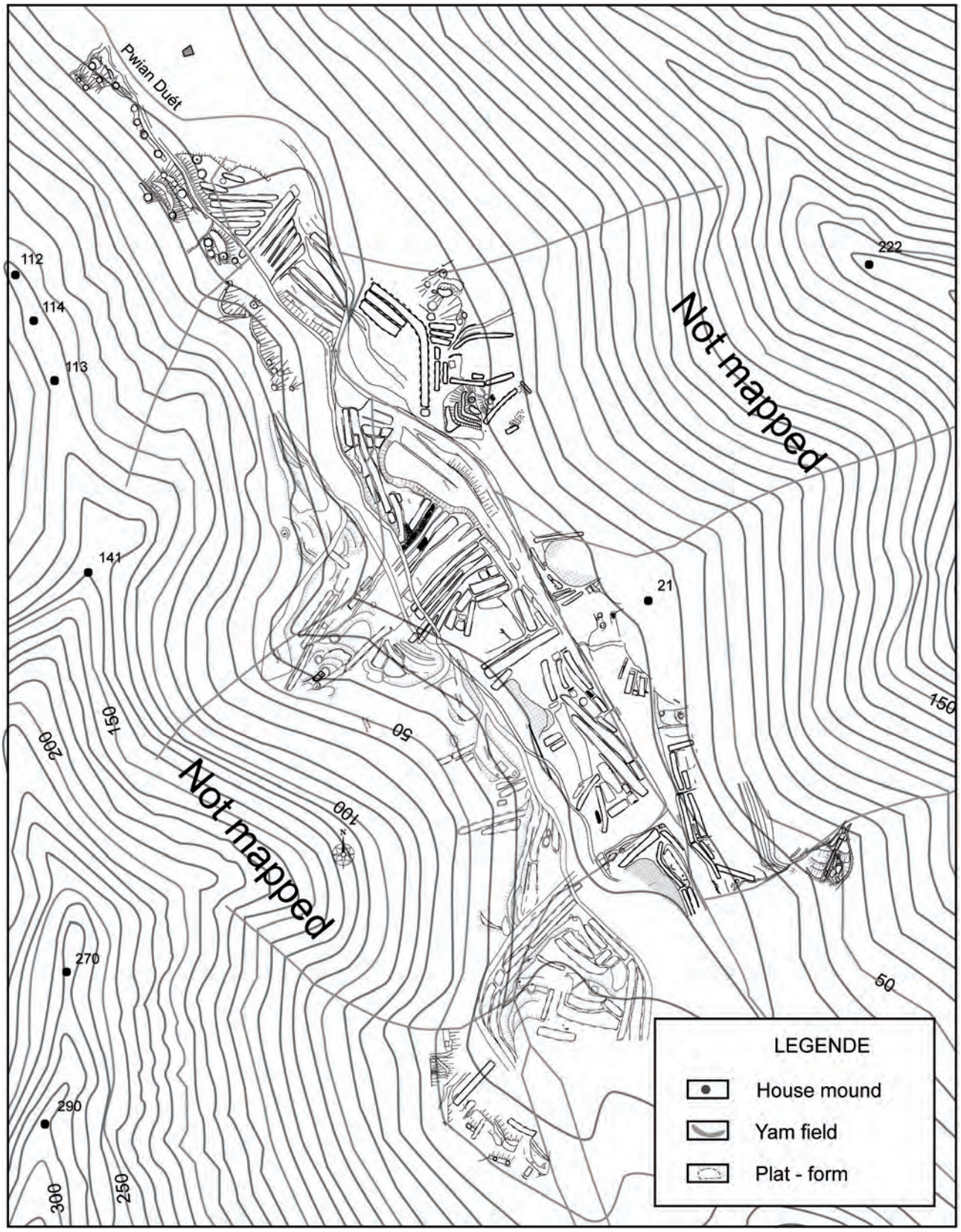


Fig. 10 – Map of the lower parts of one of the valleys of Werap tribe, illustrating the diversity of remains.
Fig. 10 *– Carte des parties basses d'une des deux vallées de la tribu Wérap, illustrant la diversité des vestiges.*

Fig. 11 – Example of retaining wall of a river bank, Hienghene region.
Fig. 11 *– Exemple d'un mur de soutènement de bord de rivière, région de Hienghène.*

the rich environmental diversity of the archipelago. Aside from the evident differences between the wet east coast and the dryer but more extensive west coast of the main island, the geological specificities of Grande Terre and the Loyalty Islands as well as variation between regions forced the indigenous settlers to adapt their settlement strategies to local constraints. The most evident achievement in this field is certainly the understanding by the Kanaks that the porous metamorphic crust which topped about 30% of the mountains of Grande Terre, allowed the creation of a unique type of natural water-storage reserve (Maurizot and Vendé-Leclerc, 2013). In an archipelago experiencing regular drought cycles (Dotte et al., 2010), the possibility of relying on permanent water flow at the foot of the geological crust allowed the Kanaks to develop on sometimes very steep mountain sides what is considered "certainly the most technically complex pondfield irrigation within Melanesia" (Kirch and Lepofsky, 1993). It is essential to take into account the Kanak adaptation of a pan-Pacific horticultural tradition to this environmental specificity if we are to understand the apparent discontinuous distribution of terraced taro fields on Grande Terre (Sand, 2012).

Traditional Kanak habitat diversity has also been greatly highlighted through archaeological settlement pattern studies. The idealized ethnographic model of a standardized hamlet with a long narrow central path surrounded by rounded house mounds, has not withstood the test of field data. Even in the central part of Grande Terre where hamlets with a straight central path are the most frequent, they are not the majority of settlements identified through mapping (Sand, 2002a). In the northern part of the island, the straight path disappears altogether, being mostly replaced by a curved U-shaped plaza. Interestingly, questions about the form and size of the traditional hamlets remain open for the south of Grande Terre, where at this stage no extensive sets of structured Kanak hamlets have been found during the surveys.

While progress has been made on characterizing former landscape uses in New Caledonia, a lot remains to be done in terms of archaeological studies to get a better understanding of the diversity of the traditional Kanak settlement patterns. Evidently, there is a need for more mapping. But aside from this central topic and when comparing the situation to recent research completed in Polynesia and Micronesia (Kirch, 2000, p. 246–301), it is clear that most questions surrounding the chronology of these dense occupations still await answers. Preliminary studies have shown that the first raised house-mounds appear at the beginning of the second millennium AD (Sand, 1997, p. 58). A process of progressive expansion in settlement size and growth of some of the house mounds through refilling has been documented (Sand et al., 2009). In unfavorable environments such as the dry hills of Deva, facing the central west coast, large settlements appear only in the middle

of the second millennium AD (Sand et al., 2013). By the time of first European contact, some house mounds had reached massive proportions, some being over 20 m wide and 2.5 m high, and collective working effort had allowed the terracing of a large part of the creek banks and taro patches with stone retaining walls. Even the barren unfertile peridotite plateaus were used, mainly for ritual and exchange purposes, leading to the building of sometimes massive stone cairns comprising hundreds or thousands of individual mounds depending on the location (see Sand et al., 2012; Wadrawane et al., 2014).

Even without more detailed data, it appears that such settlement pattern studies, tied to a better understanding of the chronological processes at play in the creation of intensified landscapes, should allow archaeologists to start reconsidering our models of traditional Melanesian political systems and hierarchy over time. It remains clear that ethnographic accounts from the late 19th and 20th centuries give the essential socio-cultural canvas of traditional ways of life. But with respect to the fundamental research topic just outlined, it is now apparent that without the input of archaeology, ethnographic data alone cannot produce a realistic picture of the complexity of organizations that existed on the densely-populated large and smaller islands of Melanesia at the eve of Western contact. This should foster support for a global multi-disciplinary think tank focused on the concept of 'archaeology of tradition' and what that might mean in the western Pacific.

CONCLUSION

For a long time, Melanesian archaeology has mainly concentrated on the study of ceramics, especially Lapita, and the creation of cultural chronologies. Until recently, a number of factors, detailed in this paper, have prevented the development of research projects concerned primarily with the study of traditional indigenous settlement patterns in a wider landscape approach. Yet traditional landscapes are at the core of Melanesian identity, and remain the real—and often the only—subject of interest of local groups when they have to deal with an archaeological research project on their land. It is not surprising in this context that, amongst other examples, the proposal of a New Zealand team wishing to research Lapita in the northern Solomons, was accepted by the local community if a parallel effort was concentrated on the late chronological phase (Sheppard, pers. com. 2000). This forced archaeologists to work on a recent time-period that was not part of their original project, but ended-up in a multi-purpose research program on the rise of a highly-hierarchical Melanesian chiefdom (Walter and Sheppard, 2000 and 2006), associating oral traditions, archaeology, mapping, ethnography and history.

Examples such as this highlight the need to take into account the interests of local communities, who expect archaeologists to work on what they define as 'their history', related to their immediate ancestors and the oral traditions related to them. But this must not conceal the fact that working on the recent past in Melanesia can be problematic, as archaeologists may become embroiled in questions of land ownership, customary prerogatives and local conflicts. It must also not overshadow the reality that environmental constraints as well as specific traditional ways of life can render in some islands the study of former settlement patterns difficult, especially when no extensive remains are present on the ground. This is for example the case of the former habitation areas on the Loyalty Islands, where the porous karstic substratum did not necessitate the building of raised mounds, leaving archaeologists with no visible evidence on the surface during surveys. Landscape studies in this context become less effective, creating an archaeological bias towards more readily visible traditional settlement patterns that might become, if we are not cautious, the new Melanesian 'model'. Nonetheless, looking overall at the large islands in our region compared with most archipelagoes of Micronesia to the north and Polynesia to the east, and at the complexity of some of the settlement pattern studies published to date, the Melanesian crescent as a cultural area clearly holds a huge and still dramatically underexplored potential in the field of landscape archaeology.

Acknowledgements: We would like to acknowledge the permission given by the different chiefdoms and landowners, for authorizing the mapping of Kanak sites in their area. The archaeological programs were fulfilled on Grande Terre by the former Department of Archaeology of New Caledonia and the Institute of Archaeology of New Caledonia and the Pacific with funding from the Government of New Caledonia, the Northern Province and the Southern Province. Our thanks go to the two reviewers of this paper and to Frédérique Valentin and Guillaume Molle for giving us the time to finalize the manuscript written by C. Sand.

BIBLIOGRAPHICAL REFERENCES

Bedford S. (2006) – *Pieces of the Vanuatu Puzzle: Archaeology of the North, South and Centre*, Canberra, Pandanus Books (Terra Australis, 23), 326 p.

Bensa A. (1981) – Clans autochtones : situation pré-coloniale, in C. Sautter (ed.), *Atlas de la Nouvelle-Calédonie et dépendances*, Paris, ORSTOM, pl. 18.

Bensa A., Rivierre J.-C. (1982) – *Les chemins de l'alliance : l'organisation sociale et ses représentations en Nouvelle-Calédonie (région de Touho – aire linguistique cèmuhî)*, Paris, SELAF (Langues et Cultures du Pacifique, 1), 386 p.

Bolé J., Ouétcho A.-J., Sand C. (2005) – *Première phase d'inventaire des sites archéologiques de la vallée de « Gala-*

pio » (*Tendo, Hiénghène)*, report, département de l'Archéologie de la direction des Affaires culturelles et coutumières, Nouméa, 10 p.

Boulay R. (1990) – *La maison kanak*, Paris, Parenthèses - ADCK – ORSTOM (Architectures traditionnelles), 168 p.

Cordy R. (1993) – *The Lelu Stone Ruins (Kosrae, Micronesia), 1978-81. Historical and Archaeological Research*, Honolulu, University of Hawaii at Manoa (Asian and Pacific Archaeology Series, 10), 454 p.

Dotte E. (2010) – « *Le bois ancêtre* ». *Arbres, forêts et occupation kanak précoloniale sur la Grande Terre de Nouvelle-Calédonie : étude de cas et approche anthracologique dans la vallée de la Tiwaka (nord-est)*, doctoral thesis, Université Paris I – Panthéon-Sorbonne and The Australian National University, Canberra, 447 p.

Dotte E., Sand C., Bolé J., Ouétcho A.-J. (2010) – « Des milieux et des paysages ». Le rôle des variations climatiques dans la transformation du système socioécologique en Nouvelle-Calédonie au deuxième millénaire apr. J.-C. : approche archéogéographique, in F. Valentin and M. Hardy (dir.), *Hommes, milieux et traditions dans le Pacifique Sud*, Paris, De Boccard, p. 211–28.

Doumenge J.-P. (1982) – *Du terroir… à la ville. Les Mélanésiens et leurs espaces en Nouvelle-Calédonie*, Talence, Centre d'études de géographie tropicale (Travaux et documents de géographie tropicale), 488 p.

Dubois M. J. (1970) – Les grands refuges de guerre de Hnaened à Maré, Nouvelle-Calédonie, *Journal de la Société des océanistes*, 26, p. 55–60.

Felgate M. W. (2003) – *Reading Lapita in Near Oceania: Intertidal and Shallow-water Pottery Scatters, Roviana Lagoon, New Georgia, Solomon Islands*, doctoral thesis, University of Auckland, 594 p.

Frimigacci D. (1975) – *La préhistoire néo-calédonienne*, doctoral thesis, Université Paris I – Panthéon-Sorbonne, 115 p.

Galipaud J.-C. (1988) – *La poterie préhistorique néo-calédonienne et ses implications dans l'étude du processus de peuplement du Pacifique occidental*, doctoral thesis, Université Paris I – Panthéon-Sorbonne, 174 p.

Garling S. (2007) – *Post-Lapita Evolutions or Revolutions? Interaction and Exchange in Island Melanesia: The View from the Tanga Islands*, doctoral thesis, The Australian National University, Canberra, 752 p.

Gifford E. W., Shutler R. Jr. (1956) – *Archaeological Excavations in New Caledonia*, Berkeley and Los Angeles, University of California Press (Anthropological Records, 18, 1), 148 p.

Glaumont G. (1888) – *Étude sur les us, mœurs, coutumes, funérailles des Néo-Calédoniens. Théorie du continent englouti. Origine des Néo-Calédoniens*, Nouméa, Document lithographié, 183 p.

Glaumont G. (1897) – La culture de l'igname et du taro en Nouvelle-Calédonie, travaux gigantesques des indigènes, *L'Anthropologie*, 8, p. 41–50.

Golson J. (1959) – Archéologie du Pacifique sud. Résultats et perspectives, *Journal de la Société des océanistes*, 15, p. 5–54.

Gony Y.-B., Ouétcho A.-J., Baret D., Sand C. (2011) – *Première phase d'inventaire dans la moyenne vallée de la Tipindjé. Site de Thêhaat (commune de Hienghène)*, Nouméa, Institut d'archéologie de la Nouvelle-Calédonie et du Pacifique, 60 p.

Gony Y.-B., Sand C., Ouétcho A.-J., Baret D., Bolé J., Wadrawane J.-M., Domergue S. (2012) – *Rapport d'inventaire archéologique « Projet d'aménagement en terre coutumières, tribu de Wérap », commune de Hienghène*, Nouméa, Institut d'archéologie de la Nouvelle-Calédonie et du Pacifique, 62 p.

Green R. C. (1961) – Moorean Archaeology, *Man*, 61, p. 169–73.

Guiart J. (1963) – *La chefferie en Mélanésie du Sud*, Paris, musée de l'Homme, 688 p.

Guiart J. (1992) – *Structure de la chefferie en Mélanésie du Sud*, 1, Paris, musée de l'Homme, 467 p.

Guiart J. (1997) – *Maurice Leenhardt. Le lien d'un homme avec un peuple qui ne voulait pas mourir*, Nouméa, Le Rocher à la Voile, 155 p.

Guillaud D., Forestier H. (1996) – *Les hameaux des karsts. Occupation ancienne de la vallée de Koumac*, Nouméa, ORSTOM, 84 p.

Hambruch P. (1911) – Die sogenannten „Ruinen" von Matolenim auf Ponape, *Korrespondenzblatt der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 42, p. 128–31.

Kasarherou C. (1992) – *Histoire démographique de la population mélanésienne de la Nouvelle-Calédonie*, doctoral thesis, Université Paris I – Panthéon-Sorbonne, 298 p.

Kirch P. V. (2000) – *On the Road of the Winds. An Archaeological History of the Pacific Islands before European Contact*, Berkeley, University of California Press, 446 p.

Kirch P. V., Lepofsky D. (1993) – Polynesian Irrigation: Archaeological and Linguistic Evidence for Origins and Development, *Asian Perspectives*, 32, p. 183–204.

Kirch P. V., Rallu J. L. (2007) – *The Growth, Regulation, and Collapse of Island Societies: Archaeological and Demographic Perspectives from the Pacific*, Honolulu, University of Hawaii Press, 390 p.

Lambert P. (1900) – *Mœurs et superstitions des néo-calédoniens*, Nouméa, Nouvelle imprimerie nouméenne, 400 p.

Leenhardt M. (1930) – *Notes d'ethnologie néo-calédonienne*, Paris, musée de l'Homme, (Travaux et Mémoires de l'Institut d'Ethnologie, 8), 340 p.

Liston J. (2013) – *Sociopolitical development and a monumental earthwork landscape on Babeldaob Island, Palau*, doctoral thesis, The Australian National University, Canberra, 377 p.

Maurizot P., VendÉ-Leclerc M. (2013) – La géologie, in J. Bonvallot, J.-C. Gay and É. Habert (eds.), *Atlas de la Nouvelle-Calédonie*, Marseille, IRD Éditions (Atlas et cartes), planche 13.

Mcarthur N. (1968) – *Island Populations of the Pacific*, Canberra, The Australian National University Press, 381 p.

Osborne D. (1966) – *The Archaeology of the Palau Islands. An Intensive Survey*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 230), 497 p.

Rallu J.-L. (1990) – *Les populations océaniennes aux XIX^e^ et XX^e^ siècles*, Paris, Presses universitaires de France (Travaux et Documents, 128), 348 p.

Riesenfeld A. (1950) – *The megalithic culture of Melanesia*, Leiden, E. J. Brill, 736 p.

Routledge K. (1919) – *The Mystery of Easter Island: The Story of an Expedition*, London, Hazell, Watson and Viney, 404 p.

Roux J.-C. (1990) –Traditional Melanesian Agriculture in New Caledonia and Pre-Contact Population Distribution, in D. E. Yen and J. M. J. Mummery (ed.), *Pacific Production Systems. Approaches to Economic Prehistory*, Canberra, The Australian National University (Occasional Papers in Prehistory, 18), p. 161–173.

Sahlins M. (1963) – Poor Man, Rich Man, Big-Man, Chief: Political Types in Melanesia and Polynesia, *Comparative Studies in Society and History*, 5, p. 285–303.

Sand C. (1994) – *« Entre mer et montagne ». Premier inventaire des sites archéologiques de la commune de Païta*, Nouméa, service territorial des Musées et du Patrimoine (Les Cahiers de l'archéologie en Nouvelle-Calédonie 4), 95 p.

Sand C. (1995) – *« Le temps d'avant ». La Préhistoire de la Nouvelle Calédonie : contribution à l'étude des modalités d'adaptation et d'évolution des sociétés océaniennes dans un archipel du Sud de la Mélanésie*, Paris, L'Harmattan, 356 p.

Sand C. (1997) – Variété de l'habitat ancien en Nouvelle-Calédonie, *Journal de la Société des océanistes*, 104, p. 39–66.

Sand C. (2000) – Reconstructing 'Traditional' Kanak Society in New Caledonia: The Role of Archaeology in the Study of European Contact, in R. Torrence and A. Clarke (eds.), *The Archaeology of Difference*, London, Routledge (One World Archaeology Series, 38), p. 51–78.

Sand C. (2002a) – Creations and Transformations of Prehistoric Landscapes in New Caledonia, the Southernmost Melanesian Islands, in T. Ladefoged and M. Graves (eds.), *Pacific Landscapes: Archaeological Approaches in Oceania*, Los Osos, Easter Island Foundation, p. 11–34.

Sand C. (2002b) – Melanesian Tribes vs. Polynesian Chiefdoms: Recent Archaeological Assessment of a Classic Model of Sociopolitical Types in Oceania, *Asian Perspectives*, 41, 2, p. 284–96.

Sand C. (2007) – *Relevé du hameau kanak de Pwadaunu (Pombei-Touho). Données générales du relevé cartographique du site*, report, département de l'Archéologie de la direction des Affaires culturelles et coutumières, Nouméa, 14 p.

Sand C. (2010) – *Lapita calédonien. Archéologie d'un premier peuplement insulaire océanien*, Paris, Société des océanistes (Travaux et documents océanistes, 2), 295 p.

Sand C. (2012) – 'Certainly the Most Technically Complex Pondfield Irrigation within Melanesia': Wet Taro Field Systems of New Caledonia, in M. Spriggs, D. Addison and P. J. Matthews (eds.), *Irrigated Taro* (Colocasia esculenta) *in the Indo-Pacific*, Osaka, National Museum of Ethnology (Senri Ethnological Studies, 78), p. 167–88.

Sand C., Baret D. (in press) – *Témoins en 3D. Occupations de l'espace Kanak cartographies par photographie aérienne*, Nouméa, IANCP (Archeologia Pasifika, 4).

Sand C., Bolé J., Ouétcho A.-J. (2003) – Prehistoric Cultural Evolutions in a Melanesian Archipelago: The New Caledonia Example, *Antiquity*, 77, 297, p. 505–19.

Sand C., Bolé J., Ouétcho A.-J. (2007) – What Were the Real Numbers? The Question of Pre-Contact Population Densities in New Caledonia, in P. V. Kirch and J.-L. Rallu (eds.), *The Growth, Regulation, and Collapse of Island Societies: Archaeological and Demographic Perspectives from the Pacific*, Honolulu, University of Hawaii Press, p. 306–25.

Sand C., Bolé J., Ouétcho A.-J. (2000) – Les sociétés préeuropéennes de Nouvelle-Calédonie et leur transformation historique. L'apport de l'archéologie, in A. Bensa et I. Leblic (dir.), *En pays kanak : ethnologie, linguistique, archéologie, histoire de la Nouvelle-Calédonie*, Paris, MSH, p. 171–94.

Sand C., Bolé J., Ouétcho A.-J., Baret D. (2005) – *Première phase de relevés cartographiques de sites archéologiques dans la vallée de Galapio, tribu de Tendo (Hienghène, Province Nord)*, report, département de l'Archéologie de la direction des Affaires culturelles et coutumières, Nouméa, 15 p.

Sand C., Bolé J., Ouétcho A.-J., Baret D. (2008) – *Parcours archéologique. Deux décennies de recherches du Département Archéologie de Nouvelle-Calédonie (1991-2007)*, Nouméa, département de l'Archéologie de la direction des Affaires culturelles et coutumières (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 17), 278 p.

Sand C., Bolé J., Ouétcho A.-J., Baret D. (2009) – Contribution à l'archéologie du « séjour paisible » kanak : étude et mise en valeur du hameau de Tipéhéne, Pombeï (Nouvelle-Calédonie), *Journal de la Société des océanistes*, 128, p. 53–68.

Sand C., Bolé J., Ouétcho A.-J., Gony Y-B., Baret D. (2012) – Occupations anciennes des plateaux miniers à Thio et à Tontouta : premières prospections et datations. *Journal de la Société des océanistes*, 134, p. 31–44.

Sand C., Kirch P. V. (2002) – *'Lapita was name of village at this site'. L'expédition archéologique d'Edward W. Gifford et Richard Shutler Jr. en Nouvelle-Calédonie au cours de l'année 1952 = Edward W. Gifford and Richard Shutler's Archaeological Expedition to New Caledonia in 1952*, Nouméa, département de l'Archéologie de la direction des Affaires culturelles et coutumières (Les Cahiers de l'Archéologie en Nouvelle-Calédonie, 13), 192 p.

Sand C., Ouétcho A.-J. (1992) – *Bwede ko-tchon tchuvanvare kein (des rivières déviées par les ancêtres). Premier inventaire archéologique de la commune de Yaté, Province Sud de la Nouvelle-Calédonie*, Nouméa, département de l'Archéologie de la direction des Affaires culturelles et coutumières (Les Cahiers de l'Archéologie en Nouvelle-Calédonie, 1), 101 p.

Sand C., Ouétcho A.-J. (1993) – *Étude d'impact de la transversale Koné-Tiwaka sur le patrimoine archéologique*, Nouméa, département de l'Archéologie de la direction des

Affaires culturelles et coutumières (Les Cahiers de l'Archéologie en Nouvelle-Calédonie, 2), 95 p.

Sand C., Terebo M., Lagarde L. (2013) – *Le passé de Déva. Archéologie d'un domaine provincial calédonien*, Nouméa, IANCP (Archeologia Pasifika 2), 80 p.

Saussol A. (1979) – *L'Héritage: essai sur le problème foncier mélanésien en Nouvelle-Calédonie*, Paris, musée de l'Homme (Publication de la Société des océanistes, 40), 493 p.

Spoehr A. (1957) – *Marianas Prehistory. Archaeological Survey and Excavations on Saipan, Tinian and Rota*, Chicago, Natural History Museum (Fieldiana, Anthropology, 48), 187 p.

Spriggs M. (1981) – *Vegetable Kingdoms: Taro Irrigation and Pacific Prehistory*, doctoral thesis, The Australian National University, Canberra, 203 p.

Terrell J. E. (1976) – *Perspectives on the Prehistory of Bougainville Island, Papua New Guinea: A Study in Human Biogeography of the Southwestern Pacific*, doctoral thesis, Cambridge, Harvard University Press, 683 p.

Terrier C. (2012) – L'exploration européenne et la colonisation (1774-1946), in J. Bonvallot, J.-C. Gay and É. Habert (eds.), *Atlas de la Nouvelle-Calédonie*, Marseille, IRD (Atlas et cartes), pl. 23.

Tjibaou J. M. (1976) – Recherche d'identité mélanésienne et société traditionnelle, *Journal de la Société des océanistes*, 53, p. 281–92.

Tjibaou J. M., Missotte P., Folco M., Rives C. (1976) – *Kanaké, Mélanésien de Nouvelle-Calédonie*, Papeete, Les Éditions du Pacifique, 120 p.

Valentin F., Sand C. (2001) – Inhumations préhistoriques en Nouvelle-Calédonie, *Journal de la Société des océanistes*, 113, p. 136–49.

Wadrawane J. M., Ouétcho A.-J., Sand C. (2014) –*Projet de classement de site archéologique, presqu'île de Bogota (Po Kwe taa) : inventaire de la zone A. Commune de Canala, Xâracùù*, report, Institut d'archéologie de la Nouvelle-Calédonie et du Pacifique, Nouméa, 715 p

Walter R., Sheppard P. (2000) – Nusa Roviana: The Archaeology of a Melanesian Chiefdom, *Journal of Field Archaeology*, 27, 3, p. 295–318.

Walter R., Sheppard P. (2006) – Archaeology in Melanesia: A Case Study from the Western Province of the Solomon Islands, in I. Lilley (ed.), *Archaeology of Oceania, Australia and the Pacific Islands*, Oxford, Blackwell Publishing (Blackwell Studies in Global Archaeology, 8), p. 137–59.

Christophe Sand
André-John Ouétcho
Jacques Bolé
David Baret
and
Yves-Béalo Gony
Institut d'archéologie de la
Nouvelle-Calédonie et du Pacifique,
65, rue T. de Laubarède, BP 11423,
98802 Nouméa Cedex, Nouvelle-Calédonie

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 49-62
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

On the importance of freshwater access in successful island colonisation

Christian Reepmeyer, Geoffrey Clark, Jolie Liston and Ella Ussher

Abstract: Subsistence strategies of early colonisers in the Pacific and settlement locations of Lapita sites in close vicinity of freshwater streams have been employed to develop predictive models about potentials of different geomorphological settings to produce archaeological sites. It was concluded that islands with depauperate environments might have been actively avoided by the earliest colonisers because of lack of access to surface freshwater. This paper presents results from recent excavations on the Rock Islands of Palau where two ceramic containers with broken bases were found in stratigraphic levels associated with freshwater lenses in a beach setting. Radiocarbon age determinations of around 2800 cal. BP place the vessels into the early colonisation phase of the Rock Islands of Palau. It is suggested that these containers might have functioned as sumps tapping the freshwater lens, providing evidence that colonising populations were able to sustain settlements on small islands without surface freshwater.

Keywords: Rock Islands, Palau, colonization, freshwater, ceramic, adaptation.

De l'importance de l'accès à l'eau douce dans le succès de la colonisation des îles

Résumé : L'hypothèse selon laquelle les premiers colons du Pacifique se seraient installés à proximité de sources d'eau douce a été utilisée pour prédire la localisation des sites archéologiques Lapita. On en a conclu que les îles aux environnements appauvris pourraient avoir été volontairement évitées par les premiers colons en raison du manque d'accès d'eau douce en surface. Cet article présente les résultats de fouilles récemment conduites dans les Rock Islands (Palau), où deux contenants céramiques aux bases brisées ont été découverts en contexte de plage, dans des niveaux stratigraphiques associés à des lentilles d'eau douce. Des datations radiocarbones, autour de 2800 cal. BP, tendent à attribuer ces céramiques à la première phase de colonisation des îles Rock (Palau). Les auteurs suggèrent que ces poteries pourraient avoir été utilisées comme puisards pour contenir l'eau douce provenant de la lentille, apportant alors l'indication que des installations durables ont pu être développées dans des environnements dépourvus d'eau au tout début de la période de peuplement.

Mots-clés : îles Rock, Palau, colonisation, eau douce, céramique, adaptation.

It must doubtless surprise the greatest parts of our readers, and perhaps stagger their belief when they are told of so many islands abounding with inhabitants, who subsist with little or no freshwater. Yet true it is, that few or none of the little low islands between the tropics have any water on the surface of the ground, except perhaps in a lagoon, the water of which is generally brackish; nor is it easy to find water by digging.
(Rickman, 1781, p. 91–92)

The availability of freshwater in newly discovered environments is an essential attribute influencing on human colonisation (Lepofsky, 1988, p. 42). Predictive models for early Lapita sites marking the founding culture of much of the Western Pacific incorporate vicinity to surface freshwater into their evaluation (Frimigacci, 1980; Lepofsky, 1988; Kirch, 1997; Spriggs, 1997). In contrast, surprisingly little is known about access to subterranean freshwater during initial colonisation. In a recent review, Specht and coworkers (Specht et al., 2014) pointed out that although Lapita colonisers preferred coastal and small-island locations in much of the south-western Pacific, none were outside the visible range of larger islands with abundant freshwater

resources (see also Specht, 2007). In Micronesia, where freshwater is significantly scarcer than on the larger volcanic islands of the south-western Pacific, it has been suggested that the earliest colonisers actively avoided small islands devoid of surface freshwater in the initial settlement phase (Wickler, 2001; Liston, 2005).

However, there is evidence for early habitation of small islands lacking surface sources of freshwater. The colonisation of Walpole, an island without surface freshwater at the south-east edge of the Melanesia region, is believed to be initially inhabited at around 2750–2450 cal. BP (Sand, 2004). This age range is slightly later than Lapita sites on Tongatapu in West Polynesia, a low-lying limestone island also without surface freshwater (Hunt, 1979; Clark and Bedford, 2008; Burley et al., 2010). On Tongatapu, a site has been observed next to a solution channel where subterranean freshwater exits into the sea (Valentin and Clark, 2013). Spring-fed freshwater might also have been accessed by early colonisers in cave sites in Fiji, and Aiwa in the Lau Group (Best, 1984, p. 298). Additionally, it has been suggested that in Vanuatu inhabitants of small, off-shore islands without surface freshwater accessed subterranean freshwater during Lapita times (Bedford, 2006) although thus far no evidence supporting this hypothesis has been found (see Bedford, 2003, p. 155, for a discussion of excavation methodology creating a research gap). A pit feature at the Nenumbo site in the Reef Santa Cruz islands has been proposed by Green (1979, p. 35) to have been utilised to access freshwater; unfortunately, this evidence is ambiguous as the pit can be associated with a multitude of other functions.

Freshwater wells in coastal locations are abundant on Pacific islands today. Most evidence for the antiquity and significance of subterranean freshwater derives from the ethnohistoric record and recent observations of wells being utilised for irrigation (Spriggs, 1997); with their importance acknowledged in creation myths and chiefly place names (Hunt and Kirch, 1988, p. 165). Early European explorers in the Pacific frequently discuss the difficulties of accessing potable water, particularly in the Pacific's eastern regions. They simultaneously observed that native inhabitants seem to have no lack of freshwater. For example, on his second voyage Captain Cook describes the island of Tongatapu by stating:

> "[…] If nature has been wanting in any thing *(sic!)*, it is in the article of fresh water, which as it is shut up in the bowels of the earth and for which they are obliged to dig wells, of these we saw only one, so that it is probable there are but few. At Middleburg we saw none, nevertheless they are not without. [Footnote: a running stream was not seen and but one well at Amsterdam: at Middleburg no Water was seen but what the Natives had in Vessels, but as it was sweet and cool I had no doubt of its being taken up upon the isle and probably not far from the spot where I saw it.]" (Beaglehole, 1969, p. 273).

Considering the lack of information about the technology used by initial colonisers to access subterranean freshwater, we report the results of recent excavations in the Rock Islands of Palau. In 2012, a team from the Australian National University conducted research in collaboration with the Bureau of Arts and Culture Palau and the Conservation and Coastal Management Division of Koror State. Excavation encountered two complete pots with missing bases sitting upright in what would have been the intertidal zone at the time of settlement. These pots may have been deliberately placed to tap into the subterranean freshwater lens.

BACKGROUND

The islands of Palau (fig. 1) are located in Western Micronesia approximately 850 km north of New Guinea and about 900 km east of Mindanao in the Philippines. The Palauan archipelago includes the main volcanic island of Babeldoab with a multitude of uplifted limestone islands to the south, including the larger limestone islands of Peleliu and Angaur. The UNESCO World Heritage property Rock Islands Southern Lagoon area, inscribed as a mixed cultural and natural site in 2012, comprises 850 km^2 of lagoon in which about three hundred small raised limestone islands are enclosed by nearly 200 km of barrier reef. These Rock Islands are renowned for the existence of marine lakes containing a huge variety of endemic wildlife (Colin, 2009). Today, the beauty of the Rock Islands and the easy accessibility from Babeldoab obscures the fact that their very steep terrain, lack of cultivable soil deposits and, most importantly, a lack of surface freshwater results in a particularly harsh environment for permanent settlement (Clark, 2005; Clark and Reepmeyer, 2012).

The first Europeans visitors noted that all of the limestone Rock Islands south of Babeldoab and north of Peleliu were uninhabited (Keate, 1788). Palauans reported, however, that a population numbering in the thousands had once lived in the area, with traces of their abandoned village sites found on many islands (Osborne, 1966; also Reepmeyer et al., 2011). Oral traditions frequently place the origin of social groups and the invention of customary practices in the Rock Islands. The origin stories trace the migration of individuals, families and entire villages from the Rock Islands to contemporary villages on Babeldoab, many of which have village names, chiefly titles and community deities retained from the original village sites (Nero, 1987).

Once inhabited, the abandonment of the Rock Islands during the 16th century was recently linked with the onset of the 'Little Ice Age (LIA)' (Fagan, 2008). The 'Little Ice Age' (LIA) is in the western Micronesian region defined by a significant decrease in overall precipitation between AD 1250 and AD 1650 (Masse et al., 2006; Sachs et al., 2009; Clark and Reepmeyer, 2012; also Allen, 2006). The Rock Islands' depauperate terrestrial environment is highly susceptible to climatic fluctuations. In the karst topography soil accumulation suitable for gardening occurs only in sinkholes. The agricultural productivity of

the sinkholes, however, is directly correlated with overall precipitation as they rely on the replenishment of subterranean freshwater by rain water (Clark and Reepmeyer, 2012). The archaeological record correlates well with traditional explanations referring to the lack of freshwater access, resource deprivation, and social conflict as the primary causes of the abandonment of permanent Rock Island settlements around 400 BP (Masse et al., 2006; Reepmeyer et al., 2011; Clark and Reepmeyer, 2012).

EXCAVATIONS AT ULONG VILLAGE SITE

The Ulong island group (fig. 1) is located in the western part of the Rock Island Southern Lagoon area. The main island, Ulong, has a very steep topography with a central ridge rising almost 80 m above sea level. Thin infertile soils overlay limestone or calcareous sand beach deposits. There are no perennial streams on the island and no other surface freshwater can be found (Clark et al., 2006). On the west side of the main island the Ulong village site (fig. 2) extends inland, up the ridge slope, from the south half of the largest beach in the Ulong island group (Clark, 2005).

The cultural sequence of the Ulong village site is relatively well understood (Clark, 2005). Initial site occupation is dated to 3000 cal. BP when small and highly mobile groups used the island for short-term camps while harvesting marine resources from the adjacent reef (Clark, 2005; Masse et al., 2006; Ono and Clark, 2012). After initial colonisation of the island, mobile encampment most likely continued until the middle of the first millennium AD. The lack of soil accumulation at the site and the frequent intertidal and storm deposits suggest that beach flat stabilisation did not occur before 2000 cal. BP (Clark, 2004; Clark et al., 2006). Permanent settlement did not establish at the site until after stabilisation of the beach flat and Ulong village was abandoned around 400 cal. BP (Clark and Reepmeyer, 2012). The most prominent feature of the site is a large defensive wall enclosing an alcove at the southern end of the beach flat. The establishing of the wall and other more permanent coral limestone features on the slope of the central ridge can be dated after sedentary settlements were established on many of the Rock Islands around 900–1200 cal. BP (Clark, 2005; Liston, 2005; Clark and Reepmeyer, 2012).

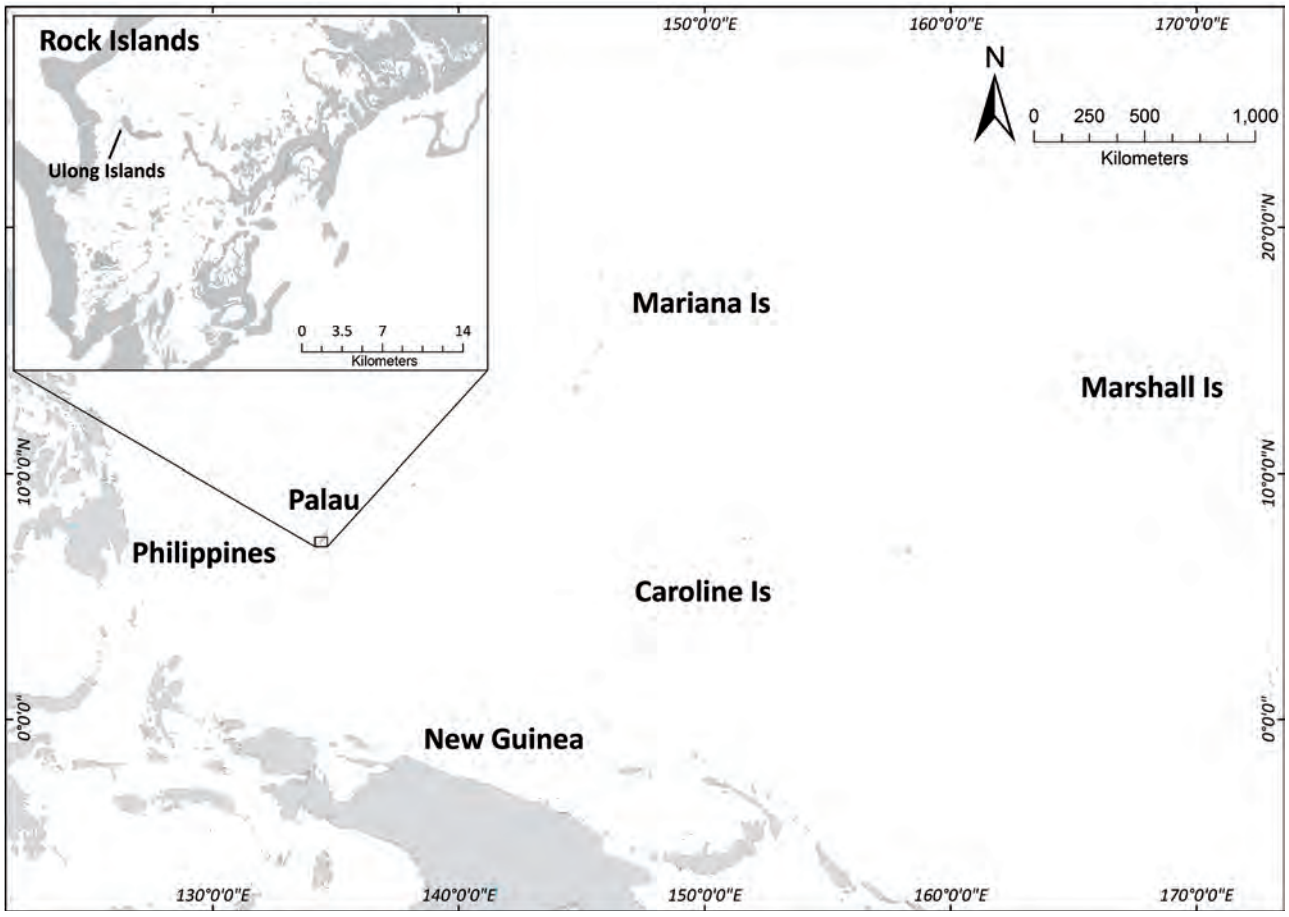


Fig. 1 – Map of the North-Western Pacific with the location of Palau, the Rock Islands and Ulong Island.
Fig. 1 *– Carte de la partie nord-ouest du Pacifique avec la localisation de Palau, des îles Rock et de l'île d'Ulong.*

In 2012, a 1 m × 3 m trench (unit 7) was excavated in the sand deposits at the back of the alcove (fig. 2), approximately 3 m from the base of the limestone slope and about 130 m from the current shoreline. The purpose of unit 7 was to determine if well-preserved material from the earliest occupation known on Ulong Island could be located as it had the potential to provide new knowledge about the first people to inhabit Palau. Previously, excavation of two 1 m² test pits in the alcove had investigated the cultural sequence (Clark, 2005) and helped understand resource exploitation during the later phases of village occupation (Ono and Clark, 2012). The discovery of a whole ceramic vessel dated to 2200 cal. BP in one of these test pits (Clark and Wright, 2007) suggested that other vessels may be interred in the sandy flat. As the alcove would be the most likely place for canoes to land, the location of unit 7 at the back of the alcove was chosen to test where the first beach would have formed following the mid-Holocene high stand.

Unit 7 was excavated in 10 cm spits to a depth of 281 cm below datum (fig. 3) with sediment wet sieved through 3 mm and 6 mm mesh. The unit descended to basal sterile sand and revealed eight distinct strata (table 1). The upper layers consist of a dark brown silty sand with abundant pottery, marine shell, fish bone and charcoal. These layers contain pottery with later period attributes, as well as some mammalian bones such as pig *(Sus scrofa)* and rat *(Rattus exulans)*. The permanent settlement horizon is at approximately 122 cm underlain by a 15–20 cm thick grey sandy silt deposit representing beach stabilisation. In the lower layers from 150 cm to about 250 cm calcareous sand with pockets of darker sediment, possibly resulting from bioturbation by crabs and tree roots, show beach flat development involving tidal and storm events. In these layers, the rarely occurring cultural material includes mineral sand-tempered pot sherds, large marine shells *(Tridacna* and *Hippopus)* with intact valve.

The cultural status of the lower levels of unit 7 was confirmed by the discovery of two substantially intact pots, pots 1 and 2, each in its own shallow pit dug into the sterile sand of the lower beach deposit that were subsequently covered by accreting sediments. Both vessels were placed upright in the pits after the vessels' bases had been broken. Pot 1 was set in a pit filled with coral boulders. It is unclear whether the coral boulders were intentionally placed to stabilise the vessel or washed in during later storm or tidal events. The rim of pot 1 was at 210 cm below datum at the same level as three large *Hippopus* and *Tridacna* sp. valves, and was located around the middle of the 1 m × 2 m area that was fully excavated to sterile sand. Substantial damage to the pot 1 rim and the presence of coarse coral gravel in the mouth of the vessel indicate that the feature was within reach

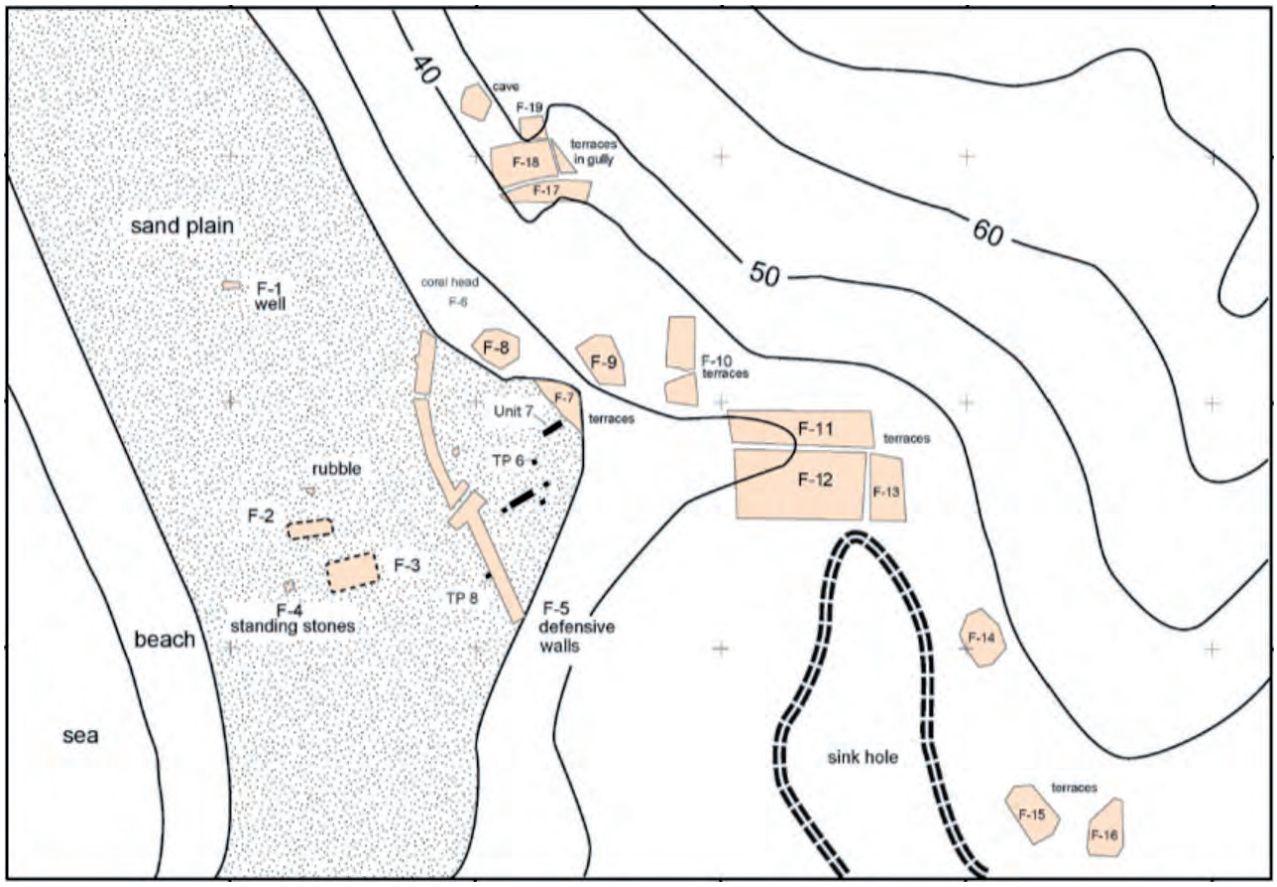


Fig. 2 – Ulong Island and Ulong village site with location of unit 7.
***Fig. 2** – L'île d'Ulong et le village d'Ulong avec la localisation de l'unité 7.*

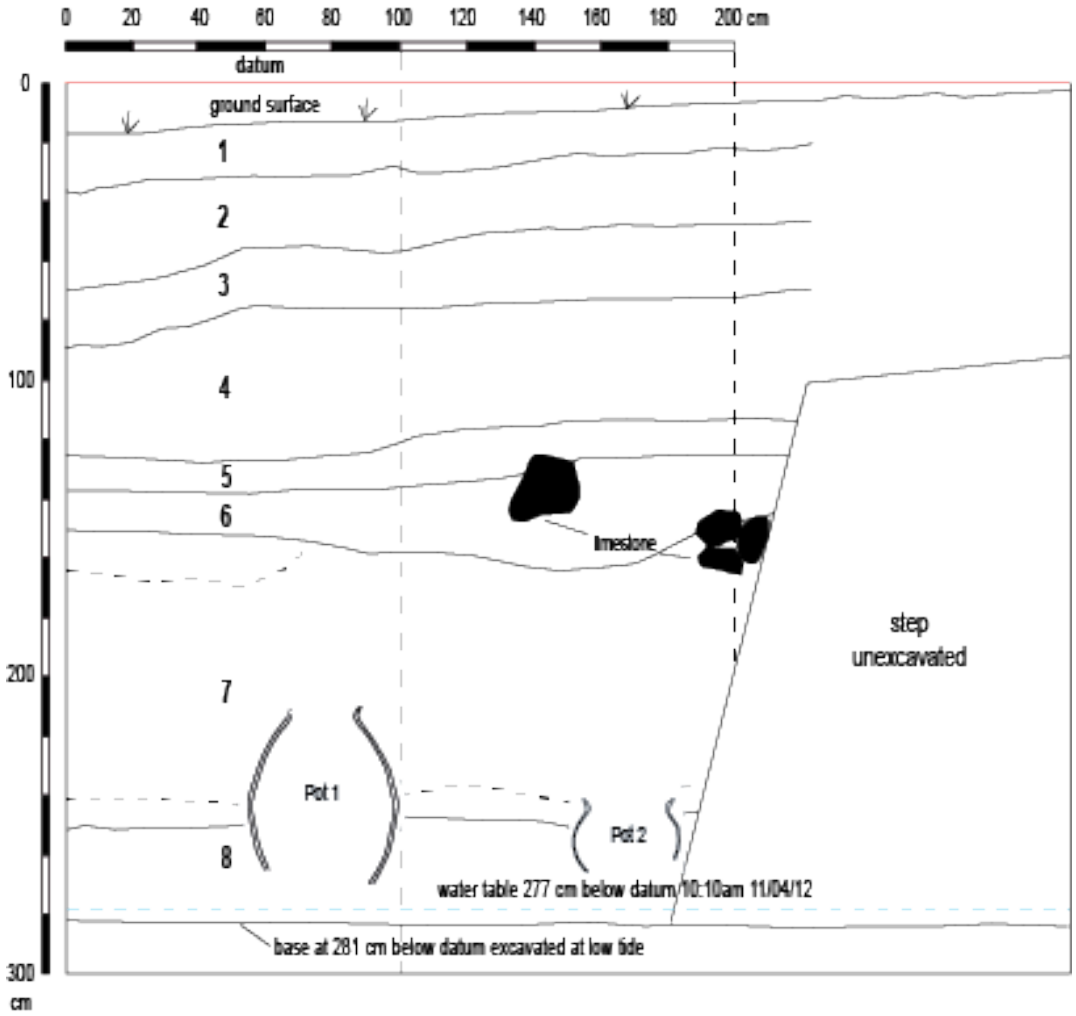


Fig. 3 – Unit 7 stratigraphy, North section, with the location of the two vessels.
Fig. 3 *– Stratigraphie de l'unité 7, section nord avec la localisation des deux récipients.*

	Colour and texture	Content
Layer 1	(10YR 3/2) Dark brown fine-medium silt with high humic content and frequent roots.	Abundant limestone gravel. Some thick walled ceramics.
Layer 2	(10YR 5/1) Medium brown sandy silt with high humic content, frequent roots.	Frequent coarse limestone fragments. Some thick walled ceramics.
Layer 3	(10YR 6/1) Light brown-grey sand with high humic content, increasing amounts of medium beach sand.	Some thick walled ceramics.
Layer 4	(10YR 3/2) Dark brown sandy silt.	
Layer 5	(10YR 3/2) Thin lens of dark brown humic material marking the transition between the silty beach flat sediments and beach sand deposits and probably representing early vegetation growth on the stabilized beach flat.	
Layer 6	(10YR 8/1) Yellow-white fine mottled limestone sand.	Limestone cobbles.
Layer 7	(10YR 7/1) Grey-white medium sand. At the base of the layer at 236–252 cm below datum is a thin lens of grey sand.	Cobbles of limestone at base, chunks of coral and some large clam valves distributed throughout the deposition. Rarely cultural material such as pottery fragments.
Layer 8	(10YR 8/1) Pale yellow-white medium sand.	No cultural material, limestone, coral or shell.

Table 1 – Description of unit 7 stratigraphy.
Tabl. 1 – *Description de la stratigraphie de l'unité 7.*

of tidal and storm waves. Pot 2 was located only 50–60 cm inland of pot 1 with the rim recorded at 242 cm below datum. The pot 2 pit contained fine sandy sediment with no coral boulders. The vessel's largely intact rim suggests it was probably quickly buried by beach sand.

RESULTS

Vessel forms

Pot 1 is an ovoid bodied vessel with an external orifice diameter of 24.4 cm and an everted rim with an orientation angle of 29 degrees (fig. 4). Extrapolation of vessel wall contours indicate a total vessel height of roughly 60 cm and a maximum body width of 46.5 cm. Body wall thickness varies from 0.8–1.6 cm with the thickest section at the juncture of the body and neck where a clay coil was added and shaped upward to form the neck-rim. The rim profile gradually thickens to terminate in a subrounded lip. The lower part of the vessel's exterior is fire blackened with carbonized residues adhering to the interior walls indicating use-life of the vessel included cooking. Mineral grains visible in the fabric under low-power magnification comprise quartz and ferromagnesian particles along with oxidized lithic fragments and calcareous inclusions. These minerals are typically found in ceramics collected in Ulong's basal levels (Fitzpatrick et al., 2003). One temper inclusion contained small linear quartz fragments in an irregular grey-black matrix. This suggests use of andesitic breccia, or possibly the early use of chamotte (low-fired clay/pottery), as a source of temper.

Pot 2 is a sub-globular vessel with an estimated height of 31 cm and a maximum body diameter of 38 cm (fig. 5). Its neck-orifice diameter is 26.8 cm and external lip diameter is 32.2 cm. The outcurving rim has an orientation angle of 31 degrees. The surface of the rim's interior displays four small depressions arranged in a column and bordered by two incised lines; this pattern may identify the pot's maker or owner. Body wall thickness varies from 0.5–0.3 cm with the thickest part of the pot below the neck where a clay coil was added to make the neck-rim. The thinnest wall sections are above and below the area of maximum body diameter.

Pots 1 and 2 are very different in height and shape. A point of similarity between the two vessels is the shape of the everted rim and lip, which in both vessels was made by the addition of a clay coil. Temper grains in the fabric of pot 2 are similar to those in pot 1 although pot 2 has a greater abundance of calcareous particles that likely

Fig. 4 – Vessel 1: reconstructed version of the pot and cross section drawing with opening and outer rim diameter (estimated).
Fig. 4 *– Récipient 1: reconstitution et dessin du profil avec le diamètre à l'ouverture et le diamètre du bord extérieur (estimés).*

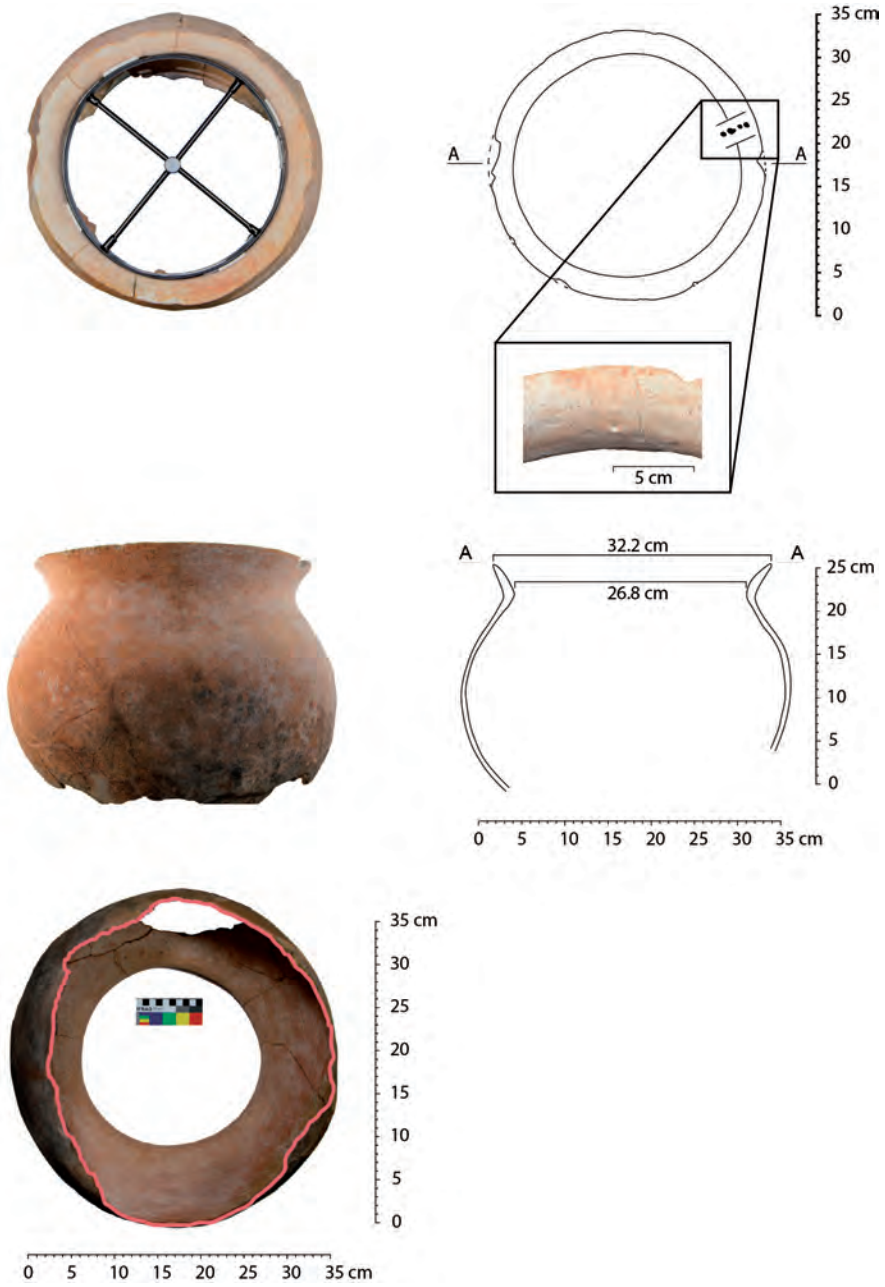


Fig. 5 – Vessel 2: reconstructed version with rim and cross section drawing. Detailed photo of rim indentation as described in the text with rim and opening diameter ; AA: Outer rim diameter.

Fig. 5 *– Récipient 2: reconstitution avec bord et dessin du profil. Photo détaillée du bord dentelé comme décrit dans le texte avec le diamètre du bord et le diamètre à l'ouverture; AA: diamètre du bord extérieur.*

reflects a lower firing temperature or heat exposure. Voids marking the removal of calcareous particles from repeated heating are common in the fabric of pot 1 near the vessel's base. The rim and manufacturing similarities indicate that the pots are probably from the same ceramic tradition. The difference in vessel forms suggests the pots served different functions before they were interred on Ulong Island.

A carbonized residue sample obtained from the interior of pot 1 and a charred twig collected at 220–230 cm below datum were submitted to the University of Waikato's Radiocarbon Dating Laboratory for AMS analysis. Once calibrated with Calib Rev 6.1.0 the radiocarbon ages indicate pot deposition occurred 2,800–2,900 years ago (table 2).[(1)]

Vessel function and relative sea level during the Late Holocene

The placement of complete pots upright into beach deposits at the Ulong site appears to be a repeated action of early visitors to the island. Clark and Wright (2007) excavated an intact upright vessel at Ulong that, similar to pots 1 and 2, had part of its base missing. In contrast,

Lab number	CRA	Cal. BP Age 2SD	^{13}C	Material	Proveniance
Wk-34934	2691 ± 32	2760–2850 (1.0)	−27.2 ± 0.3	Unidentified twigs	Unit 7: 220–230 cm
Wk-34944	2842 ± 25	2770–2890 (0.97)	−11.8 ± 0.2*	Pot 1 residue	Unit 7: 250 cm

* The ^{13}C value suggests that marine foods may have been cooked in the vessel and incorporated in the pot residue. As a result the calibrated age was calculated using the mixed Marine Northern Hemisphere curve using a 30% marine contribution.

Table 2 – Radiocarbon dates.
Tabl. 2 – *Dates ^{14}C.*

their vessel was resting on three large sherds which covered the hole in the base (Clark and Wright, 2007, p. 175). Although the role of the previously unearthed vessel remains unclear, Clark and Wright (2007, p. 187) in their review of complete vessels from the Pacific discussed a variety of possible functions, suggesting that after usage as a domestic cooking vessel, the pot was possibly recycled as storage container, but that final placement may have entailed ritual deposition. Ritual or symbolic deposition has been discussed for a series of complete pots from a multitude of archaeological sites throughout the Pacific (Sand, 1995, p. 150–152; Bedford et al., 2007; Sand, 2010, p. 228–232), but the reported vessels have in common that none of their bases are missing completely. At Ulong site, however, we suggest a novel function for these vessels.

There might be a simple explanation for the deliberate placement of the two older vessels. During the majority of excavation in the base of unit 7, the pots were in dry to semi-dry sand. It was not until the vessels were completely exposed and excavation of the pit features in which they rested had begun, that the tide rose and freshwater began to seep up from the floor of the unit. Despite supporting no surface freshwater, Ulong Island's porous bedrock allows rainwater to percolate through the limestone to accumulate on the saltwater intrusion layer to form the Ghyben-Herzberg lens (Cheng and Ouazar, 1999). The accumulated freshwater builds up as a lens floating on the heavier saltwater that rises and falls with the tidal fluctuations of the underlying seawater and can been detected by small rivulets of freshwater forming in the intertidal zone. The deliberate placement of the pots in this intertidal zone allowed freshwater to accumulate in the pots during periods of high tide. We therefore propose that the pots were used as sumps for collecting freshwater by Ulong's early inhabitants.

One of the most persistent problems in interpreting archaeological features as wells or sumps used to access subterranean freshwater in intertidal areas are long-term changes in sea-level (Peltier, 2002; Dickinson, 2003) and the very active geology throughout the Pacific (Hall, 2002). Tectonic and volcanic uplift has resulted in a number of early colonising sites being situated up to hundreds of metres inland of and several metres above the current shoreline (Bedford et al., 2006). On the other hand, island subsidence has submerged many early settlement sites (Leach and Green, 1989). A lack of understanding of uplift and subsidence on Palau had been a problem that had resulted in inaccurate assumptions about the timing of the archipelago's colonisation and early settlement pattern (Masse, 1990; Athens and Ward, 2001).

Research by W. Dickinson and his colleagues suggests Palau and other parts of Micronesia subsided under added water load resulting from the post-Pleistocene melting ice cover with a subsidence rate for Palau estimated at 0.55 mm/year (Dickinson, 2003 and 2009; Dickinson and Athens, 2007). However, mapping of a buried limestone notch on Ulong Island showed that it has the same relative elevation as the current tidal range indicating a decline in relative sea-level that has tracked subsidence (Clark et al., 2006; but see Dickinson et al., 1994, p. 94, fig. 5).

DISCUSSION

Potable water is central to human life and a prerequisite for long-distance ocean travel (Bulbeck, 2007; also Ellis, 1997). Colonisation of remote Oceanic islands required technological and behavioural strategies to store and replenish water supplies during long ocean voyages and to find freshwater after arrival in new landscapes. However, a series of questions remain: Where does the innovation of accessing subterranean freshwater originate? Did the knowledge of accessing a wide variety of possible freshwater resources enable colonisers to adapt to new environments faster? Would the availability of freshwater guide colonisation movements?

In Northern Australia coastal hunter-gatherer populations may have had knowledge of the presence of subterranean water as early as the Late Pleistocene (O'Connor, 1992; see also McCormick, 1977, p. 210). This might indicate an even longer history of knowledge about island hydrology in Island Southeast Asia. The selection of cave and rock shelters as habitation sites might be a factor of not only the need for shelter, but also the availability of easily collectable rain-fed spring water percolating out the bedrock.

A more archaeologically visible proxy for this technological innovation being available for the Pacific's colonising populations derives from its early use in agriculture (rice irrigation, Udatsu et al., 1998; Ruddiman et al., 2008, p. 1294; Qin et al., 2011). Plant species are in general highly susceptible to salinity stress in water supplies (particularly sodium-chloride salts; Parida and Das, 2005). The common reaction to increased salinity

load is reduced productivity or, depending on the amount of salinity, inability to complete the metabolism cycle. Domesticated plant species in the tropical Pacific (for example *Colocasia esculenta*) react distinctively negative to only small increases in salinity loads (Hill et al., 1998). In this context, knowledge of a subterranean freshwater lens suitable for drinking is evident from early aroid pit agriculture on low lying carbonate atolls in Micronesia (Weisler, 1999; Chazine, 2012). The innovative nature of aroid pit agriculture, particularly for *Cyrtosperma chamissonis* (giant swamp taro), is pointed out by Marshall Weisler in his research on agriculture systems in the atoll world of the Marshall Islands in Micronesia:

> The use of the subterranean fresh water lens for the cultivation of giant swamp taro was an ingenious technique that was probably a natural extension of planting aroids along the margins of low-lying swampy areas on other kinds of islands. And it was probably a period of trial and error that made it clear that the salt-tolerant giant swamp taro was better adapted to increased aridity and salt spray on low coral atolls than the *Colocasia* taro (Weisler, 2001, p. 127; see also Spriggs, 2002, p. 87).

It is unclear whether aroid pit agriculture was a Micronesian innovation or was brought in with the first colonisers at least some of whom came from Island Southeast Asia. J.-M. Chazine (Chazine, 2008, p. 121) favours the latter scenario in his hypothesis that the technique might derive from atolls in the Sulu Sea and Borneo, although there is yet no conclusive evidence (see also Yamaguchi et al., 2005). The possibility is indirectly supported by the early age of initial aroid pit agriculture in the Marshalls suggesting that this technology was available when the atolls were first colonized around 2,000 years ago (Weisler, 1999, p. 640). However, other parts of Micronesia such as Palau, the Mariana Islands and probably Yap had already been colonized for a millennium before settlement of the Marshalls and these might have been locations where aroid pits were developed.

The case for local invention of aroid pit cultivation is strengthened by the natural distribution of *Cyrtosperma ch.* which is not reported as occurring in wild forms in western Malesia and northern Island Southeast Asia (Whistler, 1991; Lebot, 1999; Mitsuru, 2002). Rather wild forms of *Cyrtosperma* extended out of eastern Malesia to include much of Micronesia (Athens and Stevenson, 2012). Today, *Cyrtosperma* agriculture is wide-spread in the Palau archipelago, particularly in the lower marshlands (*omrekongel* field system or, if mix-planted with wetland taro *(Colocasia esculenta)* or *dechel*, where it is used as a famine food or during droughts for its higher salt resistance (Koshiba et al., 2014).

In the absence of surface freshwater, liquid storing plants, such as *Cocos nucifera* (Harris, 1978) were potentially important during human colonisation. The natural dispersal range of *Cocos* is unclear (Harris, 1978), but includes much of the tropical Pacific (Ward and Brookfield, 1992; Prebble and Dowe, 2008; Athens and Stevenson, 2012; Harris and Clement, 2014). Its genetic signature suggests that the domesticated form was also transported by colonisers from Island Southeast Asia to the Pacific (Gunn et al., 2011), showing its importance as an agricultural crop and source of liquid.

However, supplying freshwater requirements of colonisers purely from plants such as *Cocos nucifera* is arithmetically unlikely (Grimwood, 1975). The amount of water necessary for a founding population of twenty-five to fifty people (Kelly, 2003, p. 51; Rallu, 2007, p. 20), estimated at 525–1,050 litres per week or in excess of 250–500 hectolitres per year, would quickly deplete an island's plant resources. In contrast, during short stays of small groups of highly mobile foragers, an adequate water supply can be sustained by employing plants such as coconuts. *Cocos* grew on the volcanic island of Babeldoab prior to human arrival (Athens and Ward, 2001), but on Ulong, it is unlikely that coconut trees were able to grow in any large quantity until the beach flat stabilised and expanded in the past 2,000 years. We assume that there were no coconut trees on the island, and accessing alternative water sources was necessary.

Landscape learning, coastal settlements, mobility and implications for colonisation events

It is unclear whether the knowledge of subterranean water was an adaptation to new, more depauperate environments in Micronesia or whether colonists arrived on these islands with a full skill-set already established as discussed above. One additional argument for an already established skill-set might derive from the distances covered while exploring the eastern regions of the Pacific. The need for immediate return voyages due to the lack of accessible freshwater sources is implicitly expressed in arguments which relate island discovery and colonisation events with suitable wind-directions (Irwin, 1992 and 2008; Anderson, 2003; Anderson et al., 2006; but see Avis et al., 2008 for a contrasting view of island discovery). Furthermore, the more remote an island, the more logistical planning is necessary to ensure survivability of a founding population. In extreme cases, if no suitable freshwater resources were available, deliberate colonisation would be prohibitive with archaeological evidence most likely reflecting accidental inhabitation, and island abandonment would be frequent (Kirch, 1984; Terrell, 1986; Anderson, 2001; Di Piazza and Pearthree, 2001).

A common strategy used to mediate environmental risk is high mobility (Binford, 1980; Halstead and O'Shea, 1989; Kelly, 1992; Winterhalder et al., 1999), particularly in cases where storage is unavailable. This is discussed by M. Weisler (Weisler, 1996) and by A. Di Piazza and E. Pearthree (Di Piazza and Pearthree, 2001) who relate environmental factors such as 'dryness' to the length of stay during the settlement process (see also Anderson, 2001 and 2011). Small off-shore islands with depauperate ecosystems, termed 'satellites' in these models, were

most likely only used during exploration and short-to-medium term visits, for example fishing expeditions. On the other hand, it is suggested that larger islands were targeted in East Polynesia and Micronesia and became permanent 'mother communities' due to their abundance of freshwater and the quantity and variety of terrestrial resources, particularly agricultural soils (Di Piazza and Pearthree, 2001; Weisler, 2001). The correlation between size and remoteness of islands with the type and age of settlement is documented not only in the Pacific but also in other parts of the world (Cherry, 1981; Anderson, 2011; Phoca-Cosmetatou, 2011).

We therefore argue that discovery and colonisation processes have to be investigated separately (Anderson, 2003). Highly mobile groups of sailors on the periphery of settled areas were able to survive for short-term stays on islands with extremely depauperate ecosystems. These sailors would then disperse the knowledge of the potential of these islands for colonisation to the more sedentary population.

Implications for the islands of Palau

The example from Ulong Island shows that early visitors had sufficient knowledge to survive, at least in short to intermediate terms, in the most marginal of environments. In the case of Ulong, the data supports a settlement model where permanent settlement was not established until beach flat stabilisation at 2000 cal. BP. The data also shows how important access to freshwater was in these highly marginal islands and that, apart from rain water collection, there was no alternative method for acquiring freshwater other than accessing the subterranean freshwater lens on the beach flat.

This data does not suggest that early colonisers understood the specifics of freshwater hydrology on these small Rock Islands as different hydrological processes can result in similar resource availability. From a consumer's perspective, accessing groundwater originating from inland aquifers in a coastal setting would not be dissimilar to accessing the Ghyben-Herzberg freshwater lens situated on top of the seawater intrusion layer. The ratio established in the Ghyben-Herzberg relation of forty times the amount of freshwater below versus above sea-level would necessitate digging a well of significant depth to reach the underlying salt water layer. Accessing the subterranean freshwater lens would be possible in certain locations. Selection of the Ulong site for short-term camps might indicate that specific geomorphological features, such as steep slopes or small rivulets in the intertidal area, were seen as an indication of possible freshwater sources, an adaptation most likely based on previous knowledge (Kelly, 2003; Erlandson and Fitzpatrick, 2006; Phoca-Cosmetatou, 2011).

It has been argued (Masse et al., 2006; Clark and Reepmeyer, 2010 and 2012) that the abandonment of the Rock Islands was most likely due to unpredictable rainfall patterns and decreasing overall precipitation during the 'Little Ice Age'. As the earliest evidence for accessing subterranean freshwater in the Pacific, the discovery of vessels used as sumps for gaining access to the freshwater lens supports the initial finding that freshwater was likely of continuous importance throughout Ulong Island's occupation.

CONCLUSION

The Palau excavations discovered the earliest evidence for people accessing a subterranean freshwater lens in the Pacific. The discovery also adds an additional role to pottery functions in the Pacific by identifying the novel use of recycled cooking vessels as sumps in a coastal island setting. At 2800 cal. BP island visitors were aware of the existence of the freshwater lens, with the only indication of its existence being rivulets in the intertidal area. It is unclear whether this new technology was an innovation driven by local adaptation to a depauperate environment not encountered before or derived from earlier technological advancements transported to the island. The advanced age of the sumps favours the latter scenario.

The Palau evidence shows that access to freshwater was a continuous challenge throughout the Rock Islands' settlement history. It also supports the hypothesis that the abandonment of islands was connected to environmental factors that pushed otherwise resilient communities to migrate to areas with more secure subsistence bases. When early colonisers spread out from Island Southeast Asia to Micronesia, they encountered a set of low-lying limestone islands with unfamiliar and challenging environments. The evidence provided here suggests that technological knowledge and landscape adaptability was well established in these colonising communities, so that the lack of potable surface water was not viewed as an obstacle, but rather a technicality to be overcome.

Acknowledgements: We would like to thank Mr Dwight Alexander (Bureau of Arts and Culture), Illebrang Olkerill of Koror State and the Traditional Chiefs for permission to undertake archaeological research; Colin MacGregor and the restoration team at the Australian Museum for their excellent work on restoring the vessels. Particularly we would like to thank Dr Pat Collins, Coral Reef Foundation, for detecting that the water intrusion was actually freshwater and for transporting the vessels safely back to Koror. The research was funded by an Australian Research Council Discovery Grant (DP 120103202) to Geoffrey Clark and Christian Reepmeyer and an ARC Discovery Early Career Research Award (DE130100046) to Christian Reepmeyer.

NOTES

(1) The ^{13}C value suggests that marine foods may have been cooked in the vessel and incorporated in the pot residue. As a result the calibrated age was calculated using the mixed Marine Northern Hemisphere curve using a 30% marine contri-

BIBLIOGRAPHICAL REFERENCES

Allen M. S. (2006) – New Ideas about Late Holocene Climate Variability in the Central Pacific, *Current Anthropology*, 47, 3, p. 521–535.

Anderson A. (2001) – No Meat on That Beautiful Shore: The Prehistoric Abandonment of Subtropical Polynesian Islands, *International Journal of Osteoarchaeology*, 11, p. 14–23.

Anderson A. (2003) – Entering Uncharted Waters: Models of Initial Colonization in Polynesia, in M. Rockman and J. Steele (eds.), *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*, Abingdon-on-Thames, Routledge, p. 169–89.

Anderson A. (2011) – Islands from the South: An Oceanian Perspective on Island Colonisation, in N. Phoca-Cosmetatou (ed.), *The First Mediterranean Islanders: Initial Occupation and Survival Strategies*, Oxford, Oxbow Books (Oxford University School of Archaeology Monograph, 74), p. 157–72.

Anderson A., Chappell J., Gagan M., Grove R. (2006) – Prehistoric Maritime Migration in the Pacific Islands: An Hypothesis of ENSO Forcing, *The Holocene*, 16, 1, p. 1–6.

Athens J. S., Stevenson J. (2012) – Pohnpei Coring Records: The Natural Distribution of Cyrtosperma chamissonis, *Journal of Pacific Archaeology*, 3, 1, p. 35–48.

Athens J. S., Ward J. V. (2001) – Palaeoenvironmental Evidence for Early Human Settlement in Palau: The Ngerchau Core, in C. M. Stevenson, G. Lee and F. J. Morin (eds.), *Pacific 2000. Proceedings of the Fifth International Conference on Easter Island and the Pacific*, proceedings of the international conference (Kamuela, 7–12 August, 2000), Los Osos, Easter Island Foundation and Bearsville Press, p. 164–77.

Avis C., Montenegro Á., Weaver A. (2008) – Simulating Island Discovery during the Lapita Expansion, in A. Di Piazza and E. Pearthree (eds.), *Canoes of the Grand Ocean*, Oxford, Archaeopress (BAR, International Series 1802), p. 121–42.

Beaglehole J. C. (1969) – *The Journals of Captain James Cook on his Voyages of Discovery*, II. *The Voyage of the Resolution and Adventure 1772-1775*, Cambridge, Cambridge University Press (Haklyut Society Extra Series, 35), 1,028 p.

Bedford S. (2003) – The Timing and Nature of Lapita Colonisation in Vanuatu: The Haze Begins to Clear, in C. Sand (eds.), *Pacific Archaeology: Assessments and Prospects. Proceedings of the International Conference for the 50th Anniversary of the First Lapita Excavation (Koné-Nouméa, 2002)*, Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 147–58.

Bedford S. (2006) – *Pieces of the Vanuatu Puzzle: Archaeology of the North, South and Centre*, Canberra, ANU E Press (Terra Australis, 23), 326 p.

Bedford S., Spriggs M., Regenvanu R. (2006) – The Teouma Lapita Site and the Early Human Settlement of the Pacific Islands, *Antiquity*, 80, 310, p. 812–28.

Bedford S., Spriggs M., Regenvanu R., Macgregor C., Kuautonga T., Sietz M. (2007) – The Excavation, Conservation and Reconstruction of Lapita Burial Pots from the Teouma Site, Efate, Central Vanuatu, in S. Bedford, C. Sand and S. P. Connaughton (eds.), *Oceanic Explorations: Lapita and Western Pacific Settlement*, Canberra, ANU E Press (Terra Australis, 26), p. 223–40.

Best S. B. (1984) – *Lakeba: The Prehistory of a Fijian Island*, doctoral thesis, University of Auckland, 812 p.

Binford L. R. (1980) – Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation, *American Antiquity*, 45, p. 4–20.

Bulbeck D. (2007) – Where River Meets Sea: A Parsimonious Model for Homo Sapiens Colonization of the Indian Ocean Rim and Sahul, *Current Anthropology*, 48, 2, p. 315–21.

Burley D., Barton A., Dickinson W. R., Connaughton S. P., Taché K. (2010) – Nukuleka as a Founder Colony for West Polynesian Settlement: New Insights from Recent Excavations, *Journal of Pacific Archaeology*, 1, 2, p. 128–44.

Chazine J.-M. (2008) – The Spread of Horticultural Techniques during the Settlement of Atolls in the Pacific, in A. Di Piazza, E. Pearthree and C. Sand (eds.), *At the Heart of Ancient Societies: French contributions to Pacific Archaeology*, Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 18), p. 119–32.

Chazine J.-M. (2012) – Wet Taro Cultivation on Atolls: A Techno-Cultural Paradox?, in M. Spriggs, D. Addison and P. J. Matthews (eds.), *Irrigated Taro* (Colocasia esculenta) *in the Indo-Pacific*, Osaka, National Museum of Ethnology (Senri Ethnological Studies, 78), p. 83–94.

Cheng A. H.-D., Ouazar D. (1999) – Chapter 6: Analytical Solutions, in J. Bear, A. H.-D. Cheng, S. Sorek, D. Ouazar and I. Herrera (eds.), *Seawater Intrusion in Coastal Aquifers. Concepts, Methods and Practices*, Dordrecht - Boston - London, Kluwer Academic Publishers (Theory and Applications of Transport in Porous Media, 14), p. 163–91.

Cherry J. F. (1981) – Pattern and Process in the Earliest Colonization of the Mediterranean Islands, *Proceedings of the Prehistoric Society*, 47, p. 41–68.

Clark G. R. (2004) – Radiocarbon Dates from the Ulong Site in Palau and Implications for Western Micronesian Prehistory, *Archaeology in Oceania*, 39, p. 26–33.

Clark G. R. (2005) – A 3000-Year Culture Sequence from Palau, Western Micronesia, *Asian Perspectives*, 44, p. 349–80.

Clark G. R., Anderson A., Wright D. (2006) – Human Colonization of the Palau Islands, Western Micronesia, *Journal of Island & Coastal Archaeology*, 1, p. 215–32.

Clark G. R., Bedford S. (2008) – Friction Zones in Lapita Colonisation, in G. R. Clark, B. F. Leach and S. O'Connor (eds.), *Islands of Inquiry: Colonisation, Seafaring and the*

Archaeology of Maritime Landscapes, Canberra, ANU E Press (Terra Australis, 29), p. 59–74.

Clark G. R., Reepmeyer C. (2010) – *World Heritage Rock Island Dossier: Cultural Sites. A report to the UNESCO Committee for the Nomination of the Rock Islands/Southern Lagoon Area to the World Heritage List*, Canberra, The Australian National University, 62 p.

Clark G. R., Reepmeyer C. (2012) – Last Millennium Climate Change in the Occupation and Abandonment of Palau's Rock Islands, *Archaeology in Oceania*, 47, p. 29–38.

Clark G. R., Wright D. (2007) – Reading Pacific Pots, in A. Anderson, K. C. Green and B. F. Leach (eds.), *Vastly Ingenious: The Archaeology of Pacific Material Culture. In Honour of Janet M. Davidson*, Dunedin, Otago University Press, p. 173–90.

Colin P. L. (2009) – *Marine Environments of Palau*, San Diego, Indo-Pacific Press, 414 p.

Di Piazza A., Pearthree E. (2001) – An Island for Gardens, an Island for Birds and Voyaging: A Settlement Pattern from Kiritimati and Tabuaeran, two 'Mystery Islands' in the Northern Lines, Republic of Kiribati, *Journal of the Polynesian Society*, 110, p. 149–70.

Dickinson W. R. (2003) – Impact of Mid-Holocene Hydro-Isostatic Highstand in Regional Sea Level on Habitability of Islands in Pacific Oceania, *Journal of Coastal Research*, 19, 3, p. 480–502.

Dickinson W. R. (2009) – Pacific Atoll Living: How Long Already and Until When?, *Geological Society of America Today*, 19, 3, p. 4-10.

Dickinson W. R., Athens J. S. (2007) – Holocene Paleaoshoreline and Paleoenvironmental History of Palau: Implications for Human Settlement, *Journal of Island & Coastal Archaeology*, 2, p. 175–96.

Dickinson W. R., Burley D. V., Shutler R., Jr. (1994) – Impact of Hydro-Isostatic Holocene Sea-Level Change on the Geologic Context of Island Archaeological Sites, Northern Ha'apai Group, Kingdom of Tonga, *Geoarchaeology*, 9, 2, p. 85–111.

Ellis R. J. (1997) – Severe Hypernatremia from Sea Water Ingestion during Near-Drowning in a Hurricane, *Western Journal of Medicine*, 167, 6, p. 430–33.

Erlandson J. M., Fitzpatrick S. M. (2006) – Oceans, Islands, and Coasts: Current Perspectives on the Role of the Sea in Human Prehistory, *Journal of Island & Coastal Archaeology*, 1, p. 5–32.

Fagan B. (2008) – *The Great Warming: Climate Change and the Rise and Fall of Civilizations*, New York, Bloomsbury Press, 304 p.

Fitzpatrick S. M., Dickinson W. R., Clark G. R. (2003) – A Petrographic Analysis of Ceramics from Palau, Micronesia, *Journal of Archaeological Science*, 30, p. 1175–84.

Frimigacci D. (1980) – Localisation écogéographique et utilisation de l'espace de quelques sites Lapita de Nouvelle-Calédonie : essai d'interprétation, *Journal de la Société des océanistes*, 36, 66–67, p. 5–11.

Green R. C. (1979) – Lapita, in J. D. Jennings (ed.), *The Prehistory of Polynesia*, Cambridge, Harvard University Press, p. 27–99.

Grimwood B. E., Ashman F. (1975) – *Coconut Palm Products: Their Processing in Developing Countries*, Roma, Food & Agriculture Organization of the UN (FAO Agricultural Development Paper, 99; FAO Plant Production and Protection Series, 7), 261 p.

Gunn B. F., Baudouin L., Olsen K. M. (2011) – Independent Origins of Cultivated Coconut *(Cocos nucifera* L.*)* in the Old World Tropics, *PLoS One*, 6, 6, p. 1-8, DOI: 10.1371/journal.pone.0021143 [online].

Hall R. (2002) – Cenozoic Geological and Plate Tectonic Evolution of SE Asia and the SW Pacific: Computer-Based Reconstructions, Model and Animations, *Journal of Asian Earth Sciences*, 20, 4, p. 353–431.

Halstead P., O'shea J. (1989) – Introduction: Cultural Responses to Risk and Uncertainty, in P. Halstead and J. O'Shea (eds.), *Bad Year Economics: Cultural Responses to Risk and Uncertainty*, Cambridge, Cambridge University Press, p. 1–7.

Harris H. C. (1978) – The Evolution, Dissemination and Classification of *Cocos nucifera* L., *Botanical Review*, 44, p. 265–319.

Harris H. C., Clement C. R. (2014) – Long-Distance Dispersal of the Coconut Palm by Migration within the Coral Atoll System, *Annals of Botany*, 113, 4, p. 565–70.

Hill S., Abaidoo R., Miyasaka S. (1998) – Sodium Chloride Concentration Affects Early Growth and Nutrient Accumulation in Taro, *HortScience*, 33, 7, p. 1153–56.

Hunt B. (1979) – An Analysis of the Groundwater Resources of Tongatapu Island, Kingdom of Tonga, *Journal of Hydrology*, 40, p. 185–96.

Hunt T. L., Kirch P. V. (1988) – An Archaeological Survey of the Manu'a Islands, American Samoa, *Journal of the Polynesian Society*, 97, 2, p. 153–83.

Irwin G. (1992) – *The Prehistoric Exploration and Colonisation of the Pacific*, Cambridge, Cambridge University Press, 260 p.

Irwin G. (2008) – Pacific Seascapes, Canoe Performance, and a Review of Lapita Voyaging with Regard to Theories of Migration, *Asian Perspectives*, 47, 1, p. 12–27.

Keate G. (1788) – *An Account of the Pelew Islands, Situated in the Western Part of the Pacific Ocean. Composed from the Journals and Communications of Captain Henry Wilson and Some of his Officers, who, in August 1783, Were there Shipwrecked, in the Antelope, a Packet Belonging to the Honourable East India company*, Dublin, L. White, 378 p.

Kelly R. L. (1992) – Mobility/Sedentism: Concepts, Archaeological Measures, and Effects, *Annual Review of Anthropology*, 21, p. 43–66.

Kelly R. L. (2003) – Colonization of New Land by Hunter-Gatherers: Expectations and Implications Based on Ethnographic Data, in M. Rockman and J. Steele (eds.), *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*, Abingdon-on-Thames, Routledge, p. 44–58.

Kirch P. V. (1984) – *The Evolution of Polynesian Chiefdoms*, Cambridge, Cambridge University Press (New Studies in Archaeology), 328 p.

Kirch P. V. (1997) – *The Lapita Peoples: Ancestors of the Oceanic World*, Cambridge, Blackwell, 353 p.

Koshiba S., Besebes M., Solaladaob K., Ngiraingas M., Lukes Isechal A., Victor S., Golbuu Y. (2014) – 2,000 Years of Sustainable Use of Watersheds and Coral Reefs in Pacific Islands: A Review for Palau, *Estuarine, Coastal and Shelf Science*, 144, p. 19–26.

Leach H. M., Green R. C. (1989) – New Information for the Ferry Berch Site, Mulifanua, Western Samoa, *Journal of the Polynesian Society*, 98, 3, p. 319–30.

Lebot V. (1999) – Biomolecular Evidence for Plant Domestication in Sahul, *Genetic Resources and Crop Evolution*, 46, 5, p. 619–28.

Lepofsky D. (1988) – The Environmental Context of Lapita Settlement Locations, *in* P. V. Kirch and T. L. Hunt (eds.), *Archaeology of the Lapita Cultural Complex: A Critical Review*, Seattle, Thomas Burke Memorial Washington State Museum (Thomas Burke memorial Washington State Museum Research Report, 5), p. 33–47.

Liston J. (2005) – An Assessment of Radiocarbon Dates from Palau, Western Micronesia, *Radiocarbon*, 47, p. 295–354.

Masse W. B. (1990) – Radiocarbon Dating, Sea-Level Change and the Peopling of Belau, in R. L. Hunter-Anderson (ed.), *Recent Advances in Micronesian Archaeology*, papers from the Micronesian Archaeology Conference (Hagåtña, 9–12 September 1987), Hagåtña, University of Guam Press (Supplement to Micronesia, 2), p. 213–30.

Masse W. B., Liston J., Carrucci J., Athens J. S. (2006) – Evaluating the Effects of Climate Change on Environment, Resource Depletion, and Culture in the Palau Islands between AD 1200 and 1600, *Quaternary International*, 151, p. 106–32.

Mccormick E. H. (1977) – *Omai Pacific Envoy*, Auckland, Auckland University Press, 382 p.

Mitsuru H. (2002) – The Origins and Spread of Tuber Crops (Imo), in Y. Shuji and P. J. Matthews (eds.), *Vegeculture in Eastern Asia and Oceania*, proceedings of the seventh International Area Studies Conference (Osaka, 2002), Osaka, National Museum of Ethnology (Japan Center for Area Studies Symposium Series, 16), p. 17–30.

Nero K. L. (1987) – *A Cherechar a Lokelii: Beads of History of Koror, Palau, 1783-1983*, doctoral thesis, University of California, Berkeley, 538 p.

O'connor S. (1992) – The Timing and Nature of Prehistoric Island Use in Northern Australia, *Archaeology in Oceania*, 27, 2, p. 49–60.

Ono R., Clark G. R. (2012) – A 2500-Year Record of Marine Resource Use on Ulong Island, Republic of Palau, *International Journal of Osteoarchaeology*, 22, 6, p. 637–54.

Osborne D. (1966) – *The Archaeology of the Palau Islands. An Intensive Survey*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 230), 497 p.

Parida A. K., Das A. B. (2005) – Salt Tolerance and Salinity Effects on Plants: A Review, *Ecotoxicology and Environmental Safety*, 60, p. 324–49.

Peltier W. R. (2002) – On Eustatic Sea Level History: Last Glacial Maximum to Holocene, *Quaternary Science Reviews*, 21, 1-3, p. 377–96.

Phoca-Cosmetatou N. (2011) – Introduction: The first Mediterranean Islanders, in N. Phoca-Cosmetatou (ed.), *The First Mediterranean Islanders: Initial Occupation and Survival Strategies*, Oxford, Oxbow Books (Oxford University School of Archaeology Monograph, 74), p. 17–29.

Prebble M., Dowe J. L. (2008) – The Late Quaternary Decline and Extinction of Palms on Oceanic Pacific Islands, *Quaternary Science Reviews*, 27, 27–28, p. 2546–67.

Qin J., Taylor D., Atahan P., Zhang X., Wu G., Dodson J., Zheng H., Itzstein-Davey F. (2011) – Neolithic Agriculture, Freshwater Resources and Rapid Environmental Changes on the Lower Yangtze, China, *Quaternary Research*, 75, 1, p. 55–65.

Rallu J.-L. (2007) – Pre- and Post-Contact Population in Island Polynesia: Can Projections Meet Retrodictions?, in P. V. Kirch and J.-L .Rallu (eds.), *The Growth, Regulation, and Collapse of Pacific Island Societies: Archaeological and Demographic Perspectives from the Pacific*, Honolulu, University of Hawaii Press, p. 15–34.

Reepmeyer C., Clark G. R., Alexander D., Olheriil I. U., Liston J., Kitalong A. H. (2011) – Selecting Cultural Sites for the UNESCO World Heritage List: Recent Work in the Rock Islands/Southern Lagoon Area, Republic of Palau, in J. Liston, G. R. Clark and D. Alexander (eds.), *Pacific Island Heritage: Archaeology, Identity and Community*, Canberra, ANU E Press (Terra Australis, 35), p. 85–100.

Rickman J. (1781) – *Journal of Captain Cook's Last Voyage to the Pacific Ocean: On Discovery: Performed in the Years 1776, 1777, 1778, 1779, and 1780*, London, E. Newberry, 376 p.

Ruddiman W. F., Zhengtang G., Zhou X., Wu H., Yu Y. (2008) – Early Rice Farming and Anomalous Methane Trends, *Quaternary Science Reviews*, 27, 13–14, p. 1291–95.

Sachs J. P., Sachse D., Smittenberg R. H., Zhang Z., Battisti D. S., Golubic S. (2009) – Southward Movement of the Pacific Intertropical Convergence Zone AD 1400–1850, *Nature Geoscience*, 2, p. 519–25.

Sand C. (1995) – *« Le temps d›avant » : La Préhistoire de la Nouvelle-Calédonie : contribution à l'étude des modalités d'adaptation et d'évolution des sociétés océaniennes dans un archipel du Sud de la Mélanésie*, Paris, L'Harmattan, 356 p.

Sand C.. (2004) – Walpole, a 'Mystery Island' in Southeast New Caledonia?, *Records of the Australian Museum, Supplement*, 29, p. 109–22.

Sand C. (2010) – *Lapita calédonien. Archéologie d'un premier peuplement insulaire océanien*, Paris, Société des océanistes (Travaux et documents océanistes, 2), 295 p.

bution.

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*, Canberra, ANU E Press (Terra Australis, 26), p. 51–70.

Specht J., Denham T. P., Goff J., Terrell J. E. (2014) – Deconstructing the Lapita Cultural Complex in the Bismarck Archipelago, *Journal of Archaeological Research*, 22, p. 89–140.

Spriggs M. (1997) – *The Island Melanesians*, Oxford, Blackwell, 326 p.

Spriggs M. (2002) – Taro Cropping Systems in the Southeast Asian-Pacific Region: An Archaeological Update, in Y. Shuji and P. J. Matthews (eds.), *Vegeculture in Eastern Asia and Oceania*, proceedings of the seventh International Area Studies Conference (Osaka, 2002), Osaka, National Museum of Ethnology (Japan Center for Area Studies Symposium Series, 16), p. 77–94.

Terrell J. E. (1986) – *Prehistory in the Pacific Islands. A Study of Variation in Language, Customs, and Human Biology*, Cambridge, Cambridge University Press, 316 p.

Udatsu T., Tang L., Wang C., Zheng Y. F., Yanagisawa K. (1998) – Investigation of Paddy Relics in China, *Agricultural Archaeology*, 49, 1, 138–52.

Valentin F., Clark G. R. (2013) – Early Polynesian Mortuary Behaviour at the Talasiu Site, Kingdom of Tonga, *Journal of Pacific Archaeology*, 4, 1, p. 1–14.

Ward G. R., Brookfield M. (1992) – The Dispersal of the Coconut: Did It Float or Was It Carried to Panama?, *Journal of Biogeography*, 19, 5, p. 467–80.

Weisler M. I. (1996) – Taking the Mystery out of the Polynesian 'Mystery' Islands: A Case Study from Mangareva and the Pitcairn Group, in J. M. Davidson, G. Irwin, B. F. Leach, A. Pawley and D. Brown (eds.), *Oceanic Culture History, Essays in Honour of Roger Green*, Dunedin, New Zealand Journal of Archaeology (*New Zealand Journal of Archaeology* Special Publication), p. 615–29.

Weisler M. I. (1999) – The Antiquity of Aroid Pit Agriculture and Significance of Buried A Horizons on Pacific Atolls, *Geoarchaeology*, 14, 7, p. 621–54.

Weisler M. I. (2001) – *On the Margins of Sustainability: Prehistoric settlement of Utrōk Atoll Northern Marshall Islands*, Oxford, Archaeopress (BAR, International Series 967), 144 p.

Whistler W. A. (1991) – Polynesian Plant Introductions, in P. A. Cox and S. A. Banack (eds.), *Islands, Plants, and Polynesians: An Introduction to Polynesian Ethnobotany*, Portland, Dioscorides Press, 228 p.

Wickler S. (2001) – The Colonization of Western Micronensia and Early Settlement in Palau, in C. M. Stevenson, G. Lee and F. J. Morin (eds.), *Pacific 2000. Proceedings of the Fifth International Conference on Easter Island and the Pacific*, proceedings of the international conference (Kamuela, 7–12 August, 2000), Los Osos, Easter Island Foundation and Bearsville Press, p. 185–96.

Winterhalder B., Lu F., Tucker B. (1999) – Risk-Sensitive Adaptive Tactics: Models and Evidence from Subsistence Studies in Biology and Anthropology, *Journal of Archaeological Research*, 7, 4, p. 301–48.

Yamaguchi T., Kayanne H., Yamano H., Najima Y., Chikamori M., Yokoki H. (2005) – Excavation of Pit-Agriculture Landscape on Majuro Atoll, Marshall Islands, and Its Implications, *Global Environmental Research*, 9, 1, p. 27–36.

Christian Reepmeyer
Department of Anthropology
Archaeology and Sociology,
James Cook University,
Cairns (Australia)

Geoffrey Clark
Archaeology and Natural History,
The Australian National University,
H.C. Coombs Bld. 9
Canberra (Australia)

Jolie Liston
Garcia and Associates (GANDA),
Honolulu, Hawaii (USA)

Ella Ussher
Archaeology and Natural History,
The Australian National University,
H.C. Coombs Bld. 9,
Canberra (Australia)

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 63-77
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Marine Prey Vulnerability versus Resilience to Human Foragers

Insights from Agent-Based Modeling

Alex E. Morrison and Melinda S. Allen

Abstract: The resilience and susceptibility of key marine organisms to human predation and environmental change is a topic of importance to archaeologists, wildlife managers, and conservation biologists. While contemporary studies are useful for linking managerial strategies to prey population patterns, zooarchaeological assemblages when combined with computer-based simulation methods provide additional insights into marine prey resilience or susceptibility to harvesting pressures over the long-term. In this paper we generate a set of predictions, drawing on concepts from life-history theory, and then build an agent-based model to examine how energetic return rate and age at reproductive maturity influence prey resilience to foraging pressures. Our agent-based model results are then compared with archaeological observations from a limited number of Pacific island assemblages to assess the validity of the model. The results of the simulation indicate that prey taxa with low energetic return rates which reach reproductive maturity at young ages are more impervious to human predation than those which reach reproductive maturity later in life and have greater energetic returns. The archaeological assemblages examined support these key findings and suggest that the susceptibility of marine organisms to human predation is likely to be multi-faceted and context dependent. Our results also demonstrate the utility of agent-based modeling as a technique for establishing the dynamic sufficiency of competing explanations and for generating new hypotheses.

Keywords: agent-based modelling, marine mollusks, resilience, foraging dynamics, Pacific Islands.

Vulnérabilité des proies marines versus *résistance aux prédateurs humains : résultats d'une modélisation multi-agents*

Résumé : La capacité de résilience et la vulnérabilité de certains organismes marins face à la prédation humaine et aux changements environnementaux sont des sujets d'importance tant pour les archéologues que les biologistes. Si les études actuelles permettent de relier les stratégies de conservation des espèces aux profils démographiques des populations exploitées, les assemblages archéozoologiques combinés aux méthodes de simulation assistées par ordinateur fournissent un aperçu de la résilience et de la vulnérabilité des proies marines aux pressions de collecte sur le long terme. Dans cet article, nous proposons un ensemble de prédictions et développons un modèle multi-agents pour documenter la manière dont les taux de rendement énergétique et l'âge de reproduction influencent la résilience des proies aux pressions de collecte. Les résultats issus du modèle sont ensuite mis en rapport avec des observations archéologiques relevées dans plusieurs assemblages dans le Pacifique afin d'évaluer sa validité. Il apparaît dans notre simulation que les espèces à faible retour énergétique et ayant une maturité reproductive précoce sont plus résistantes à la prédation humaine que celles ayant une maturité reproductive tardive et un plus grand retour énergétique. Les assemblages archéologiques étudiés soutiennent ces résultats et suggèrent que la vulnérabilité des organismes marins à la prédation anthropique dépend du contexte. Nos résultats montrent également l'utilité de modèles multi-agents en tant que technique pour établir l'autonomie d'explications concurrentes et pour générer de nouvelles hypothèses.

Mots-clés : modélisation multi-agents, mollusques marins, résilience, dynamiques d'approvisionnement, Pacifique.

The resilience of marine organisms to human predation is of considerable concern to archaeologists, conservation biologists, and wildlife managers (Jackson et al., 2001; Dulvy et al., 2003; Hutchings and Reynolds, 2004). Current estimates suggest that at least 133 marine populations and species worldwide have gone extinct, with the majority of cases caused by human predation (Dulvy et al., 2003, p. 27). In an exten-

sive study of 232 marine populations, J. Hutchings and J. Reynolds (Hutchings and Reynolds, 2004, p. 298) found an average maximum population decline of 83% during the historic period. These estimates are likely conservative given the absence of long-term records that might provide reliable ecological baselines from which to measure population trajectories (Pauly, 1995). Contemporary studies that document relationships between managerial strategies and resilience in prey populations can provide important insights into the short-term consequences of enforcing size and catch restrictions. We further suggest that diachronic records derived from archaeological studies, especially when combined with computer-based simulation methods, provide additional and unique insights into marine prey resilience or vulnerability to harvesting by human foragers. Usefully, archaeological studies provide the time depth necessary to examine long-term predator-prey dynamics, as well as informing on predator-prey interactions in a variety of marine ecological settings. Often representing several centuries of marine resource use, these data sets in combination with ethnographic and ecological information can track the development and outcomes of customary marine tenure practices (Aswani, 2014; Aswani and Hamilton, 2004; Thomas, 2007), traditional ecological knowledge regarding the vulnerability of specific taxa to overharvesting (Berkes et al., 2000; Drew, 2005), and long-term human adaptations to marine ecosystems variation (Fitzpatrick and Keegan, 2007; Rick and Erlandson, 2008)..

D. O'Sullivan and G. Perry (O'Sullivan and Perry, 2013, p. 14) have recently suggested that one of the difficulties associated with contemporary research on predator-prey dynamics is the inability to separate the complex causes of resilience and population-scale impacts when examining the interaction of multiple factors over long time periods. Quite simply, the majority of these studies are short-term and not capable of identifying the key variables that operate over multi-decadal or centennial time scales. Moreover, the interaction of multiple variables may result in population level consequences that are impossible to predict from analyses made over short temporal scales.

While numerous archaeological studies demonstrate how humans have impacted marine species across the globe (e.g., Allen, 2002 and 2003; Braje et al., 2007; Erlandson et al., 2008; Mannino and Thomas, 2002; Morrison and Hunt, 2007), the processes responsible for changes in marine ecosystems often are difficult to determine. These may include not only human predation but also variation in habitats and regional climate fluctuations. Agent-based computer modeling has proven useful in a range of scientific analyses where the phenomena that make up the empirical record are the result of multiple processes occurring over different temporal scales and from the interaction of many variables (e.g., O'Sullivan and Perry 2013, p. 52; Premo, 2010, p. 31).

Agent-based modeling (ABM) is a computer simulation approach used to examine population scale patterns and outcomes which arise from multiple interacting autonomous (individual) entities. Here we utilize a combination of life-history theory, ABM, and archaeological observations to examine how marine mollusk characteristics contribute to prey population resilience or vulnerability in the face of human predation pressures. Our aim is not only to explore factors contributing to prey vulnerability/resilience, but also to illustrate how ABM can augment theoretical models from foraging theory. Of note, our model does not include real life taxa and their specific life history and ecological traits; rather we evaluate a set of hypothetical taxa which vary in these dimensions. We begin by outlining a simple foraging model that stipulates the relationships between prey energetic return rates and reproductive ages, based on principles from life history theory. Our theoretical model provides a set of expectations about prey resilience and vulnerability to human predation. We then generate an ABM to explore the temporal dynamics of this theoretical foraging model, manipulating interactions between two key variables, energetic returns and reproductive age, at variable settings across multiple model runs. Finally, we compare our ABM results with empirical records of marine mollusk use in the prehistoric past, as derived from Pacific archaeological studies.

GENERAL MODEL

The agent-based model described below focuses on two primary variables: first, the probability that a prey item will be pursued upon encounter, based on its energetic return rate; and second, the age of reproductive maturity of each hypothetical molluscan taxon. We discuss the relevance of each of these variables in greater detail below.

Prey return rate

The prey choice model, originally developed in evolutionary ecology, identifies which taxa should be pursued by predators upon encounter and which should be ignored, all else being equal (Stephens and Krebs, 1986). The model stipulates that predators choose prey based on their post encounter return rates, relative to other potential resources encountered during a foray. Prey therefore are ranked according to their post encounter return rate or Θ, defined as: the ratio of energy gained (E_g) over energy spent (E_s) while foraging (Weimerskirch et al., 2003).

$$\Theta = E_g/E_s \text{ (equation 1)}$$

Often in human behavioral ecology studies, energy spent (Es) can be further defined as the sum of:

$$E_s = T_h + T_s \text{ (equation 2)}$$

In most archaeological studies, energy gained (E_g) is approximated using prey body size (P_s; Broughton et al., 2011) or based on ethnographic studies where handling and search time can be directly observed and measured (e.g., Bird and Bliege-Bird, 1997; Codding et al., 2014; Thomas, 2007). Prey return rate can be defined as the expected caloric gain per unit of handling cost (a combination of handling time and search time). If we make a

further simplifying assumption that all prey of the same taxon are handled in the same way, then a prey item can be ranked based on the simple ratio of energy gained over search time.

The decision of whether to pursue an item also depends on the encounter rate of other potential resources in the environment. For example, if high ranked (i.e., large-bodied) resources are common, and frequently encountered, lower ranked items should be ignored. However, as higher ranked resources are less frequently encountered, diet breadth will expand to include lower ranked prey that provide lower energetic returns. The increased abundance of lower ranked items in the diet often is taken to signal a change in the encounter rate of high ranked resources, although with some technologies (e.g, mass harvesting) collection of small-bodied prey can be quite efficient (Madsen and Schmitt, 1998; Ugan, 2005). Hypothetically, if taxa with varied return rates were available in equal amounts, lower ranked items would be pursued less frequently and therefore be less susceptible to human foraging through time. However, as the highest ranked prey are depleted, foragers typically move to those of intermediate rankings; in other words, prey rankings vary over time and ultimately are influenced by the encounter rate of the suite of possible prey in any particular setting.

Prey reproductive age

While energetic return is clearly an important variable in prey population resilience, life-history characteristics (e.g., reproductive features, life span, etc.), along with prey habitat preferences and mobility, also play significant roles. The age at which a prey taxon reaches reproductive maturity is negatively correlated with population growth (Roff, 2002), and this characteristic provides an estimate of the potential resilience of taxa to predation. In other words, high recovery rates following perturbations are associated with prey that reach reproductive maturity at a young age (Denney et al., 2002; Hutchings and Reynolds, 2004; Reynolds, 2003; Reynolds et al., 2001). Moreover, T. Lasiak (Lasiak, 1991) notes that the population level effects of size-at-sexual-maturity are closely linked to the size preferences of foragers. Prey taxa that reproduce at sizes below those preferred by their predators are less susceptible to exploitation resource depression because reproducing individuals are more likely to escape predation and remain in the population. In contrast, when foragers target prey organisms at sizes below reproductive maturity, prey populations are placed at greater risk of demographic instability. Thus, assuming the correlation between prey size and prey age is robust, and holds across taxonomic groups, then prey size may provide useful information on prey age at sexual maturity.

However, there are reasons to suspect that body size in mollusks may not be a reliable indicator of age, and by extension, reproductive maturity. This is because mollusk size can be affected by food supply and other ecological conditions, which affect prey population density. Individuals living in less dense populations may grow more rapidly, leading to large but reproductively immature individuals. Dense clustered living conditions, in contrast, may potentially result in prey reaching reproductive age at smaller body sizes. Ultimately, reproductive maturity should be assessed by determining individual age rather than size alone (Swadling, 1976; Morrison and Allen, 2014).

Interactions between variables

Combining information regarding the relationship between human prey choice criteria and reproductive biology allows us to make the following general predictions about prey resilience to human predation (fig. 1):

– prey taxa that have high energetic return rates and reach reproductive maturity at older ages should be the most vulnerable to human impacts;

– prey taxa that have low energetic return rates and reproduce at younger ages should be the most resilient prey populations;

– prey taxa with intermediate return rates will vary in resilience, depending on their corresponding age at reproductive maturity and interaction between the two variables.

It is important to note that while organisms with high energetic return rates are hypothesized to be more vulnerable to foraging-induced resource depression (because foragers typically pursue these items more frequently upon encounter), the effect of energetic return rate is best conceptualized in relationship to the entire set of prey items which are potentially available at a given locality. This is because although energetic returns are more or less constant (assuming predation pressure has not

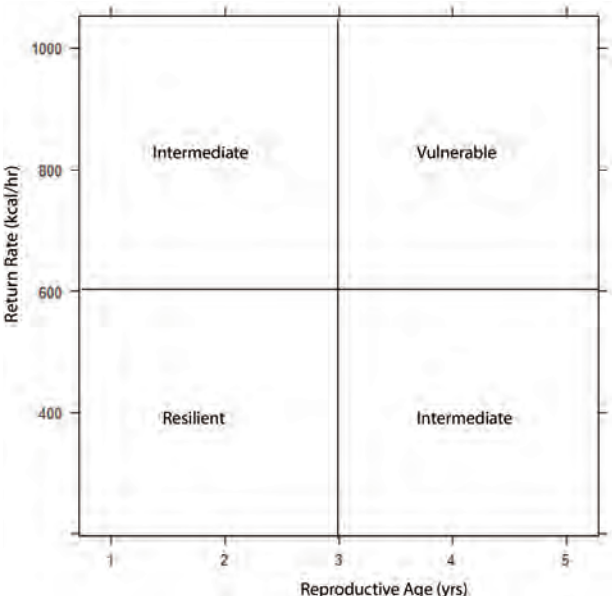


Fig. 1 – The relationship between return rate, reproductive age, and population resilience.

***Fig. 1** – Le rapport entre le taux de rendement, l'âge de maturité reproductive et la résilience de la population.*

affected changes in the overall population structure), prey rankings are relative and context specific to some degree. We return to this issue in the discussion section.

A number of ethnographic and archaeological studies have explored the dynamics of reproductive age and prey population resilience in marine mollusk populations (e.g., Catterall and Poiner, 1987; Codding et al., 2014; Giovas et al., 2013; Poiner and Catterall, 1988; Thomas, 2007). Here we augment these studies by simulating prey population dynamics under varied return rate and reproductive age settings across multiple model runs. Our aim is not simply to replicate outcomes from the foregoing studies, but also to assess phenomena which emerge over long time periods. The following section describes the ABM structure, model details, and design concepts, following Grimm and colleagues (Grimm et al., 2006 and 2010).

AGENT-BASED MODEL STRUCTURE

ABM is a computer simulation based approach that has recently seen wide-scale application in ecology, urban planning, archaeology, and a variety of other fields. A fundamental assumption of the approach is that population scale phenomena arise from the interactions of the individual entities that exist at lower organizational scales. For example, in ecological ABM applications it is common to include different agents that represent both predators and prey. Each individual may have different life history characteristics, such as age, size, and feeding strategies. These individual autonomous entities interact with each other according to a series of scheduled actions. Macroscale patterns, which emerge at the population level, then can be tracked and the primary causative factors potentially deduced from the model structure.

In the following agent-based simulation, we model two primary types of entities: human foragers and immobile mollusk taxa with various life-history characteristics and return rates. Human foragers are represented as mobile agents and prey are characterized as immobile properties of patches. In all of the models discussed below, the initial predator population size is 50 and the prey population starting size is set at 10,000. These starting parameters were chosen to create relatively stable frequencies of prey which would not be immediately susceptible to resource depression from human exploitation. The state variables, their parameters, symbols, and parameter settings are presented in tables 1 and 2. The environment consists of a 101 × 101 square grid, represented as a torus in order to avoid edge effects. Iterations of the model correspond to one day, although foraging trips only occur every three days. The model was allowed to run for 10,000 iterations across twenty different possible parameter combinations. Prey population mortality and reproduction occurs once a year, and prey grow and age with every iteration of the model. Ecological studies suggest that some mollusk species, such as *Tridacna maxima*, may reproduce during distinct seasons and are influenced by environmental factors such as sea surface salinity and temperature (Tan and Yasin, 2000), but these variables are not varied in the current analysis. In the present study, once individual prey reach a minimum maturity age, they are reproductively viable and then can participate in a reproduction sub-model described in detail below. Importantly, we hold human population growth and reproduction constant in these models.

Process overview and scheduling

Human foragers participate in several foraging related activities. First, a forager can move according to two different movement types, a correlated random walk (f_2), or an area restricted search, ARS (f_1), depending on if they were successful at capturing a prey item on their previous foray (following Bailleul et al., 2013). Foragers are allowed to capture up one item per foraging trip. Prey growth and aging occur at daily increments, while both crude mortality and reproduction are scheduled at annual time scales. The model's schedule is shown in figure 2.

We model prey return rate by defining different probabilities of being captured based on a return rate parameter R_k that varies from 1000 to 250 kcal/hr. The return rate setting determines the probability that an item will be harvested upon encounter. As a result, items with higher energetic return values are foraged more frequently than items with lower energetic return rates (see table 1). The energetic return rate parameter varies across model runs and is one of the primary analytic variables in our model.

Design concepts

This section describes the design concepts of emergence, adaptation, prediction, memory, learning, and stochasticity. Emergence is modeled as the prey population size at the completion of a given model run and its overall resilience to predation. Individual foragers adapt by changing their movement strategy after they are successful at capturing a prey item. Human foragers use very simple sensing upon encounter of prey items and therefore predict that more resources are located in close proximity to the items they have recently encountered and adjust their movement strategy accordingly. Empirical and computer simulation studies demonstrate that foraging return rates can be influenced by the ability of predators to remember the location of prey (Barraquand et al., 2009). Consequently, for simplicity we chose not to include memory and learning in the model. Stochasticity is included through the use of random variables that control the location of hard substrates and therefore the location of prey resources. Prey mortality, reproduction, and initial age also vary randomly upon initialization of the model. Prey population size is observed and reported twice a year, once after crude mortality and once after reproduction.

Movement and collection

Predator forays consist of two different sub-models which make up the overall foraging activity; movement and col-

State Variables	Description	Initial Parameter Range
Predator		
Current location	The current x, y coordinates corresponding to the location of the agent	–
Success on last forage	Boolean variable indicating TRUE or FALSE	FALSE
Prey captured	The number of prey captured by each predator on a single foray	0
Number of moves	The total number of forays an agent has participated in	0
Capture probability	The probability that a prey will be captured based on kcal/hr	0.10–1
Prey		
Location	The x, y coordinates corresponding to the patch a prey resides within	n of hard substrate patches
Number of prey on patch	The number of prey residing within a patch	0–8,000
Age	The age of the prey items	0–15 years
Maturity	If the prey age is greater than M_k then the value is TRUE	TRUE or FALSE
Substrate	Boolean variable indicating either hard substrate of soft substrate	–
Reproductive age	The age parameter (M_k) at which prey participate in the reproductive sub-model	1–5 years
Energy/Kcal	The modeled energetic return rate for prey agent	250–1,000

Table 1 – State variables and parameter settings used in the agent-based model.
Tabl. 1 – *Variables d'état et paramètres utilisés dans le modèle multi-agents.*

Symbol	Description	Initial Parameter values and ranges
f_1	Movement Strategy 1 ; Area Restricted Search	–
f_2	Movement Strategy 2 : Correlated Random Walk	–
A_k	Prey age	0 to 25 years
M_k	Prey age at reproductive maturity	1–5 years
P	Prey population	10,000
k	Carrying capacity	$d * E_h$
E_h	The number of patches with hard substrate	0–10,201
d	Density limit	8,000
P_p	Number of prey on a patch.	0–8,000
P_w	Prey mortality rate	0.15
R	Predator population size	50
R_k	Prey return rate (kcal/hr)	250–1,000

Table 2 – Simulation symbols, description, and initial model values.
Tabl. 2 – *Symboles de simulation, description et valeurs initiales du modèle.*

lection. These subroutines run once every three iterations. Upon initialization, all foragers move approximately in a straight line (f_2) until they reach a prey resource, after which they switch their movement strategy to an area restricted search radius (f_1). The area restricted search radius is meant to increase the probability of prey encounter by assuming that prey resources are aggregated in space. Only one predator is allowed to occupy a single grid cell at a time.

Capture

After the movement sub-model is completed, foragers check for the presence of any prey resources within the patch they are residing in. Resource units vary according to return rate and the return rate determines the probability that an item will be foraged once encountered. If there is no prey present, the forager simply stops without capturing any items.

Age

Immobile prey organisms have a corresponding life history attribute of age (A_k). Prey items age at a rate of one day per each iteration. When items reach a reproductively mature age (M_k) they are separated into a mature subset of the population. The reproductively mature age (M_k) parameter is varied across model runs from a minimum age of one year to a maximum of five years.

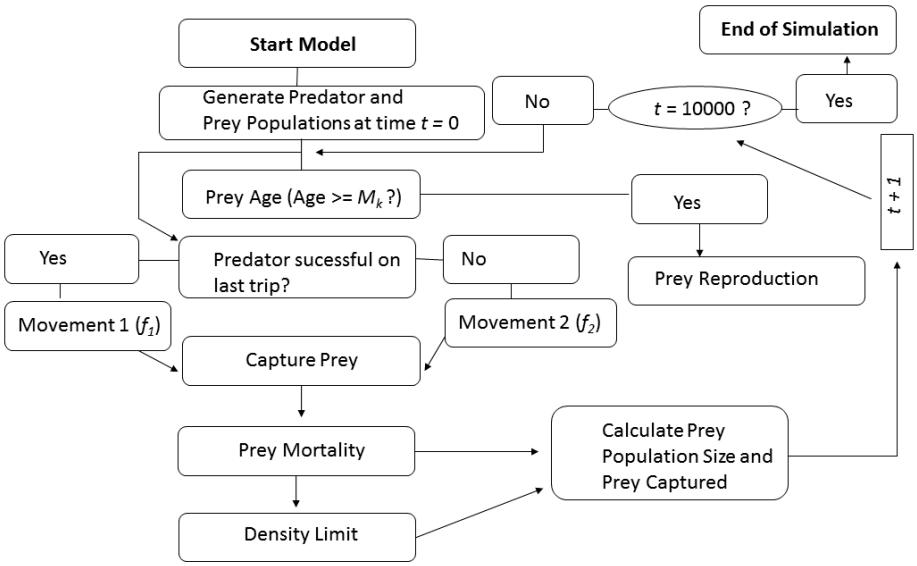


Fig. 2 – The agent-based model schedule. Note that the prey mortality and reproduction sub-models only run at annual time steps.
***Fig. 2** – Le modèle multi-agents. À noter que les sous-modèles de mortalité et de reproductivité des proies ont été appliqués par tranche annuelle.*

Birth

Prey items are able to reproduce if two criteria are satisfied. First, individual prey must be reproductively mature, a criterion which is satisfied by reaching a specified prey age of (M_k). Secondly, two reproductively mature organisms must be located within a patch. If these criteria are met, a mature prey reproduces one offspring, which is then distributed randomly on any hard substrate patch in the environment.

Mortality

The prey population (P) is subjected to a specified adult mortality rate (P_w), which for simplification occurs once every three hundred sixty iterations. The mortality sub-model is run by calculating the prey population at t + 1 or (P'): $P' = P - (P * P_w)$.

While mollusk mortality and survivorship can vary dramatically depending on age, habitat, and taxonomic characteristics (Black et al., 2011; Mekawy and Madkour, 2012; Mies et al., 2012; Smith 2011), for simplification prey mortality is fixed at 15% in all of the models following the general results of R. Black and coworkers (Black et al., 2011).

Density limit

To keep prey populations from growing to infinitely large numbers, and also to include some realistic population parameters in the model, a density limit (d) of prey items per patch (P_p) is specified. If $P_p > d$, then P_p is automatically reduced to d-1 by a random mortality procedure. The density limit sub-model has the ultimate effect of setting the prey population carrying capacity (k) = $d * E_h$, where E_h is the number of hard substrate patches available for resources.

AGENT-BASED MODEL RESULTS

The results of the agent-based simulations (fig. 3) highlight a number of important trends. When return rate is set to 1,000 kcal/hr, only the youngest age at reproductive maturity groups (M_k) cohort (i.e., when one year-old individuals are reproductively mature) produces a resilient prey population. The effect of high foraging intensity reduces population sizes for all other reproductive ages, providing support for the idea that prey populations with high energetic return rates are more vulnerable. Similar results also were produced in model runs where the prey energetic return rate was set to 750 kcal/hr. However, resilient populations were present in the young reproductive age groups, those of one and two years.

At an intermediate prey return rate of 500 kcal/hr, the interaction of return rate and prey reproductive age also is apparent. When reproductive age is set to one, two, or three years, prey populations were resilient to foraging pressure. However, prey that reproduced at ages over three years ultimately were susceptible to human predation. Finally, when energetic return is set to the lowest parameter setting, 250 kcal/hr, individuals of all reproductive ages resulted in resilient populations. In other words, organisms with low energetic return rates are generally resilient, regardless of their inherent reproductive ages, because they are unattractive to human foragers, as long as prey with higher return rates are available in the local environment. Only when the latter decline and encounter rates fall, do we see prey switching behaviors (assuming all other factors are held constant).

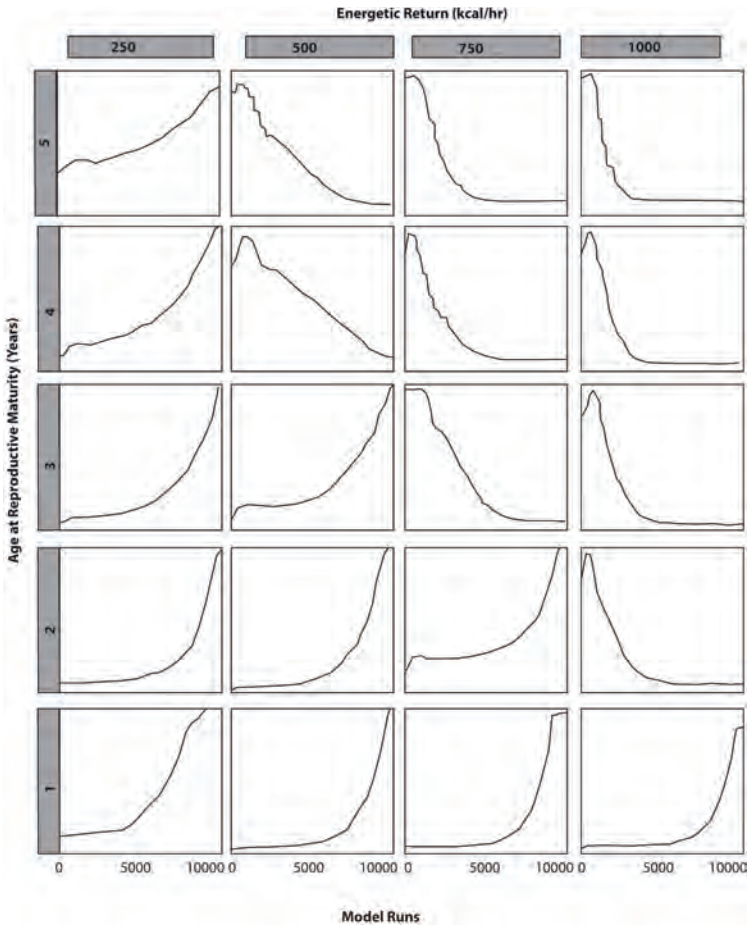


Fig. 3 – Results of the agent-based model runs. Note that the Y axis values for each individual model pane refers to prey population size. The prey population size varies and for convenience is not shown on each model pane. All model prey population sizes began at 10,000 and the ending population sizes are presented in table 3.

Fig. 3 *– Résultat des calculs du modèle multi-agents. Pour chaque volet du modèle, les valeurs sur l'axe y se réfèrent à la taille de la population de proies. La taille de la population de proies varie et n'est pas indiquée sur chaque volet du modèle pour des raisons de facilité. Toutes les tailles des populations de proies du modèle débutent à 10 000 et les tailles finales des populations sont indiquées dans le tableau 3.*

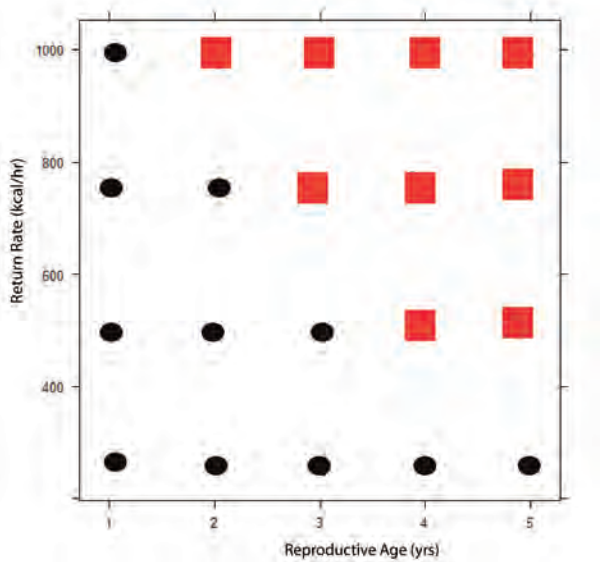


Fig. 4 – Black circles indicate resilient prey populations; red squares indicate heavily predated and susceptible populations.

Fig. 4 *– Les cercles noirs indiquent les populations de proies résilientes et les carrés rouge indiquent des populations fortement touchées par la prédation et vulnérables.*

Resilience analysis

Figure 4 displays the bivariate parameter space of resilient populations and non-resilient populations based on the intersection of reproductive age and energetic return rate. The results demonstrate that organisms with young reproductive ages (one year) always produce resilient prey populations, regardless of energetic return rate. Identical results were produced when the energetic return parameter was set to the lowest setting of 250 kcal/hr. Low settings produced resilient prey populations with very little interaction between the two variables. However, as prey reproductive age increases, so does the interaction between energetic return and reproductive age. For example, when reproductive age is set to three years, only two possible parameter combinations produce resilient populations. These combinations correspond to low energetic return rates (250 kcal/hr, 500 kcal/hr). Moreover, as age of reproductive maturity increases, the number of parameter settings producing resilient prey populations decreases. Reproductive ages of four and five years result in resilient prey populations only when the energetic return rate is at the lowest setting: 250 kcal/hr.

Prey population size at completion of model run

Reproductive age and energetic returns also affect overall population size and therefore may render populations vulnerable to other external factors. These could include climate change, habitat destruction, or increased foraging pressure as a result of predator population growth. To assess how these variables influence overall prey population size, we conducted a bivariate sensitivity analysis with the twenty different parameter combinations of reproductive age and energetic returns (fig. 5). The results are displayed as a three-dimensional contour plot with total population size set as the z value (see also table 3).

The prey population size after 10,000 model runs demonstrates that as reproductive age increases total terminal population size deceases. The lowest ending populations sizes, associated with reproductive ages of four and five, are zero. The parameter space corresponding to young reproductive age and low energetic return results in the largest prey population. The overwhelming influence of reproductive age on population size is indicated by the steep vertical nature of the contour lines in the parameter space corresponding to reproductive ages of one and two years. Moreover, the steep increasing contours also indicate that prey population size is sensitive to reproductive age, especially when reproductive age is set to low values.

The influence of energetic return also is visible in the contour plot. As previously mentioned, when reproductive age is set to mature age settings (four or five years), populations are resilient only at the lowest energetic return rate setting (250 kcal/hr). The interaction between energetic return and reproductive age is indicated by the diagonal direction of the contour lines in the parameter space corresponding to high energetic return rates and reproductive ages over two. Additionally, even though young reproductive ages produce large population sizes, there is a slight interaction effect with high energetic

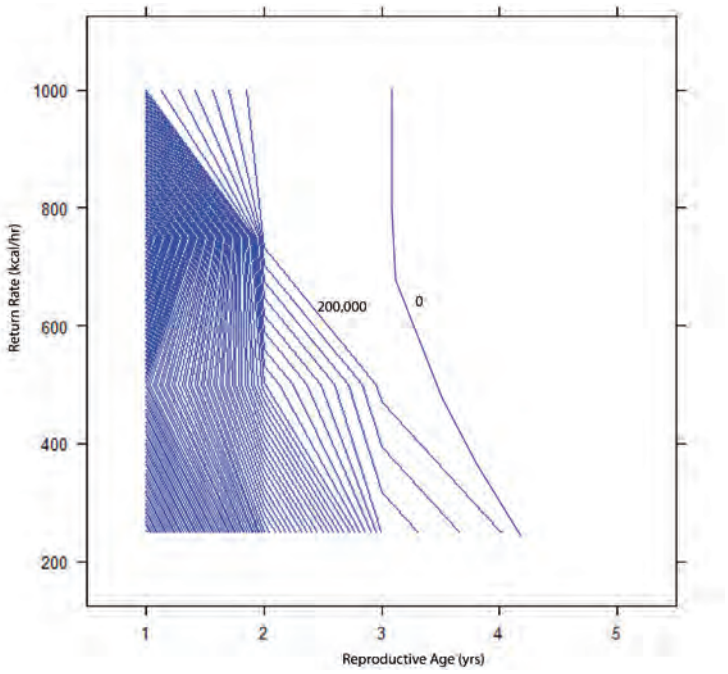


Fig. 5 – Population size as a function of energetic return rate and prey reproductive age after 10,000 iterations. The contour interval is 200,000 resources and the Z value is population size.

***Fig. 5** – Taille d'une population en fonction du taux de rendement énergétique et de l'âge de procréation des proies après 10 000 itérations. L'intervalle entre deux lignes de courbes correspond à 200 000 ressources et la valeur Z indique la taille de la population.*

Model	Return Rate k/cal	Reproductive Age	Ending Population Size
1	250	1	14,741,780
2	500	1	9,259,847
3	750	1	1,609,102
4	1,000	1	1,373,486
5	250	2	5,215,601
6	500	2	1,821,728
7	750	2	77,030
8	1,000	2	0
9	250	3	774,325
10	500	3	125,392
11	750	3	0
12	1,000	3	0
13	250	4	202,069
14	500	4	1,512
15	750	4	0
16	1,000	4	0
17	250	5	77,376
18	500	5	224
19	750	5	0
20	1,000	5	0

Table 3 – The twenty different model parameter combinations and the ending prey population sizes. All models began with a prey population size of 10,000.
Tabl. 3 – *Les vingt combinaisons de paramètres du modèle et les tailles finales des populations de proies. Tous les modèles ont été lancés avec une taille de la population de proies de 10 000.*

return rates, which produces population sizes at lower abundances than those characterized by young reproductive ages and low energetic returns.

Agent-based model summary

The results of the ABM support the hypotheses outlined in the general behavioral ecology model we presented above. First, resilience to human predation in prey populations is strongly influenced by age of reproductive maturity and energetic return rate. Specifically, taxa with lower return rates that reproduce at young ages are the most likely to be resilient to human predation. In contrast, taxa that reach reproductive maturity later in life and have greater energetic return rates are the most susceptible to human-induced resource depression. The strongest interaction between the two variables occurs at moderate parameters settings. Specifically, when reproductive age is set to three years, the influence of energetic return can lead to either a resilient or a susceptible prey population. Finally, terminal population size, like resilience, is strongly influenced by both age of reproductive maturity and energetic return rate.

Comparison of these results with those from archaeological assemblages provides a better understanding of why certain mollusk species remain stable though time and others are more susceptible to human foraging. In the following section we compare our ABM results with case studies from island archaeological contexts to assess how well they compare with actual sequences and assess the model's utility for understanding different prey responses to human foraging over long time scales.

COMPARISON WITH PACIFIC ARCHAEOLOGICAL SEQUENCES

The foraging model presented here is quite simple in that it explores the effects of, and interaction between, only two variables. Usefully the results do conform to expectations derived from foraging theory models (e.g., Broughton, 2002). In real life situations, however, a large number of cultural, ecological, and/or environmental factors might be at play and affect prey populations and long-term foraging outcomes. Nonetheless, our simple ABM serves as a null hypothesis which appears to account for multi-century outcomes predicted at the outset. In particular we have sought to understand how variation in energetic returns and reproductive age might singly, or in combination, factor into prey vulnerability (or resilience) to human predation over extended periods of time. In this section we compare theoretical predictions and simulated outcomes with empirical archaeological records relating to human use of three molluscan taxa which are common

Taxon	Energetic Return (kcal/hr)	Reproductive Age
Nerita	42 to 1,106	1–2 years
Turbo	520 to 606	3–4 years
Tridacna	2,622 to 13,064	4–5 years

Table 4 – Energetic return rates and age at maturity for common archaeological taxa (summarized from Codding et al., 2014).
Tabl. 4 – *Taux de rendement énergétique et âge de maturité pour des taxons archéologiques (résumé d'après Codding* et al.*, 2014).*

food resources in the Pacific, now and in the past: *Tridacna*, *Turbo* and *Nerita* (table 4). The aim is to assess how closely the archaeological records, from diverse geographic settings and variable time periods, conform to theoretical and model predictions and, where there are departures, potential causal factors.

Description of important mollusk taxa recovered from archaeological assemblages

Tridacna is the largest of the three selected taxa. This long-lived, sessile bivalve can reach sizes of 40 cm to 1.4 m and provides energetic return rates ranging from 2,622 to 13,064 kcal/hr, depending on the species under consideration (Codding et al., 2014, p. 242, table 1; Ellis, 1998). *Tridacna maxima*, one of the more common species, typically reach maturity between four to five years of age (Codding et al., 2014, p. 242, table 1). In terms of energetic returns, *Tridacna* not only provides the highest returns of the three taxa considered here, but also exceeds all of the hypothetical prey species modeled in our simulation. *Turbo*, a medium-size, browsing gastropod, provides energetic returns, between 520 to 606 kcal/hr, and reaches reproductive maturity between three and four years (Codding et al., 2014). *Turbo* is analogous to one of our model prey taxa, with a return rate of 500 kcal/hr and a reproductive age of three to four years. Usefully, the large and dense opercula of *Turbo* often preserve in archaeological sites and provide an independent means of assessing foraging impacts (Sealy and Galimberti, 2011, p. 408). Finally, *Nerita*, a small browsing gastropod, has the lowest return rates, ranging between 42 and 1,106 kcal/hr. (Codding et al., 2014, p. 242, table 1). *Nerita* reproduce at the very young age of one to two years. Although there is variability in average body sizes and reproductive ages within these three genera, this variation is less than inter-generic variability. It is worth noting that prey population spatial patterning associated with aggregation or dispersion also can impact on foraging return rates and vulnerability to predation (Broughton, 2002; Wolverton et al., 2012), however, we do not model these effects here. Given the foregoing, the expectation is that *Tridacna* will be the most susceptible to human predation, *Nerita* generally resilient and *Turbo* intermediate, as indicated by the ABM results and the position of these three taxa in figure 6, based on variation in energetic return rates and age of reproductive maturity. We consider trends in the abundance of these three species across three geographic contexts and in archaeological sequences which also vary in duration.

Archaeological case studies

Case study 1: Tikopia Island, Solomon Islands

Tikopia Island is a small Polynesian outlier of 5 km^2 located in the Western Pacific and provides the longest occupation sequence of the case studies discussed here (Kirch and Yen, 1982). Drawing on assemblages from site TK-1 or the Sinapupu site, the authors document marked shifts in molluscan use over an approximately 1800-year period of human occupation. Of particular note are declines in the relative abundance of *Tridacna maxima* (Kirch and Yen, 1982, p. 300, fig. 117), a taxon which features prominently despite the fact that the heavy shell remains are often discarded at the site of collection (Bird and Bliege-Bird, 1997; Thomas, 2007). *Tridacna* appears to be sustainable for most of the 1800-year sequence, but declines markedly in the last few hundred years of occupation. This is most notable after layer III (dated to approximately 1200 BP), when *Tridacna maxima* declines from 2,333 grams/m^3 (layer III) to 500 grams/m^3 (layer I; approximately 500 BP). These changes also are reflected in the rank order of *Tridacna*, which moves from a rank of 2 to 6.5 during the corresponding period.

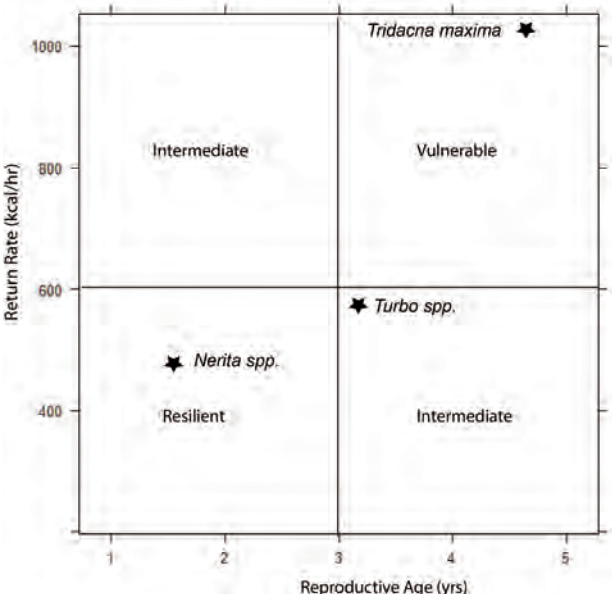


Fig. 6 – Relationship between model results and common molluscan taxa described in the archaeological case studies.
Fig. 6 *– Rapport entre les résultats du modèle et les taxons de mollusques communs décrits dans les cas d'études archéologiques.*

Turbo crassus, a second important taxon, is an intermediate size member of the Turbinidae family, varying in length from 50 to 80 mm (Alf and Kreipl, 2003). Contrasting with *Tridacna*, this species is relatively stable during the earliest Tikopia occupations but increases in density in late prehistory as *Tridacna* declines. Both *Turbo crassus* and a second turban species, *Turbo marmoratus*, increase substantially in layer II, with densities of 3,750 grams/m^3 and 2,875 grams/m^3 respectively. Together these two taxa are ranked second in abundance in layers I and II. This shift from *Tridacna* to *Turbo* is consistent with our ABM results.

Case study 2: Aitutaki, Cook Islands

Aitutaki, a slightly larger island with 18 km^2 land area and a 54 km^2 lagoon, is an almost-atoll in the southern Cook Islands. Here a sequence of molluscan usage dating from the 12th century AD derives from four sites on the island, three open coastal sites on the mainland and one rockshelter site on an offshore basalt islet of Moturakau (Allen, 1992; Allen and Morrison, 2013; Allen and Wallace, 2007). *Tridacna* ranks first in the oldest occupation layers but over time decreases in abundance, although it remains a relatively high ranked taxon (Allen, 1992). *Turbo*, in contrast, is ranked relatively low early in time but by late prehistory is the top ranked shellfish at several sites. Analysis of *Turbo* opercula from Moturakau rockshelter revealed no significant changes in body size over time, suggesting that human exploitation had negligible effects on prey body size (Allen, 1992). In contrast, none of the three local *Nerita* species figure importantly in the mainland assemblages at any point in time. *N. plicata*, however, is moderately well represented in the Moturakau sequence, fluctuating between rank 6 and 7 (Allen, 1992, p. 343; also appendix E, table E5). Again, these findings are consistent with the ABM outcomes.

Case study 3: Nualolo Kai, Kauai, Hawai'i

The Nualolo Kai site (K3) on the windward coast of Kaua'i island in the Hawaiian Archipelago is relatively isolated, being situated in a narrow valley bounded by steep rocky cliffs which is difficult to access even from the sea. The molluscan assemblage here derives from a coastal rockshelter with an approximately 1.8 m deep stratified deposit, dating from the 15th century AD and into the post-contact period (Hunt, 2005; Morrison and Hunt, 2007, p. 31). Unlike the foregoing examples, the large *Tridacna* clams are not represented in the Hawaiian Islands. Here one of the largest species available to early Hawaiian colonists was *Turbo sandwicensis*, measuring up to 90 mm in length (in Morrison and Hunt 2007, p. 333).

Morrison and Hunt (Morrison and Hunt, 2007) found that the relatively large endemic *Turbo sandwicensis* was initially the top-ranking taxon at Nualolo Kai, comprising 64% of the earliest occupation layer. However, by the 19th century the species represented only 19% of the recovered remains by shell weight, and had dropped from 1 to 2 in rank order abundance. In contrast, the smaller *Nerita picea* (ca. 14 mm in length) increased in both absolute and relative abundance through time. In the earliest occupation it comprised only 3% of the assemblage but by the late period had increased to 16% by weight, with an associated increase in rank from 5 to 4. In general, these findings are consistent with the intermediate position of *Turbo* in our ABM-modelled relative scale of vulnerability. However, it is more vulnerable in this Hawaiian context because of the lack of larger taxa. This third case illustrates that resilience is situational. While energetic return rates (essentially meat weights) may be relatively constant for a given taxon, prey rankings are defined by the array of taxa present within any given habitat.

DISCUSSION

In this final section we discuss how ABM, when integrated with theoretical expectations and archaeological observations, helps us build more refined understandings of human activities in the past. Notably the agent-based models are simple and lacking in realism, focusing on a limited number of variables. Nonetheless, they are invaluable for iteratively exploring particular sets of interactions and making predictions about what we might expect in archaeological contexts given limited and explicit assumptions. They assist in identifying empirical departures from theoretical expectations and in designing further tests with other variables to better understand past processes. With these general ideas in mind we identify three contributions of the current ABM analysis.

An initial result is that our ABM reproduces outcomes predicated by life history (e.g., Codding et al., 2014) and optimal foraging theory (e.g., Broughton, 2002). One specific prediction is that molluscan taxa which reach reproductive maturity comparatively late in life are more likely to be vulnerable to human foragers. Similarly, taxa of larger body size provide higher energetic returns but also are more vulnerable to anthropogenic resource depression. An advantage of the ABM analysis is that we have strictly specified the model conditions and can be confident that our results are not affected by taphonomic conditions, recovery procedures, spatial variability or sampling. Further, the ABM not only replicates expected outcomes but also gives insights into relative thresholds of vulnerability and the conditions under which resilience is maintained. These features are most visible through our use of different parameter settings which help define the points at which any given taxon moves from resilient to vulnerable.

The three archaeological case studies described herein, from Tikopia, Aitutaki, and Hawai'i, demonstrate that the predicted outcomes have been observed in multiple empirical contexts. Moreover, similar temporal declines and examples of prey switching are common elsewhere in Polynesia. For example, at the To'aga site on Ofu Island (American Samoa), *Turbo setosus* is the highest ranked taxon by weight (main trench) and remains so across an

approximately 2,200-year occupation sequence (Nagaoka, 1993). Similarly, at the Fatumafuti site on Tutuila Island (American Samoa), Morrison and Addison (Morrison and Addison, 2008) observed a decline in *Tridacna* and a concomitant increase in *Turbo* over an approximately 1,500-year time period. At Harataonga, Great Barrier Island, New Zealand, Allen (Allen, 2012) reports a marked decline in the largest Turbinidae *(Astraea)*, a moderate increase in the medium-sized *Turbo setosus*, and a marked increase in a small *Nerita* species over two occupations spanning approximately 450 years. These examples highlight the relative vulnerability of *Tridacna* to human predation and the process of prey switching to apparently more resilient species like *Nerita* and *Turbo* as more vulnerable taxa decline. Overall, our results suggest that return rates and reproductive age are major drivers of foraging-induced resource depression, while other ecological features such as ease of collection or visibility (e.g., Catterall and Poiner, 1987; Poiner and Catterall 1988) play more minor roles. Future research might formally test these ideas.

A third insight from our analysis is that while certain taxa may be inherently more resilient or susceptible to human-induced resource depression, the specific marine ecological contexts also will ultimately prove important. Specifically, vulnerability varies depending on the array of available resources, the positioning of a given taxon within the economic suite, as well as forager population size, availability of suitable habitat, etc. In the ABM, energetic return rate is taken as a proxy for prey ranking (*sensu* Codding et al., 2014) and is the basis for hypothesizing that higher ranked prey items will be more susceptible to human predation, specifically because harvesting pressures intensify as these items are more frequently pursued upon encounter. However, the ranking of a given taxon is dependent on the other prey inhabiting a specific marine environment that is being foraged. In our initial ABM the highest ranked prey provides 1,000 kcal/hr but prey items with such high energetic return rates may not always be present. In their absence we can expect medium or even small organisms to be more frequently used and probably also susceptible to human predation over time. However, it also is possible that other factors (e.g., ease of collection, larval dispersal patterns, etc.) may also influence the vulnerability or resilience of small to medium sized taxa. The context dependence of prey ranking provides insights into why *Turbo* is resilient in the Aitutaki and Tikopia cases, but susceptible in the Hawaiian example. *Turbo* is heavily foraged on Aitutaki and Tikopia only after *Tridacna* decline in abundance and over the long-term we might expect *Turbo* also to decline if sustained human exploitation continued.

An even more compelling example of resilience of a small-bodied prey comes from a 600-year sequence on Nevis Island in the northern Lesser Antilles (Giovas et al., 2013; Poteate et al., 2015). Here, three 5 m × 5 m trenches were excavated and subsequent analysis demonstrates that *Nerita tessellata* (typically up to 25 mm) was resilient to increasing human predation over several centuries. There are no signs of taxon size decreases, typically used to signify resource depression; in fact, C. Giovas and coworkers (Giovas et al., 2013) document a statistically significant increase of 0.40 to 0.45 mm in mean length through time (Giovas et al., 2013, p. 4029). Summing up the results of nearly six hundred years of *Nerita tessellata* exploitation, C. Giovas and coworkers (Giovas et al., 2013, p. 4035) state: "This evidence strongly implies that tessellated nerite exploitation by Coconut Walk inhabitants was sustainable over the duration of several centuries of habitation."

Our ABM results, presented in combination with empirical archaeological records, also may aid understanding of the vulnerability of prey taxa to other external factors such as human population growth and increasing harvesting pressure, habitat alteration due to climate change or local environmental variability, and overall variation in a given subsistence economy. We are currently developing related agent-based simulations that focus on how specific prey taxa respond to climate parameters such as variability in sea surface temperature and habitat alteration related to sediment runoff. Ultimately, agent-based computer models like those we present here are exploratory in nature (*sensu* Premo, 2010), aimed at generating hypotheses about long-term patterning in human-marine ecosystems which can then be compared with archaeological records from varied geographic, temporal and social contexts.

Acknowledgements: This research, and Alex E. Morrison's position as a post-doctoral research fellow at University of Auckland, was supported by Marsden Fund, The Royal Society of New Zealand, Grant 11-UOA-027 to M. S. Allen, A. M. Lorrey, and M. N. Evans. Ben Davies provided valuable advice on programming using lists in Netlogo and Briar Sefton assisted with production of the graphics. We thank Frédérique Valentin and Guillaume Molle for inviting us to participate in the 2014 conference 'Spatial Dynamics in Oceania: Discovery, Appropriation and the Emergence of Traditional Societies' and for their assistance with this paper, along with that of two anonymous reviewers who assisted with clarity of the arguments.

BIBLIOGRAPHICAL REFERENCES

Alf A., Kreipl K. (2003) – *The Family Turbinidae, Subfamily Turbininae, Genus Turbo*, Harxheim, Conch Books (A Conchological Iconography, 8), 68 p.

Allen M. S. (1992) – *Dynamic Landscapes and Human Subsistence: Archaeological Investigations on Aitutaki Island, Southern Cook Islands*, doctoral thesis, University of Washington, 557 p.

Allen M. S. (2002) – Resolving Long-Term Change in Polynesian Marine Fisheries, *Asian Perspectives*, 41, 2, p. 195–212.

Allen M. S. (2003) – Human Impact on Pacific Nearshore Marine Ecosystems, in C. Sand (ed.), *Pacific Archaeology: Assessments and Prospects*, proceedings of the International Conference for the 50th Anniversary of the First

Lapita Excavation (Koné-Nouméa, 2002), Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 317–25.

Allen M. S. (2012) – Molluscan Foraging Efficiency and Patterns of Mobility amongst Agricultural Foragers: A Case Study from Northern New Zealand, *Journal of Archaeological Science*, 39, 2, p. 295–307.

Allen M. S., Morrison A. E. (2013) – Modelling Site Formation Dynamics: Geoarchaeological, Chronometric and Statistical Approaches to a Stratified Rockshelter Sequence, Polynesia, *Journal of Archaeological Science*, 40, 12, p. 4560–75.

Allen M. S., Wallace R. (2007) – New Evidence from the East Polynesian Gateway: Substantive and Methodological Results from Aitutaki, Southern Cook Islands, *Radiocarbon*, 49, 3, p. 1163–79.

Aswani S. (2014) – Investigating Coral Reef Ethnobiology in the Western Solomon Islands for Enhancing Livelihood Resilience, *Journal of the Polynesian Society*, 123, 3, p. 237–76.

Aswani S., Hamilton R. J. (2004) – Integrating Indigenous Ecological Knowledge and Customary Sea Tenure with Marine and Social Science for Conservation of Bumphead Parrotfish *(Bolbometopon muricatum)* in the Roviana Lagoon, Solomon Islands, *Environmental Conservation*, 31, 1, p. 69–83.

Barraquand F., Inchausti P., Bretagnolle V. (2009) – Cognitive Abilities of a Central Place Forager Interact with Prey Spatial Aggregation in their Effect on Intake Rate, *Animal Behaviour*, 78, 2, p. 505–14.

Bailleul F., Grimm V., Chion C., Hammill M. (2013) – Modeling Implications of Food Resource Aggregation on Animal Migration Phenology, *Ecology and Evolution*, 3, 8, p. 2535–46.

Berkes F., Colding J., Folke C. (2000) – Rediscovery of Traditional Ecological Knowledge as Adaptive Management, *Ecological Applications*, 10, 5, p. 1251–62.

Bird D. W., Bliege-Bird R. L. (1997) – Contemporary Shellfish Gathering Strategies among the Meriam of the Torres Strait Islands, Australia: Testing Predictions of a Central Place Foraging Model, *Journal of Archaeological Science*, 24, 1, p. 39–63.

Black R., Johnson M. S., Prince J., Brearley A., Bond T. (2011) – Evidence of Large, Local Variations in Recruitment and Mortality in the Small Giant Clam *(Tridacna maxima)* at Ningaloo Marine Park, Western Australia, *Marine and Freshwater Research*, 62, 11, p. 1318–26.

Braje T. J., Kennett D. J., Erlandson J. M., Culleton B. J. (2007) – Human Impacts on Nearshore Shellfish Taxa: A 7,000 Year Record from Santa Rosa Island, California, *American Antiquity*, 72, 4, p. 735–56.

Broughton J. M. (2002) – Prey Spatial Structure and Behavior Affect Archaeological Tests of Optimal Foraging Models: Examples from the Emeryville Shellmound Vertebrate Fauna, *World Archaeology*, 34, 1, p. 60–83.

Broughton J. M., Cannon M. D., Bayham F. E., Byers D. A. (2011) – Prey Body Size and Ranking in Zooarchaeology: Theory, Empirical Evidence, and Applications from the Northern Great Basin, *American Antiquity*, 76, 3, p. 403–28.

Catterall C. P., Poiner I. R. (1987) – The Potential Impact of Human Gathering on Shellfish Populations, with Reference to Some NE Australian Intertidal Flats, *Oikos*, 50, 1, p. 114–22.

Codding B. F., O'connell J. F., Bird D. W. (2014) – Shellfishing and the Colonization of Sahul: A Multivariate Model Evaluating the Dynamic Effects of Prey Utility, Transport Considerations and Life-History on Foraging Patterns and Midden Composition, *The Journal of Island and Coastal Archaeology*, 9, 2, p. 238–52.

Denney N. H., Jennings S., Reynolds J. D. (2002) – Life-History Correlates of Maximum Population Growth Rates in Marine Fishes, *Proceedings of the Royal Society of London. Series B: Biological Sciences*, 269, 1506, p. 2229–37.

Drew J. A. (2005) – Use of Traditional Ecological Knowledge in Marine Conservation, *Conservation Biology*, 19, 4, p. 1286–93.

Dulvy N. K., Sadovy Y., Reynolds J. D. (2003) – Extinction Vulnerability in Marine Populations, *Fish and Fisheries*, 4, 1, p. 25–64.

Ellis S. (1998) – *Spawning and Early Larval Rearing of Giant Clams (Bivalvia: Tridacnidae)*, Waimanolo, Center for Tropical and Subtropical Aquaculture, Oceanic Institute (Center for Tropical and Subtropical Aquaculture Publication, 130), 55 p.

Erlandson J. M., Rick T. C., Braje T. J., Steinberg A., Vellanoweth R. L. (2008) – Human Impacts on Ancient Shellfish: A 10,000 Year Record from San Miguel Island, California, *Journal of Archaeological Science*, 35, 8, p. 2144–52.

Fitzpatrick S. M., Keegan W. F. (2007) – Human Impacts and Adaptations in the Caribbean Islands: An Historical Ecology Approach, *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, 98, 1, p. 29–45.

Giovas C. M., Clark M., Fitzpatrick S. M., Stone J. (2013) – Intensifying Collection and Size Increase of the Tessellated Nerite Snail *(Nerita tessellata)* at the Coconut Walk Site, Nevis, Northern Lesser Antilles, AD 890–1440, *Journal of Archaeological Science*, 40, 11, p. 4024–38.

Grimm V., Berger U., Bastiansen F., Eliassen S., Ginot V., Giske J., Goss-Custard J., Grand T., Heinz S. K., Huse G., Huth A., Jepsen J. U., Jørgensen C., Mooij W. M., Müller B., Pe'er G., Piou C., Railsback S. F., Robbins A. M., Robbins M. M., Rossmanith E., Rüger N., Strand E., Souissi S., Stillman R. A., Vabø R., Visser U., Deangelis D. L. (2006) – A Standard Protocol for Describing Individual-Based and Agent-Based Models, *Ecological Modelling*, 198, 1, p. 115–26.

Grimm V., Berger U., Deangelis D. L., Polhill J. G., Giske J., Railsback S. F. (2010) – The ODD Protocol: A Review and First Update, *Ecological Modelling*, 221, p. 2760–68.

Hunt T. L. (2005) – Archaeological Stratigraphy and Chronology at Nu'alolo Kai, Na Pali District, Kaua'i, in M. T. Carson and M. W. Groves (eds.), *Na Mea Kahiko o Kaua'i: Archaeological Studies in Kaua'i*, Honolulu, Society for Hawaiian Archaeology (Society for Hawaiian Archaeology, Special Publication, 2), p. 236–58.

Hutchings J. A., Reynolds J. D. (2004) – Marine Fish Population Collapses: Consequences for Recovery and Extinction Risk, *BioScience*, 54, 4, p. 297–309.

Jackson J. B. C., Kirby M. X., Berger W. H., Bjorndal K. A., Botsford L. W., Bourque B. J., Bradbury R. H., Cooke R., Erlandson J., Estes J. A., Hughes T. P., Kidwell S., Lange C. B., Lenihan H. S., Pandolfi J. M., Peterson C. H., Steneck R. S., Tegner M. J., Warner R. R. (2001) – Historical Overfishing and the Recent Collapse of Coastal Ecosystems, *Science*, 293, 5530, p. 629–37.

Kirch P. V., Yen D. E. (1982) – *Tikopia: The Prehistory and Ecology of a Polynesian Outlier*, Honolulu, Bishop Museum Press (Bernice P. Bishop Museum Bulletin, 238), 396 p.

Lasiak T. (1991) – The Susceptibility and/or Resilience of Rocky Littoral Molluscs to Stock Depletion by the Indigenous Coastal People of Transkei, Southern Africa, *Biological Conservation*, 56, 3, p. 245–64.

Madsen D. B., Schmidt D. N. (1998) – Mass Collecting and the Diet Breadth Model: A Great Basin Example, *Journal of Archaeological Science*, 25, 5, p. 445–55.

Mannino M. A., Thomas K. D. (2002) – Depletion of a Resource? The Impact of Prehistoric Human Foraging on Intertidal Mollusc Communities and its Significance for Human Settlement, Mobility and Dispersal, *World Archaeology*, 33, 3, p. 452–74.

Mekawy M. S., Madkour H. A. (2012) – Studies on the Indo-Pacific Tridacnidae *(Tridacna maxima)* from the Northern Red Sea, Egypt, *International Journal of Geosciences*, 3, 5, p. 1089–95.

Mies M., Braga F., Scozzafave M. S., Lavanholi De Lemos D. E., Gomes Sumida P. Y. (2012) – Early Development, Survival and Growth Rates of the Giant Clam *Tridacna crocea* (Bivalvia: Tridacnidae), *Brazilian Journal of Oceanography*, 60, 2, p. 127–33.

Morrison A. E., Allen M. S. (2014) – Investigating the Effects of Climate Variability on Long-term Predator/Prey Dynamics in Marine Ecosystems. An Agent Based Model, in *Proceedings of the 12th ICAZ International Conference* (San Rafael, 22–27 September 2014).

Morrison A. E., Addison D. J. (2008) – Assessing the Role of Climate Change and Human Predation on Marine Resources at the Fatumafuti Site, Tutuila Island, American Samoa: An Agent Based Model, *Archaeology in Oceania*, 43, 1, p. 22–34.

Morrison A. E., Hunt T. L. (2007) – Human Impacts on the Nearshore Environment: An Archaeological Case Study from Kaua'i, Hawaiian Islands, *Pacific Science*, 61, 3, p. 325–45.

Nagaoka L. (1993) – Faunal Assemblages from the To'aga Site, in P. V. Kirch and T. L. Hunt (eds.), *The To'aga Site: Three Millennia of Polynesian Occupation in the Manu'a Islands, American Samoa*, Berkeley, University of California (University of California Archaeological Research Facility Contributions, 51), p. 189–216.

O'sullivan D., Perry G. L. W. (2013) – *Spatial Simulation: Exploring Pattern and Process*, Chichester, John Wiley & Sons, 298 p.

Pauly D. (1995) – Anecdotes and the Shifting Baseline Syndrome of Fisheries, *Trends in Ecology & Evolution*, 10, 10, p. 430.

Poiner I. R., Catterall C. P. (1988) – The Effects of Traditional Gathering on Populations of the Marine Gastropod Strombus luhuanus Linné 1758, in Southern Papua New Guinea, *Oecologia*, 76, p. 191–99.

Poteate A. S., Fitzpatrick S. M., Clark M., Stone J. H. (2015) – Intensified Mollusk Exploitation on Nevis (West Indies) Reveals Six centuries of Sustainable exploitation, *Archaeological and Anthropological Sciences*, 7, 3, p. 361–74.

Premo L. S. (2010) – On the Role of Agent-Based Modeling in Post-Positivist Archaeology, in A. Costopoulos and M. W. Lake (eds.), *Simulating Change: Archaeology into the Twenty-First Century*, Salt Lake City, The University of Utah Press (Foundations of Archaeological Inquiry), p. 28–37.

Reynolds J. D. (2003) – Life Histories and Extinction Risk, in T. M. Blackburn and K. J. Gaston (eds.), *Macroecology: concepts and consequences*, proceedings of the international symposium (Birmingham, 17–19 April, 2002), Oxford, Blackwell (Symposia of the British Ecological Society, 43), p. 195–217.

Reynolds J. D., Jennings S., Dulvy N. K. (2001) – Life Histories of Fishes and Population Responses to Exploitation, in J. D. Reynolds, G. M. Mace, K. H. Redford and J. G. Robinson (eds.), *Conservation of Exploited Species*, Cambridge, Cambridge University Press (Conservation Biology, 6), p. 147–68.

Rick T. C., Erlandson J. M. (2008) – *Human Impacts on Ancient Marine Ecosystems: A Global Perspective*, Berkeley, University of California Press, 336 p.

Roff D. A. (2002) – *Life History Evolution*, Sunderland, Sinauer Associates, 465 p.

Sealy J., Galimberti M. (2011) – Shellfishing and the Interpretation of Shellfish Sizes in the Middle and Later Stone Ages of South Africa, in N. F. Bicho, J. A. Haws and L. G. Davis (eds.), *Trekking the Shore: Changing Coastlines and the Antiquity of Coastal Settlement*, New York, Springer (Interdisciplinary Contributions to Archaeology), p. 405–19.

Smith S. D. A. (2011) – Growth and Population Dynamics of the Giant Clam *Tridacna maxima* (Röding) at Its Southern Limit of Distribution in Coastal, Subtropical Eastern Australia, *Molluscan Research*, 31, 1, p. 37–41.

Stephens D. W., Krebs J. R. (1986) – *Foraging Theory*, Princeton, Princeton University Press (Monographs in Behavior and Ecology), 262 p.

Swadling P. (1976) – Changes Induced by Human Exploitation in Prehistoric Shellfish Populations, *Mankind*, 10, 3, p. 156–62.

Tan A. S. H., Yasin Z. B. (2000) – The Reproduction Cycle of *Tridacna squamosa* and *Tridacna maxima* in Rengis Island (Tioman Island), Malaysia, *Journal of Shellfish Research*, 19, 2, p. 963–66.

Thomas F. R. (2007) – The Behavioral Ecology of Shellfish Gathering in Western Kiribati, Micronesia 1: Prey Choice, *Human Ecology*, 35, 2, p. 179–94.

Ugan A. (2005) – Does Size Matter? Body Size, Mass Collecting, and Their Implications for Understanding Prehistoric Foraging Behavior, *American Antiquity*, 70, 1, p. 75–89.

Weimerskirch H., Inchausti P., Guinet C., Barbraud C. (2003) – Trends in Bird and Seal Populations as Indicators of a System Shift in the Southern Ocean, *Antarctic Science*, 15, 2, p. 249–56.

Wolverton S., Nagaoka L., Dong P., Kennedy J. H. (2012) – *On Behavioral Depression in White-tailed Deer*, Journal of Archaeological Method and Theory, 19, 3, p. 462–89.

Alex E. Morrison
Anthropology, School of Social Sciences,
University of Auckland,
Private Bag 92019,
Auckland, New Zealand
and
International Archaeological Research Institute,
2081 Young Street,
Honolulu, Hawaii 96826, USA
alex.morrison@auckland.ac.nz

Melinda S. Allen
Anthropology, School of Social Sciences,
University of Auckland,
Private Bag 92019
Auckland, New Zealand
ms.allen@auckland.ac.nz

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 79-90
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Horticultural Structures on Ultramafic Soils

The Case of Isle of Pines and Other Parts of Southern Grande Terre Island (New Caledonia)

Louis Lagarde and André-John Ouétcho

Abstract: This article addresses questions relating to traditional horticultural practices in some supposedly infertile environments of New Caledonia. It is widely accepted that this southern Melanesia archipelago hosts an extremely elaborate set of horticultural systems, mainly dating to the last millennium and iconic of what is defined as the Traditional Kanak Cultural Complex. These systems are usually distinguished by irrigated terraces dedicated to the production of species which need a constant water supply, such as taro; and also by the construction of elongated earth mounds connected with dryer cultivars such as yam, banana and sugarcane. However, a significant part of New Caledonia's main island, Grande Terre, and the Isle of Pines, is covered by ferralitic soil, derived from the degradation of ultramafic rocks whose origin goes back to a partial, tectonic subduction event which occurred over 37 million years ago. The pedological environment which derived from this phenomenon is particularly acidic, with very low levels of key nutrients (N, K, P, Mg, Ca) but high concentrations of toxic elements, such as metals. These conditions fostered the advent of highly efficient, well-adapted vegetation with extremely high endemism levels and also introduced strong local constraints to the cultivation of species of alimentary importance, introduced by the first Austronesian people who arrived three thousand years ago. It is in these inauspicious settings that important horticultural structures have been archaeologically surveyed in recent years; which, though chronologically linked to other, better-known horticultural structures found on more favorable soils throughout the archipelago, present some clear structural differences. By studying these structures discovered in the south of Grande Terre (in the Yaté and Ouinné regions) and the Isle of Pines, the chemical particularities and the requirements of the soils (to become productive), we were able to form a series of possible interpretations regarding these distinctions. After analysis, it seems reasonable to state that at least some of these specificities were linked to empirical experiences in soil enhancing, and oriented towards productivity. In particular, the deviation of streams in order to irrigate ferralitic plains has long since been demonstrated. The constitution of stone enclosures, usually interpreted as private parcel delimitations, could have been undertaken in order to minimize the evaporation process and the impact of saline conditions in coastal environments. Also, they could have been constructed to enhance the soils key nutrients, through confinement and mulching, in a similar way to that previously observed in the basaltic environments of Polynesia.
The existence of these structures and the care taken in their edification was put into perspective; especially as cultivation in the ferralitic environments of southern New Caledonia still proves difficult today, despite the extensive use of fertilizers. Naturally, it raised the question of intensification in relation to the spatial occupation of the archipelago during the last millennium. Therefore, if one considers that one third of the available surface of Grande Terre and the Isle of Pines is characterized by ultramafic formations, what is one to think of the occupation on the rest of the archipelago where the soils are of better quality? A large amount of archaeological research has been undertaken during the past twenty years on the intensification processes in horticulture implantations throughout the last millennium, leading to the Kanak landscapes as witnessed by the first Westerners. This field has considerably expanded our knowledge of the last thousand years of the archipelago. In particular, the results have demonstrated that the population of the indigenous Kanak, prior to European contact in the late 18th century, was considerably higher than the usual demographic evaluations, which were based solely on missionary accounts and the beginning of French colonial rule in 1853. In conclusion, it seems clear that the existence of the horticultural structures and habitat in marginal zones with poor quality soil provides a supplementary argument in favor of a largely superior pre-European population to that previously recorded.

Keywords: New Caledonia, Kanak, horticulture, irrigation, ultramafic, ferralitic, soil enhancement, lithic mulching.

Structures horticoles sur sols ultramafiques : le cas de l'île des Pins et d'autres régions du sud de la Grande Terre (Nouvelle-Calédonie)

Résumé : Cet article propose d'aborder les questions d'horticulture traditionnelle sur les milieux *a priori* hostiles de Nouvelle-Calédonie. Cet archipel de Mélanésie du Sud est connu pour abriter des systèmes horticoles très élaborés, datés en général du dernier millénaire de

notre ère, et emblématiques de ce qu'il est convenu d'appeler l'ensemble culturel traditionnel kanak. Ceux-ci sont principalement caractérisés par des aménagements en terrasses irriguées pour les cultures humides (taro d'eau notamment) ainsi que des billons surélevés dédiés aux cultures sèches (igname mais aussi bananier, canne à sucre). Toutefois, une partie du territoire de la Grande Terre et l'île des Pins, qui font partie de cet archipel, est recouverte de sols issus de la dégradation de roches ultramafiques, dont l'origine remonte à une période de subduction partielle qu'a connue l'archipel il y a plus de 37 millions d'années. L'environnement pédologique qui a découlé de ce phénomène est particulièrement acide, pauvre en éléments nutritifs et riche en éléments toxiques comme les métaux, ce qui a à la fois permis le développement d'une végétation performante à très fort taux d'endémicité, et aussi rendu difficile, depuis l'arrivée des premières pirogues il y a trois millénaires, la culture d'espèces introduites à vocation alimentaire. C'est dans ces environnements, peu propices, que des structures horticoles importantes ont été mises en évidence ces dernières années. Si elles s'inscrivent chronologiquement en parallèle des autres aménagements connus ailleurs dans l'archipel, elles restent structurellement différentes. À travers celles découvertes dans le sud de la Grande Terre (régions de Yaté et Ouinné) et à l'île des Pins, nous proposons de dégager leurs principales particularités. La prise en compte des caractéristiques chimiques, et donc des besoins de ces sols, permet également de poser un certain nombre de pistes interprétatives sur les différences structurelles observées d'avec les autres aménagements horticoles connus sur l'archipel, pourtant contemporains. En effet, il semble probable qu'une partie de ces spécificités soient liées à des essais empiriques d'amélioration des substrats. En particulier, le détournement de cours d'eaux entiers afin d'irriguer les zones de plaines est avéré. La constitution d'enclos murés aménageant de petites surfaces de culture, généralement interprétées comme des délimitations de parcellaire horticole, pourraient en réalité avoir été entreprise afin d'au moins diminuer l'évaporation et l'impact des conditions salines littorales, voire pour essayer de concentrer le substrat en éléments nutritifs, comme cela a déjà été mis en évidence dans des environnements basaltiques de Polynésie. Lorsque l'existence même de ces structures et le soin apporté à leur réalisation sont mis en perspective, alors même que les mises en culture dans les zones à substrat ultramafique sont encore problématiques aujourd'hui, malgré l'apport massif d'engrais, alors se pose naturellement la question de la densité d'occupation de l'espace sur l'archipel calédonien durant le dernier millénaire. En effet, si l'on considère que les zones ultramafiques représentent un tiers de la surface de la Grande Terre et de l'île des Pins, alors que penser de l'occupation des zones plus propices à la culture, sur substrats moins acides ? Les recherches archéologiques menées depuis maintenant plus de deux décennies sur les intensifications dans les aménagements horticoles, tendent à démontrer que la population Kanak était plus importante qu'il n'a longtemps été pensé, lors des premiers contacts avec les navigateurs européens. Il semble clair que l'existence même de structures et d'habitats en zones pourtant marginales, défavorables à l'horticulture, corrobore ce propos et apporte des arguments supplémentaires à l'image d'une population pré-européenne largement supérieure à ce qui a été longtemps écrit.

Mots-clés : Nouvelle-Calédonie, Kanak, horticulture, irrigation, ultramafique, ferralithique, amendement des sols, paillage lithique.

Studies of horticultural systems in the Pacific have a long and complex history throughout Polynesia (’Uvea in Kirch, 1978, Futuna and Alofi in Kirch, 1995, the Tuamotu islands in Chazine, 1985, the Cook islands in Allen, 1971 or Hawai’i in Kirch, 1977) and Melanesia (for Aneityum, Vanuatu, see Spriggs, 1981). When one mentions traditional horticultural structures in New Caledonia, one is almost inevitably referring to the famous, massive, field organizations that can be seen throughout the main island. It is through their study that New Caledonian anthropologist and ethnobotanist Jacques Barrau produced a thought-provoking article, ‘L’Humide et le Sec’ (Barrau, 1965), which founded a new way of understanding and studying horticultural systems in the Pacific. Since then, they have been actively surveyed and studied, especially by the local archaeological team of the Institute of Archaeology of New Caledonia and the Pacific (IANCP) over the past few decades (Sand et al., this volume). These structures are connected chronologically to the last millennium and socially to the *ensemble culturel traditionnel kanak* (Sand et al., 2012a). This *ensemble* or ‘complex’ (Sand et al., this volume) is defined by the progressive emergence of knowledge, techniques, skills and material culture, indigenous to the New Caledonian archipelago. This phenomenon took place progressively during the first millennium AD, in response to new constraints: extensive use of slash-and-burn practices during the first part of the chronology by an ever-growing population caused a global pauperization of soils, and probably consequential intensification of social tensions in land ownership (Sand et al., 2012a, p. 103). This triggered a renewed and highly complex set of horticultural structures than can be seen in most environments of mainland New Caledonia, also called Grande Terre Island. These horticultural systems consist of built terraces showing evidence of complex irrigation, for wet crops such as wet taro *(Colocasia esculenta)* and also a series of elongated earth mounds used for dry crops such as yam (*Dioscorea* sp.; see Barrau, 1965). Here, the aim is to highlight the specific horticultural structures that were built on ultramafic soils. This archaeological issue has yet to be fully discussed; partly because of its rarity but mainly because of New Caledonia’s famous archaeological diversity and chronological depth, which spans three millennia of human settlement, presence and adaptation (Sand, 1995).

We will focus on the horticultural systems found in the ferralitic and acidic geological environments of southern mainland New Caledonia and the Isle of Pines (located at the southern tip of the main island, fig. 1). Their location and special features, as well as their differences to other nearby horticultural systems are discussed in order to finally address the adaptation process of the Kanak cultural complex to the highly peculiar ferralitic zones of New Caledonia. Therefore, we shall mention the geological, pedological and floral characteristics of these environments as well as their limited tolerance to imported crops. The different kinds of structures that have been discovered here over the years will also be presented, including how they relate to the better-known structures found elsewhere

on the mainland. Finally, we will discuss the presence of these structures and the necessity of a better understanding of their particularities in order to obtain a 'better picture' of human adaptation during the last millennium in New Caledonia.

SOIL AND ENVIRONMENTAL CHARACTERISTICS

Local ultramafic geological and pedological formations in New Caledonia come from the earth's mantle. At the end of the Eocene period, 37 million years ago, during a phase of complete submersion, the deeper layers of the earth's crust covered mainland New Caledonia and the Isle of Pines. This phenomenon was caused by the subduction of tectonic plaques: the Indo-Australian going under the Pacific one (Picard, 1999; L'Huillier et al., 2010). When New Caledonia re-emerged, erosion and fragmentation led to the formation of the complex geology of Grande Terre Island, with different ferralitic environments roughly covering a third of its surface (5,500 km², fig. 1).

In the remainder of New Caledonia, soils are generally considered of medium to good quality, with a large variety of textures, components and abilities. The Caledonian Agronomical Institute (IAC) considers that 2,100 km² are ideal for crops, 9,600 km² are good for forestry exploitation and the remaining, ferralitic 5,500 km² are unfit for modern-day cultivation (L'Huillier et al., 2010). Indeed, these geological formations are known for their high concentrations of metals, a component usually only found as traces in 99% of the surface rocks in the rest of the world (L'Huillier et al., 2010). The soils produced by these geological formations therefore bear some unique pedological characteristics which support a rich, mostly endemic flora. It is in these ferralitic environments that New Caledonia's floral endemism is at its highest with 88.8% of all the vascular plants (Jaffré et al., 2001, p. 32). Therefore, even though chrome and nickel generally have a toxic effect on plants, biologists have discovered that some endemic species found in southern New Caledonia show extreme adaptation abilities to the soils encountered (Jaffré et al., 2013). Known as 'hyperaccumulators', they are able to filter and accumulate nickel, such as *Pycnandra acuminata* (fig. 2) whose blue sap can contain more than 20% of nickel citrate.

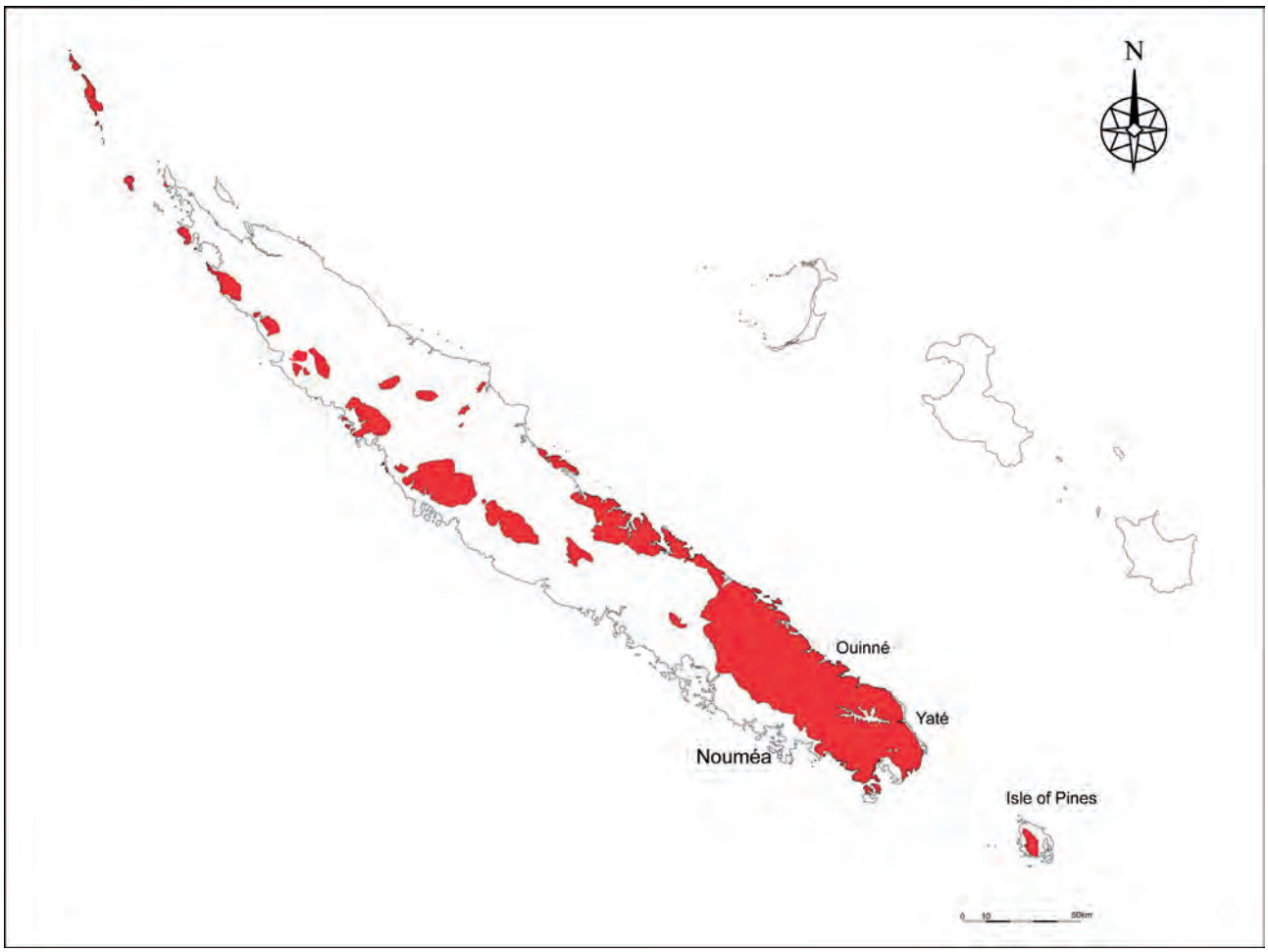


Fig. 1 – Ultramafic formations in New Caledonia.
Fig. 1 *– Formations ultramafiques en Nouvelle-Calédonie.*

There are three main ferralitic soil types to be found in New Caledonia, all of which contain high levels of metal and are therefore toxic to non-indigenous plants. However, they do not all bear the same levels of nutrients, nor do they have exactly the same pH or the same water-retaining characteristics, essential factors for the cultivation of crops.

The three categories are (L'huillier et al., 2010; here: table 1):

– a) Non eroded ferralitic soils located on slopes, highlands and peaks, are the poorest kinds of soils to be encountered in New Caledonia. They show high acidity (a very low pH of 4.6), high levels of toxicity, and few exchangeable chemical nutrients;

– b) Recently eroded ferralitic soils or rejuvenated soils are located on the slopes or peaks, and are extremely poor in exchangeable nutrients; yet, their pH is quite high for an acidic soil (5.9) which is partially due to the presence of high levels of magnesium ions (Mg);

– c) Ferralitic soils connected with alluvial deposits: their higher pH (6.3) is connected with the presence of magnesium and calcium ions (Ca). Even though potassium and nitrogen nutrients are in the same low levels as the two first categories, organic deposit levels in the plains can provide immediate supply and give crops a slightly better chance of survival.

Therefore, plains and lower slopes possess better characteristics for the survival of crops, because of erosion, breakage of the ferralitic elements, and the presence of organic deposits. Overall, though, it remains an extremely harsh environment for non-indigenous, introduced species and cultivars.

Fig. 2 – *Pycnandra acuminata* (© Bernard Suprin).
Fig. 2 – Pycnandra acuminata *(© Bernard Suprin).*

The most important aspect of these soils, other than their metal-induced toxicity, is the scarcity of key nutrients such as nitrogen (N), potassium (K) and phosphorus (P). Used as supplements in mineral or organic fertilizers, these were, in the past, almost impossible to obtain in island societies which did not breed animals for food. On other Pacific islands, the occurrence of chickens *(Gallus gallus)* or pigs *(Sus scrofa)* is due to the early colonizing phase, during which the first settlers voluntarily introduced these species. However, though open to much debate, in New Caledonia evidence of these commensals prior to European contact is unlikely or rare (Sand, 2010): no traces of pig or chicken bones have been found in any Lapita or post-Lapita layers. Pigs were clearly introduced during the 19th century, and chickens appear only later in the chronology, during the last millennium, possibly through Polynesian contact (Lagarde, 2012). With no animal source of organic nutrients, the main source of useful chemicals for horticulture (especially nitrogen) was rainwater. But, for crops to grow in a non-fertilized ferralitic environment, heavy and regular rainfall is essential in order to receive high levels of nitrogen. This happens to be the case on the southeastern mainland of New Caledonia and the Isle of Pines, where the archaeological structures discussed in this paper, were discovered. The global rainfall there is between 1500 and 3500 mm/year, on the higher end of the global New Caledonian spectrum, the average being of 1700 mm/year (L'Huillier et al., 2010).

Another aspect to consider is the water-retaining ability of ferralitic soils: the presence of clay and organic matter plays an important role in the high humidity rate of the alluvial ferralitic soil, almost four times higher than those of the other two ferralitic soil types (on slopes and summits) rising from 7.4 % to 26.8 % (L'Huillier et al., 2010). This, however, is moderated by the evaporation caused by the sun and wind. This, it should be noted, is naturally stronger on the seashore in southeastern mainland New Caledonia, where south-easterly winds clearly dominate.

Here we have a basic contradiction: the best soils in ferralitic environments are located in the alluvial plains close to the coast (higher pH, more nutrients and better water-retaining abilities). However, these areas are generally windy, a condition which favors evaporation, loss of humidity and suffering to crops.

ARCHAEOLOGICAL FEATURES

Large horticultural structures are common all over mainland New Caledonia, and can be roughly separated in two main categories. In the first type, the best soil was gathered in order to form elongated mounds for dry crops, the water being supplied by rainfall. Gener-

	Non-eroded ferralitic soils	Recently eroded ferralitic soils	Alluvial feralitic soils	Common brown soils
pH	4,6	5,96	6;35	6.81
Exchangeable ions (mEq/100 g)				
K^+	0.08	0.06	0.07	0.22
Metals (%)				
Fe	46.5	42.59	36.5	17.3
Ni	0.26	0.94	0.84	0.27
Cr	4.24	2.11	4.62	1.21

Table 1 – Main geological characteristics of New Caledonian ferralitic soils, compared to magnesian brown soils found elsewhere on Grande Terre Island (from L'Huillier et al., 2010).
***Tabl. 1** – Principales caractéristiques des sols ferralitiques de Nouvelle-Calédonie comparées aux sols bruns magnésiens trouvés ailleurs sur la Grande Terre (d'après L'Huillier* et al.*, 2010).*

ally such mounds were dedicated to bananas or sugar cane, but here their main focus was yam *(Dioscorea* sp.*)*: a sacred tuber in Kanak culture, a masculine symbol and a central piece in customary practices and trade. The second type consisted of irrigated terraces, often built on hill slopes dedicated to the cultivation of wet taro *(Colocasia* sp.*)*, another highly praised tuber and feminine counterpart of the yam (Barrau, 1965; Sand et al., 2012a, p. 103). The organization of this new, previously locally unknown, system of horticulture in the New Caledonian archipelago, through the edification of these two main categories of structures has been dated to the last millennium. Therefore, the oldest dates acquired in the southern part of mainland New Caledonia (in the Païta region, close to the ferralitic environments discussed in this article) go back to the last quarter of the first millennium AD (Beta 61956: 1210 ± 70 BP; Sand, 1995, p. 60).

In ferralitic environments, the structures linked to horticultural activities were of four main types:

– a) Terraces on ferralitic slopes showing evidence of water irrigation (fig. 3), as found on the Isle of Pines (Lagarde, 2012). Most notably, a set of twenty-eight terraces, perpendicular to the slopes and measuring between 10 and 50 m, were discovered on the Isle of Pines at site KKR003 in 2010. Each terrace bore masonry of large boulders. Trapped within the masonry was a fragment of *Tridacna* sp. shell which was dated to 704 ± 29 BP (430 cal. BP, 2 σ, Waikato 32924; here: Lagarde, 2012). This is consistent with the attribution of these structures to the emergence of the 'Traditional Kanak Cultural Complex' (Sand, 2012);

– b) Small enclosures on ferralitic slopes which create small walled gardens (fig. 4), as found on the Isle of Pines (Lagarde, 2012). These gardens are generally small, bearing a reduced cultivable surface (from 12 m^2 to around 30 m^2) with separation walls made of piled-up ferralitic boulders, 50 to 80 cm above the ground. These enclosures are generally round or oval-shaped, with some extended ones which usually contained an elongated earth mound similar to those dedicated to yam cultivation found elsewhere on the mainland. Similar small enclosures are also known from places such as the nearby Loyalty Islands (i.e. Sand, 1995, p. 185) and generally throughout the Pacific, in non-ferralitic environments. Usually interpreted as private, nuclear family gardens, they are still seldom seen on the rest of Grande Terre Island;

– c) High circular enclosures along narrow coastal plains, as found in the Ouinné region, southeastern part of Grande Terre Island (fig. 5). Constructed with massive quantities of piled-up boulders, their height ranged from 1.2 m to 2 m, which created a fairly small space for horticulture within (between 5 m^2 and 12 m^2). They have yet to be documented elsewhere in the New Caledonian archipelago. Witnessed from different sites along the 14 km shoreline of the Ouinné zone, surveyed in 2008, they are still considered as indigenous to that location (Lagarde et al., 2008);

– d) Large structures built to divert the course of streams in order to bring water to the coastal plains, as recorded in Yaté (Sand and Ouétcho, 1992; here: fig. 6). Evidence of barrages diverting creeks from their original beds exists elsewhere on the mainland, in non-ferralitic environments, as the irrigation of taro-dedicated terraces needed constant water supply. There are numerous accounts of open air water ducts carved in stone or water-retaining barrages in order to divert stream water for irrigation. Yet, in the Yaté region, these impressive structures can be as wide as 20 m and as long as 70 m, and are not connected to terraces but are created to allow the irrigation of the nearby plains.

INTERPRETATION

To summarize, although these horticultural structures are clearly different, they do bear some common characteristics. The common earth terraces dedicated to wet crops and the elongated yam mounds found on Grande Terre Island are typically carved out or piled-up as previously described. Here, a considerable addition to this practice is that the structures found in ferralitic envi-

Fig. 3 – Built terraces on ferralitic slopes, site KKR003, Isle of Pines (photo L. Lagarde, 2010).
Fig. 3 *– Terrasses construites sur des pentes ferralitiques, site KKR003, île des Pins (cliché L. Lagarde, 2010).*

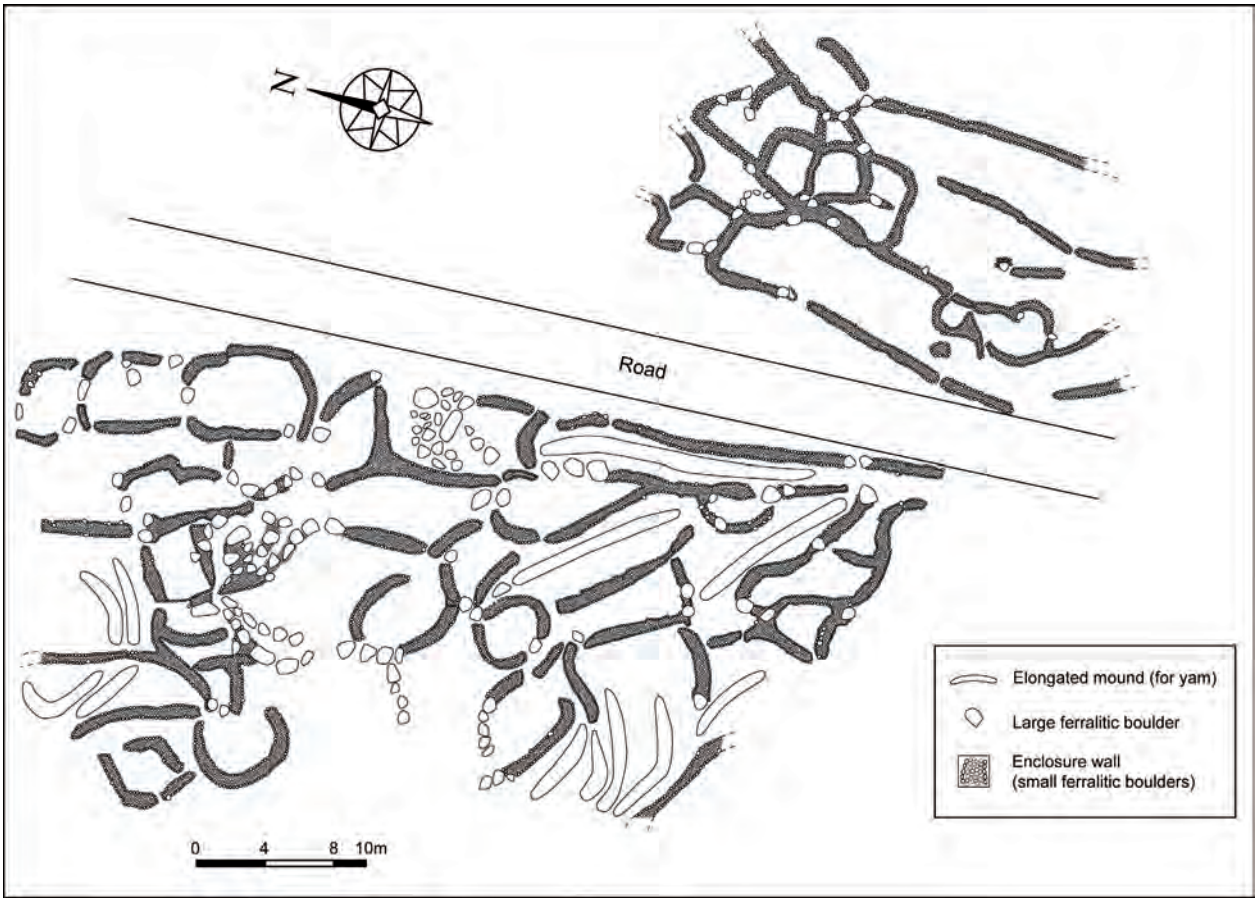


Fig. 4 – Small enclosed gardens on slopes, site KWA001, Isle of Pines (Lagarde, 2012).
Fig. 4 *– Petits jardins enclos aménagés sur des pentes, site KWA001, île des Pins (Lagarde, 2012).*

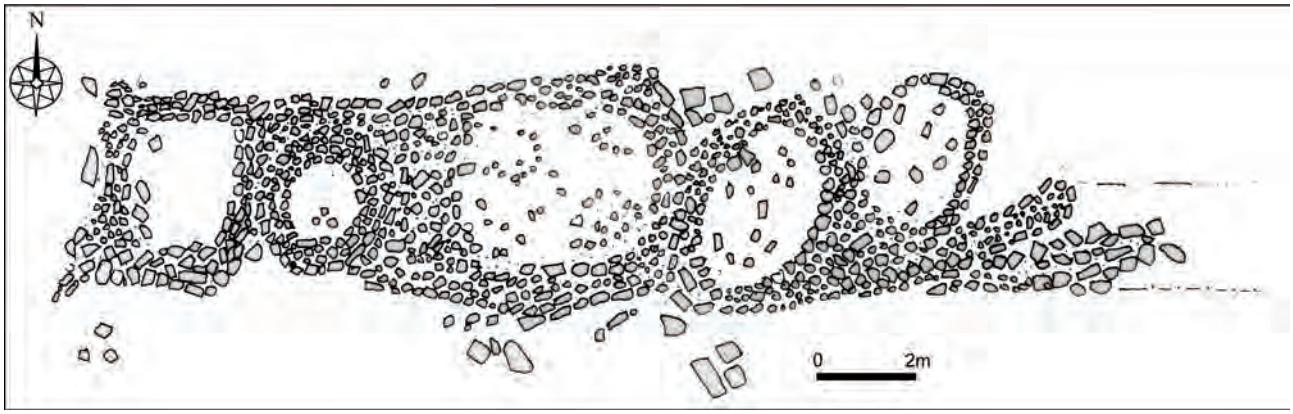


Fig. 5 – High enclosures by the coast, site SOU016, Ouinné (Lagarde et al., 2008).
Fig. 5 *– Enclos hauts dressés le long de la côte, site SOU016, Ouinné (Lagarde* et al.*, 2008).*

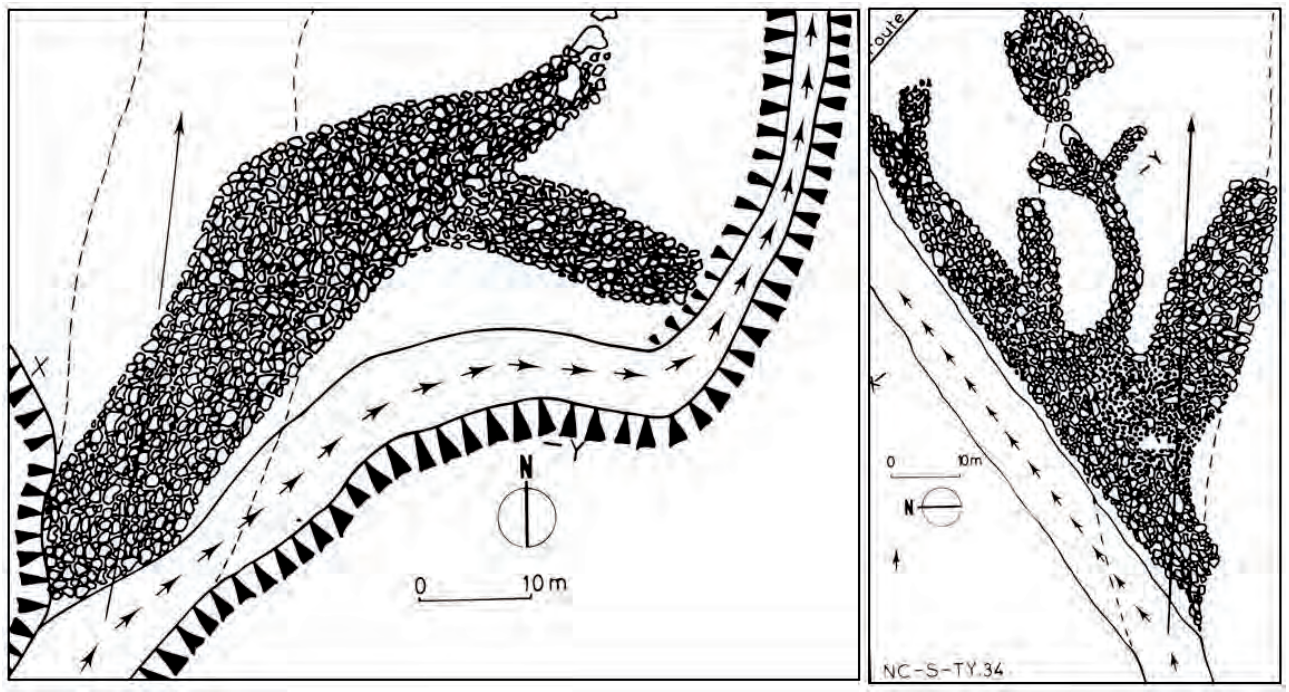


Fig. 6 – Anthropic structures diverting the course of rivers, sites STY024 and STY047, Yaté (Sand and Ouétcho, 1992).
Fig. 6 *– Structures anthropiques modifiant le cours des rivières, sites STY024 et STY047, Yaté (Sand et Ouétcho, 1992).*

ronments were also built (fig. 7). The large ferralitic boulders coming from the fragmentation of the available top geological layers, outcropping nearby, became the material used to build the terraces, the enclosure walls and barrages. The terraces were then reinforced with blocks and the yam mounds were encircled with enclosure walls. Furthermore, even though the structures on ferralitic soils are less common than on the rest of the mainland, they show clear evidence of more extra effort having been taken in their construction.

These characteristics might have been aimed at enhancing the soil, or at least increasing productivity. In the case of the stream diverting structures, for example, allowing irrigation of the plains is obviously productive for crops. In the case of small enclosures, it is possible that the edification of small walls around crops was a way to diminish the evaporation process. This hypothesis can be verified on the Isle of Pines because two different geological environments coexist (fig. 8):

– a) A flat plateau, dating to the Eocene period, of ferralitic origin and located in the center of the island. Its general altitude is around 80 m above sea level, and it is linked to a small mountainous range in the south of the island culminating at 262 m (N'Ga peak). On the top of the plateau, the soil is very poor (of the non-eroded ferralitic category), and there are no known horticultural structures. However, on the slopes the soil is slightly richer, and this allowed a number of different sets of enclosed gardens and terraces to be surveyed (Lagarde, 2012);

– b) Surrounding the plateau, only slightly higher than sea level, is a recently uplifted coral limestone plain. In this non-acidic environment, with deep rich soil and ever-

Fig. 7 – Retaining wall constructed as part of a horticultural terrace, site KKR003, Isle of Pines (photo L. Lagarde, 2010).
***Fig. 7** – Mur de soutènement faisant partie de la construction d'une terrasse horticole, site KKR003, île des Pins (cliché L. Lagarde, 2010).*

green forests, similar enclosures were not found, even though coral boulders are frequent (Cherrier, 1986).

These structures are difficult to analyze, as formal Melanesian or Polynesian equivalents are not always used in the same way. Similar stone walls exist elsewhere in Oceania, but are not necessarily linked together: their function or functionality differing from island to island or archipelago to archipelago. They are often referred to as 'gardens' or 'horticultural parcels' (in New Caledonia, see Sand, 1995, p. 186), which indicates a relation of property and limits to the walls encountered. If traditionally some walls were built in order to physically determine land ownership, the small enclosures found on the Isle of Pines do not necessarily fall in this category.

Thus, throughout the Polynesian triangle, similar enclosures have been used since ancient times in order to enhance soils and productivity (Ladefoged et al., 2010, p. 84–85), as in the Easter Island *manavai* (McCoy, 1976; Hunt and Lipo, 2007, p. 96). There, small enclosures are known to significantly increase the level of key nutrients (i.e. K, P, Ca, Mg) within the soil, particularly potassium (K) and phosphorus (P).

This process, known as lithic mulching, has proven to be efficient in basaltic environments and has taken many different aspects in Polynesia (Kirch et al., 2005, p. 255; Palmer et al., 2009; p. 1450). It is clearly difficult to state, at this stage of research, that the structures found on the Isle of Pines could have been built (and been effective) to enhance poor ferralitic soils. To confirm this, further comparative chemical analyses would be required. Yet, what is certain is that the forefathers of the present-day islanders had no precise knowledge of chemicals and nutrients necessary to ensure crop production. Empiric observation of leaves and their growing rates is what must have fostered either the search for innovative restructuration of horticultural land, or the local adaptation of traditional techniques brought from elsewhere in Oceania. Furthermore, it is clear that even if the enclosure technique did not significantly enhance the poor ferralitic soils it inevitably reduced evaporation and maintained a higher internal humidity, an essential factor for the growth of crops. This was probably of importance on the Isle of Pines, especially during the two dry periods of the year (March-April and July-September, fig. 98). Maintaining a constant water supply in ferralitic soils with high drainage ability seems to have been an important issue, as several freshwater sumps were found close to horticultural structures during the survey of the plateau slopes (Lagarde, 2012).

The soil enhancement-related interpretation of these structures can be further confirmed on the Isle of Pines, as these structures are only be found on the slopes of the ferralitic plateau. On the surrounding calcareous forest plains, where classic Kanak horticultural structures are

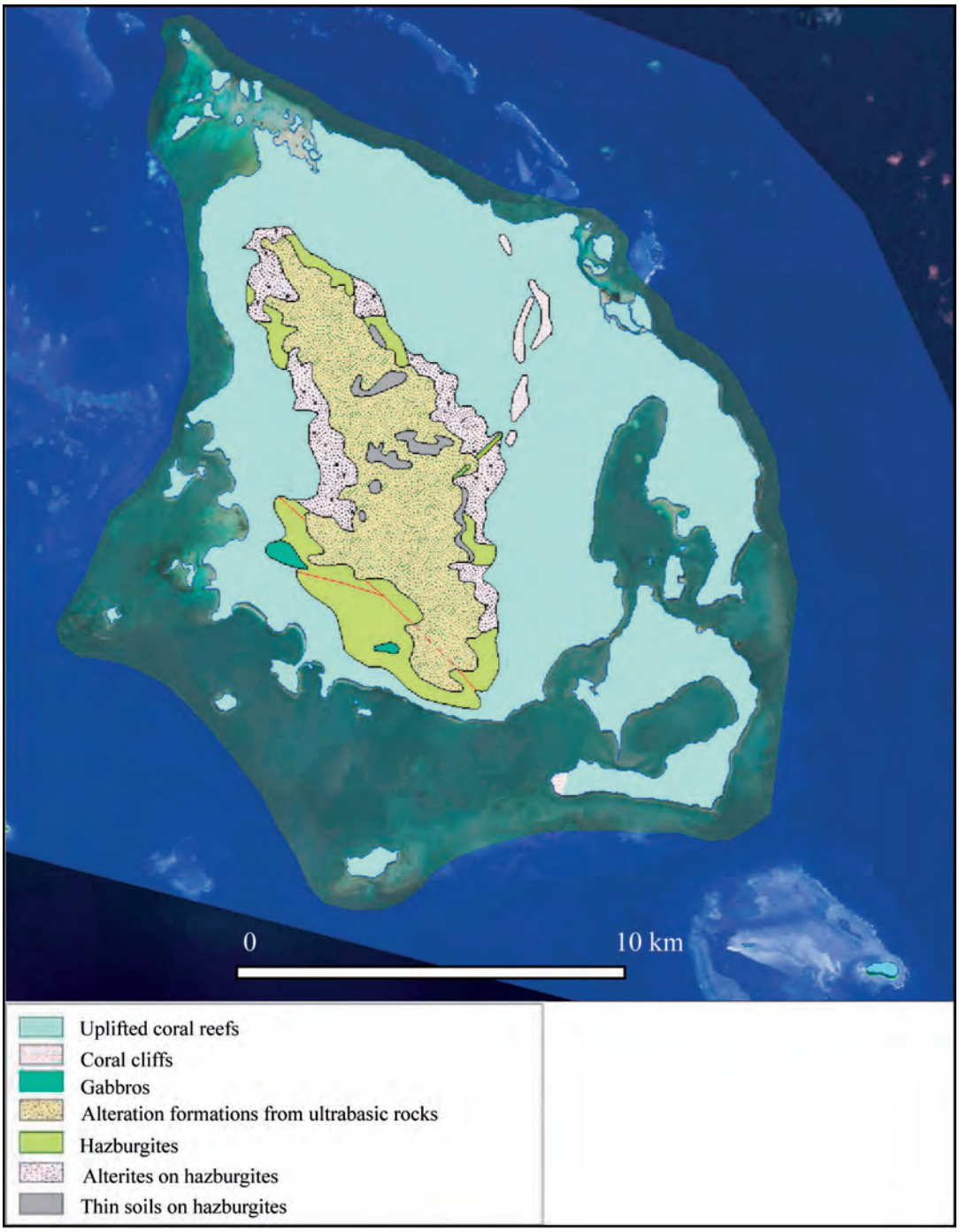


Fig. 8 – Geological map of the Isle of Pines (GIS GEOREP, New Caledonia).
Fig. 8 *– Carte géologique de l'île des Pins (SIG GEOREP, Nouvelle-Calédonie).*

located and oral traditions relating to the production of tubers have been recorded, there are no such enclosures. This does not mean that a limestone setting is ideal for cultivation, as on small uplifted island environments in Melanesia, similar stone enclosures are known. Some were discovered on Tiga Island (Sand et al., 2010), where the locals believe they were built in order to facilitate the growth of tubers by protecting them from saline air (C. Sand, personal communication, 2012). On the Isle of Pines, however, the width of the coastal plains (several kilometers) has allowed crop production, on rich brown rendzine soils, without any kind of protective measures. Lastly, soil enhancing techniques, such as the concentration of useful nutrients, reduction of the evaporation process, or the impact of saline air are not necessarily in contradiction with the interpretation of private gardens or parcels. The appropriation of land for gardening by a family or clan is fully compatible with technical innovation. These smaller structures could be related to cultivation within a kinship relation of different, more fragile species or cultivars which necessitated alternative traditional practices, for instance mulching within the enclosures.

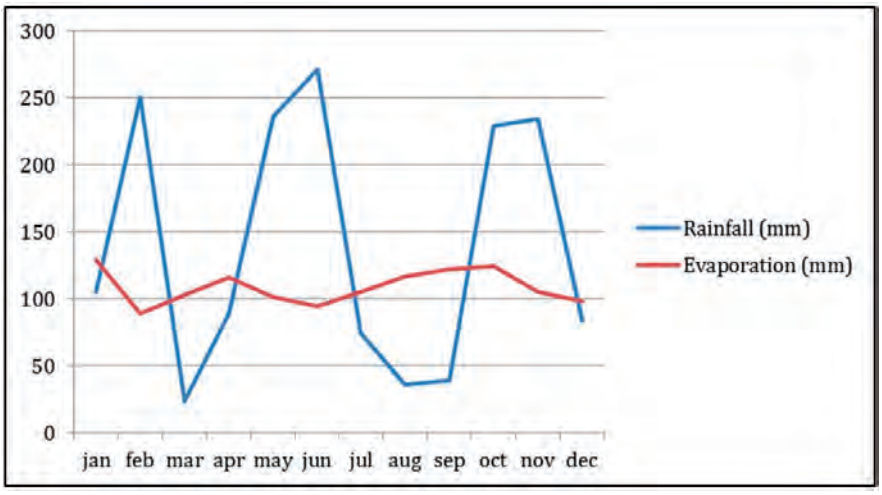


Fig. 9 – Comparison of rainfall and evaporation in soil over the course of a year (here 1984, in Cherrier, 1986).
***Fig. 9** – Comparaison des précipitations et des évaporations des sols au cours d'une année (ici 1984, in Cherrier, 1986).*

The techniques used also seem to be different to those used on the larger irrigated terraces, as much as they seem to be related to different social uses.

It appears, therefore, that these enclosures, discovered on the slopes of the plateau, were connected with a strategy to enhance the soil. Similarly, in the Ouinné region, the large, high enclosures found on the narrow coastal plains seem to be linked to mulching processes: the poor soil is put under the stress of nearby saltwater in a windy environment. Protection of crops has to be obtained through the construction of high and thick walls, thus preventing high levels of toxic chlorine (through salt), and also preventing wind-induced evaporation.

If the soil-enhancing hypothesis seems like a reasonable explanation for the characteristics of these layouts, evidence is difficult to obtain. Whether or not these structures and their characteristics can be interpreted as systematic experiments in soil enhancing is a difficult debate, especially as too few dates and too little analyses have been made on the structures themselves. None of this can be proven until a considerable amount of further research has been undertaken and experimental data acquired on the topic.

However, a series of important questions remains: why are there horticultural systems in place in such poor environments? Why would traditional societies bother with unfertile soils, and build, with such a high degree of care and attention, complex systems in order to grow crops where they knew the soil was not good enough? Indeed, if 70% of the global surface of the Grande Terre Island is covered in medium-to-good soil why bother at all?

Generally speaking, archaeological remains in harsh ferralitic environments are quite rare: on the summits and higher slopes, where the soil is extremely poor, there is generally no trace of perennial human settlements or horticulture. These results were obtained recently by the IANCP, after a large number of archaeological surveys were completed at the demand of mining corporations. The only traces of human presence are cairns, some occasional hearths, ancient Kanak pathways, meeting places for traditional exchange rituals and funerary deposits (Sand et al., 2012b; Lagarde et al., 2008). The same can be said for the top of the Isle of Pines' plateau, where only the mysterious tumuli are to be found. However, the lower slopes and alluvial plains are archaeologically richer because they were easier to access, they have slightly better soil, and the proximity of the sea allowed fishing and a better food intake for those living there. Yet these environments are far from ideal in a society where the main nutrients of the diet are acquired through the consumption of tubers. Therefore, if these horticultural structures and the nearby habitats are linked to the last millennium, as appears to be the case, then it probably means that most of the cultivable land must have been in use during this period. The intensification of archaeological remains found in ferralitic environments dating to the second millennium AD has already been noted. This intensification is visible through the growth in the use of these landscapes as customary landmarks. Specific zones defined as locations for traditional exchange ceremonies and/or meeting places, as well as being spiritually important, are linked with the imaginary origin of kinship ensembles (Sand et al., 2012b). All of this supports the idea that during this period, the archipelago was under strong demographic pressure. This is indeed consistent with general remarks that have been made since the 1990s (Sand, 1995), regarding the intensification of landscape occupation during that period, eventually leading to this comment by Captain James Cook upon his discovery of southern New Caledonia: "…Smoke was seen at the first place all the day, we also saw smokes daily on several parts of the coast, a sure sign the whole was inhabited…" (cited in Sand, 1995). This once again forces us to reconsider the size of the Kanak population prior to European contact, and the effects of the introduction of disease to local populations in the eighty years between the first contact (1774) and the beginning of the French colonial administration (1853).

CONCLUSION

The study of horticultural intensification processes in Pacific island environments has proven a difficult task. The adequation between intensification and demographic growth, long believed solely relevant, has been threatened by other causes so that nowadays it is generally considered as the result of multiple factors. If demographic and social variables played an important role in the emergence of the intensification processes, then so did ecological variability and its interdependent technological developments (Kirch, 1995, p. 18). The aim of this paper was to bring attention to the peculiar horticultural systems documented on the ferralitic soils of New Caledonia, which can hopefully help us understand the global processes at stake during the last millennium. We believe they hold fundamental information which could help refine our understanding of the traditional Kanak adaptation mechanisms to their landscape. We hope that this article will inspire further research on the soils themselves, from an anthropic, archaeological and horticultural perspective. New Caledonia has the double privilege of having a unique geological environment in the Pacific and a rather long anthropogenic chronology spanning three millennia. Global population growth throughout this length of time seems to have eventually led its indigenous inhabitants towards more inhospitable sites, at least as far as horticultural practices were concerned. The traditional soil enhancement techniques uncovered may not have been very helpful in the past, however, future research could use the structures specific measurements to show how or if empiric solutions to local problems helped the natural growth processes of crops.

P. V. Kirch wrote that "…the contrast of wet and dry environments, crops and agricultural technologies holds a key to understanding the history of Polynesian agriculture…" (Kirch, 1995, p. 10). This statement can be further addressed by the geology of New Caledonia's unique and complex pedology. However, the lack of archaeological dates on these structures still remains a problem. It is partially due to the limited archaeological work undertaken in these environments, and also the general paucity of relevant datable archaeological material. Furthermore, the lack of available ethnographic information from most of the horticultural structures discovered in ferralitic environments is an issue, partially due to some of these unfertile areas being currently deserted (like the Ouinné region). In other populated areas like the Isle of Pines, traditional horticulture is still an important part of the Kanak socio-economical system, but the ferralitic zones are no longer used for cultivation. Once again, if favorable soils are available, the effort of cultivation does not need to be placed on ferralitic zones.

More broadly, the generalized collapse of the Kanak population throughout the 19th century (and in some areas, its relocation) led to an abandonment of these environments as fields.

However, a few of these ferralitic areas are currently used to produce crops, like in the Mouirange region (20 km south of Noumea), with the extensive use of fertilizers. Hopefully, with more intensive research, some effective traditional methods can be rediscovered, and maybe even reused?

Acknowledgements: We wish to thank the organizers of the Paris conference of January 2014, the Société Préhistorique Française, the Université Paris 1 and the Équipe Ethnologie Préhistorique of the CNRS (UMR 7041 ArScAn), and especially Frédérique Valentin and Guillaume Molle. We also thank our colleagues of the IANCP who have helped us both in the field and in the survey and inventory process of ferralitic zones over the past years, mainly Christophe Sand, Yves-Béalo Gony and Jean-Marie Wadrawane. Finally, we wish to express our gratitude to our colleague David Baret, who has taken much care in the infography of the figures.

BIBLIOGRAPHICAL REFERENCES

Allen B. (1971) – Wet-Field Taro Terraces in Mangaia, Cook Islands, *Journal of the Polynesian Society*, 80, 3, p. 371–78.

Barrau J. (1965) – 'L'humide et le sec': An Essay on Ethnobiological Adaptation to Contrastive Environments in the Indo-Pacific Area, *Journal of the Polynesian Society*, 74, 3, p. 329–46.

Chazine J.-M. (1985) – Les fosses de culture dans les Tuamotu. Travaux en cours et perspectives, *Journal de la Société des océanistes*, 41, 80, p. 25–32.

Cherrier J.-F. (1986) – La forêt de l'île des Pins, *Bois et Forêts des Tropiques*, 211, p. 35–46.

Hunt T. L., Lipo C. P., (2007) – Chronology, Deforestation, and 'Collapse': Evidence vs. Faith in Rapa Nui Prehistory, *Rapa Nui Journal*, 21, 2, p. 85–97.

Jaffré T., Morat P., Veillon J.-M., Rigault F., Dagostini G. (2001) – *Composition et caractérisation de la flore indigène de Nouvelle-Calédonie = Composition and Characterisation of the Native Flora of New Caledonia*, Nouméa, IRD (Documents scientifiques et techniques, II4), 121 p.

Jaffré T., Pillon Y., Thomine S., Merlot S. (2013) – The Metal Hyperaccumulators from New Caledonia Can Broaden Our Understanding of Nickel Accumulation in Plants, *Frontiers in Plant Science*, 4, 7 p., doi: 10.3389/fpls.2013.00279 [online].

Kirch P. V. (1977) – Valley Agricultural Systems in Prehistoric Hawaii: An Archaeological Consideration, *Asian Perspectives*, 20, p. 246–80.

Kirch P. V. (1978) – Indigenous Agriculture on 'Uvea (Western Polynesia), *Economic Botany*, 32, p. 157–81.

Kirch P. V. (1995) – *The Wet and the Dry: Irrigation and Agricultural Intensification in Polynesia*, Chicago, University of Chicago Press, 408 p.

Kirch P. V., Coil B. J., Hartshorn A. S., Jeraj M., Vitousek P. M., Chadwick O. A. (2005) – Intensive Dry-

land Farming on the Leeward Slopes of Haleakala, Maui, Hawaiian Islands: Archaeological, Archaeobotanical, and Geochemical Perspectives, *World Archaeology*, 37, 2, p. 240–58.

Ladefoged T. N., Stevenson C. M., Haoa S., Muyl-rooney M., Puleston C., Vitousek P. M., Chadwick O. A. (2010) – Soil Nutrient Analysis in Rapa Nui Gardening, *Archaeology in Oceania*, 45, 2, p. 80–85.

Lagarde L. (2012) – *Peuplement, dynamiques internes et relations externes dans un ensemble géographique cohérent de Mélanésie insulaire : l'exemple de l'île des Pins en Nouvelle-Calédonie*, doctoral thesis, université Paris 1 – Panthéon-Sorbonne, 2 vols.

Lagarde L., Ouétcho A.-J., Gony Y.-B. (2008) – *Prospection archéologique sur le massif minier de Ouinné, mai 2008*, travaux du département de l'Archéologie de la direction des Affaires culturelles et coutumières de Nouvelle-Calédonie pour le compte de la Province Sud et de la société Gladstone, Nouméa, 57 p.

L'huillier L., Jaffré T., Wulff A., Lebrun M., Maggia L., Barré N., Chazeau J., Jourdan H., Amir H., Ducousso M., Gatblé G., Fogliani B., Zongo C., Vea C. (2010) – *Mines et environnement en Nouvelle-Calédonie : les milieux sur substrats ultramafiques et leur restauration*, Païta, IAC, 412 p.

Mccoy P. C. (1976) – *Easter Island Settlement Patterns in the Late Prehistoric and Protohistoric Periods*, New York, Easter Island Committee, International Fund for Monuments (Easter Island Committee, International Fund for Monuments Bulletin, 5), 164 p.

Palmer M. A., Graves M. W., Ladefoged T. N., Chadwick O. A., Duarte T. K., Porder S., Vitousek P. M. (2009) – Sources of Nutrients to Windward Agricultural Systems in Pre-Contact Hawai'i, *Ecological Applications*, 19, 6, p. 1444–53.

Picard M. (1999) – *L'archipel néo-calédonien. 300 millions d'années pour assembler les pièces d'un puzzle géologique*, Nouméa, CDPNC, 102 p.

Sand C. (1995) – *« Le temps d'avant » : La Préhistoire de la Nouvelle-Calédonie. Contribution à l'étude des modalités d'adaptation et d'évolution des sociétés océaniennes dans un archipel du Sud de la Mélanésie*, Paris, L'Harmattan, 356 p.

Sand C. (2010) – *Lapita calédonien. Archéologie d'un premier peuplement insulaire océanien*, Paris, Société des océanistes (Travaux et documents océanistes, 2), 295 p.

Sand C. (2012) – 'Certainly the Most Technically Complex Pondfield Irrigation within Melanesia': Wet Taro Field Systems of New Caledonia, in M. Spriggs, D. Addison and P. J. Matthews (eds.), *Irrigated Taro* (Colocasia esculenta) *in the Indo-Pacific*, Osaka, National Museum of Ethnology (Senri Ethnological Studies, 78), p. 167–88.

Sand C., Bolé J., Ouétcho A.-J. (2012) – L'ensemble culturel traditionnel kanak, in J. Bonvallot, J.-C. Gay and É. Habert (eds.), *Atlas de la Nouvelle-Calédonie*, Marseille, IRD; Nouméa, Congrès de la Nouvelle-Calédonie, pl. 22.

Sand C., Bolé J., Ouétcho A.-J., Gony Y.-B., Baret D. (2012) – Occupations anciennes des plateaux miniers à Thio et à Tontouta : premières prospections et datations. *Journal de la Société des océanistes*, 134, p. 31–44.

Sand C., Lilley I., Valentin F., Bolé J., Gony Y.-B., Baret D. (2010) – Tiga (îles Loyauté). Préhistoire et ethnoarchéologie d'une île mélanésienne en marge, in F. Valentin and M. Hardy (eds.), *Hommes, milieux et traditions dans le Pacifique sud*, Paris, De Boccard (Travaux de la Maison Archéologie & Ethnologie, René-Ginouvès, 9), p. 33–46.

Sand C., Ouetcho A.-J. (1992) – *Bwede ko-tchon tchuvanvare kein (des rivières déviées par les ancêtres). Premier inventaire archéologique de la commune de Yaté, Province Sud de la Nouvelle-Calédonie*, Nouméa, département de l'Archéologie, direction des Affaires culturelles et coutumières (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 1), 102 p.

Spriggs M. (1981) – *Vegetable Kingdoms: Taro Irrigation and Pacific Prehistory*, doctoral thesis, The Australian National University, Canberra, 203 p.

Louis Lagarde
Université de Nouvelle-Calédonie,
BP R4
98851 Nouméa, Nouvelle-Calédonie
louis.lagarde@univ-nc.nc

André-John Ouétcho
Institut d'archéologie
de Nouvelle-Calédonie et du Pacifique
65, rue Teyssandier-de-Laubarède,
98800 Nouméa, Nouvelle-Calédonie
andre-john.ouetcho@iancp.nc

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 91-99
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

'Controlling the Elements'

Anthropogenic Landscape Transformation at Ava Ranga Uka A Toroke Hau, Rapa Nui (Easter Island)

Annette Kühlem

Abstract: The site of Ava Ranga Uka A Toroke Hau is located in the very center of Rapa Nui (Easter Island) on the eastern slope of the Terevaka volcano. Its location within the small valley of the Quebrada Vaipú (Vaipú Creek) as well as the presence of two massive gravity walls and an elaborately built water basin with petroglyphs initially motivated an archaeological investigation, which eventually provided unexpected new results. Indeed, excavations in the center of the site have shed further light on the dimension of anthropogenic landscape transformation in pre-contact times. It turned out that cultural deposits of more than 6 m form an artificial plateau in the original creek bed. Anthropogenic use surfaces were created by transporting some sediment from different sources including alluvial sediment and boulders washed down the river during catastrophic rain events. These were moved and spread out to form an even surface. The sediment was highly compacted over large areas. Elaborately laid pavements also spanned great parts of the small valley. Some outstanding features were discovered in these layers: parallel canals for channeling the water flow, circular planting pits for palm trees, hearths for the production of red pigment etc. These demonstrate the hitherto unknown dimension of 'domestication' of the natural elements on Rapa Nui.

Keywords: Easter Island, Rapa Nui, archaeology, landscape transformation, earthworks, pavements, planting pits, palm trees, water, fertility cult.

« Contrôler les éléments » : transformations anthropiques du paysage à Ava Ranga Uka A Toroke Hau, Rapa Nui (île de Pâques)

Résumé : Le site Ava Ranga Uka A Toroke Hau est localisé au centre de l'île de Rapa Nui, sur la pente orientale du volcan Terevaka. Sa position dans le petit vallon Quebrada Vaipú, ainsi que la présence de deux murs de soutènement et d'un bassin artificiel portant des pétroglyphes constituaient les raisons premières motivant un projet de fouilles archéologiques, qui a finalement produit des résultats inattendus. Ces fouilles conduites au centre du site ont révélé l'importance de la transformation anthropique du paysage durant l'époque pré-européenne. On observe notamment que des dépôts non naturels de plus de six mètres d'épaisseur ont formé un plateau artificiel au-dessus du lit de la Quebrada Vaipú. Ces dépôts, d'origine anthropique, sont constitués de différents types de sédiments : alluvions et roches transportées en aval lors de pluies catastrophiques furent déplacées et épandues dans le but de créer une surface plane. De plus, des sédiments furent compactés dans certains endroits et des pavages bien élaborés ont couvert d'importants secteurs du petit vallon. Parmi ces couches d'origine anthropique, plusieurs particularités furent mises en évidence : des canaux parallèles pour diriger le flux de l'eau, des fosses circulaires destinées à la plantation de palmiers, des foyers pour la production de pigments rouges etc., démontrant clairement une « domestication » des éléments naturels à Rapa Nui, phénomène jusqu'alors mal connu.

Mots-clés : île de Pâques, Rapa Nui, archéologie, transformation du paysage, pavages, fosses de plantation, palmiers, eau, culte de la fertilité.

Easter Island, or Rapa Nui, is the most isolated island in the world. It politically belongs to Chile although it lies over 3,000 km from the coast of South America and 1,800 km from Tahiti. Despite its remoteness, the island is famous worldwide, mainly for the prominent stone statues, the *moai*, often displayed on ceremonial platforms called *ahu*. The great majority of the *ahu* are found along the shoreline with the erected

moai looking inland. Apart from these so-called image *ahu*, there are many platforms without statues of various types and sizes (see Martinsson-Wallin, 1994). For decades, archaeological research on the island focused on these stone giants and their platforms and only in recent years have other aspects of pre-contact life on Rapa Nui been investigated.

The German Archaeological Institute in cooperation with the Museo Anthropológico Padre Sebastian Englert has been conducting excavations in the center of the island since 2007 (Vogt, 2009 and 2013; Vogt and Moser, 2010a and 2010b; Kersten et al., 2009; Fassbinder et al., 2009; Vogt and Kühlem, in press; Kühlem et al., 2015). The site is called Ava Ranga Uka A Toroke Hau and lies in a small widening of the Vaipú creek running from the crater lake (Rano Aroi) of the Terevaka volcano to the sea shore on the south coast of the island (fig. 1). The location of the site is of particular importance because of two reasons. First, its position almost exactly in the center of the roughly triangular island, which makes the associated Ahu Hanua Nua Mea (Rainbow Ahu) the most inland ceremonial platform on Rapa Nui. Second, the fact that it lies partly within, partly on the sides of one of the very few seasonal streams on the island. Even though a few ravines carry water to the shore in the event of heavy rains, the Vaipú creek is the only significant source of surface fresh water aside the three crater lakes of the volcanos Rano Aroi, Rano Raraku and Rano Kau.

THE PROBLEM OF FRESH WATER ON RAPA NUI

Fresh water has always been and still is a scarce resource on Rapa Nui. While rivers are usually frequent on most Polynesian high islands, they are here missing. The crater lakes are difficult to access and the sources of subterranean water in many caves were surely not known to everybody and in many cases involved exer-

Fig. 1 – The location of the site in the center of the island (map DAI).
Fig. 1 *– La localisation du site au centre de l'île (carte DAI).*

tive climbing. In pre-contact times, the only containers for transporting the water were small gourds, as pottery for larger vessels was unknown. Early European explorers such as Cook and La Perouse already mentioned that the water from the wells in the coastal areas was brackish and of poor quality. Water management thus must have always played an important role for the Rapanui people.

THE VAIPÚ CREEK

At Ava Ranga Uka A Toroke Hau (from here designated as ARUTH), archaeological investigation seem to indicate that water management may have been part of a larger fertility cult. This manifested itself in

the intensive transformation of the local environment along the Vaipú creek. The importance of this life vein becomes clearer once realizing that the entire course of the creek has been anthropogenically altered: dam structures, embankment enforcements, pavements, etc., line the creek bed. These features demonstrate the intensity of ‘landscape domestication’ on Rapa Nui that eventually affected all natural elements on the island.

While hydraulically active structures along the Vaipú creek are numerous, settlement structures are not. All forms of house architecture documented on Rapa Nui display stone foundations that were mapped as part of a survey and mapping project in the 1970s (see Cristino et al., 1981). The scarcity of settlement sites in this area is surprising bearing in mind that fresh water was a limited resource. One would expect a significantly higher settlement density in the vicinity of the very few accessible sources of surface water. The lack of archaeological evidence for dwelling areas indicates that water in the Vaipú creek probably did not serve profane purposes and was not accessible by everybody. Another indicator of this is the existence of the most inland Ahu Hanua Nua Mea located on the side of the creek, meaning that the area was under the control of Rapanui elites.

THE EXCAVATIONS AT AVA RANGA UKA A TOROKE HAU

As mentioned above, the site of Ava Ranga Uka A Toroke Hau (ARUTH) lies directly in and along the course of the Vaipú creek. As it is a seasonal river, there is no or very little water coming down the creek during most part of the year. However, during and after heavy rainfall, the small creek can instantly transform into a torrential stream. As the entire palm tree vegetation of Easter Island was cut down in pre-contact times, the surface was left with no means to hold back water. It runs unhindered from the sides of the creek into the ravines, sometimes with destructive force.

The toponym of the site stands in direct relation to such heavy flood events. Ava Ranga Uka A Toroke Hau means “creek in which the body of Uka, daughter of Toroke Hau, floated in the water” (Englert, 1948, p. 283). This name is connected to an undated oral tradition that relates how the hut of Uka was washed away from the side of the creek during heavy rains and how she drowned in the water.

One or more such flood events were also responsible for the destruction of a part of the installations at ARUTH, cutting through a thick succession of cultural layers and through two massive walls that initially spanned the creek bed.

These massive walls where among the visible surface structures at the beginning of the excavations (fig. 2). Others were the Ahu Hanua Nua Mea mentioned above with a fallen *moai* on the northeastern embankment and the uppermost slabs of a stone basin in the creek bed (fig. 3). The presence of an *ahu* at the site indicates the frequentation by elites and the strong religious component of the installation.

Initially the two massive walls were interpreted as dam structure and the widening of the creek above them as reservoirs to hold back and store fresh water. This interpretation had to be revised as excavations where conducted in the area. It appeared that the entire part above the walls consists of a series of three pavements and anthropic layers including only minor stratigraphic units of natural deposits in between (fig. 4). The stratigraphy is over six meters thick, making it quite unique on Rapa Nui. The red arrows on figure 5 show where an entire sediment island was anthropogenically formed.

Anthropogenic layers

Not only the thickness of the anthropogenic layers is exceptional for Easter Island. In fact the sediment island mentioned above is an undocumented kind of earthwork involving a great amount of human labor. Sediment was transported to the site from different locations and there spread out over large areas (fig. 6). These almost perfectly horizontal use-surfaces were compacted to different degrees. In the upper layers, the soil is less compacted and the layers seem to have had a primarily agricultural purpose: planting pits filled with garden soil were evenly spaced and interspersed with numerous fire pits. Some of these yielded a very fine powdery red substance interpreted as pigment, possibly for body (and/or image?) painting. Such pits for the production of pigment have been found in great numbers in the area around ARUTH (pers. comm. Hans-Rudolf Bork and Andreas Mieth).

A thick layer of rubble seems to mark a change of use of the central part of the site. It is clearly related to an extreme flood event that occurred in ARUTH. The material was carried down the stream bed by gushing waters and was then again spread out by people to form an almost horizontal surface.

Underneath this layer of rubble, the anthropogenic use-surfaces are noticeably different: the soil is so densely compacted that the surface is very hard and still shows imprints of pavement slabs that had been removed secondarily. This layer practically seals off the underlying pavement, which is the uppermost of three that could be documented in the embankment profile (see fig. 4).

This succession of anthropic surfaces is a phenomenon that was so far unknown on Rapa Nui. In the upper layers, this can be explained as bringing in favorable sediments for the cultivation of plants. Many evenly spaced planting pits have been found in those layers. They yielded numerous obsidian tools, namely *mata’a* (tanged pieces). Recent phytolite analysis of those tools has shown that they were largely used for cutting plant material, thus seem to have been used mainly for agricultural purposes (Atam, 2010). The many finds are hence a further indicator that agricultural activities took place in the upper layers at ARUTH.

The function of the lower densely compacted layers is more difficult to explain. The level of compaction of the

Fig. 2 – Massive stone walls photographed upstream (photo B. Vogt).
Fig. 2 *– Murs massifs de pierre photographiés en amont du cours d'eau (cliché B. Vogt).*

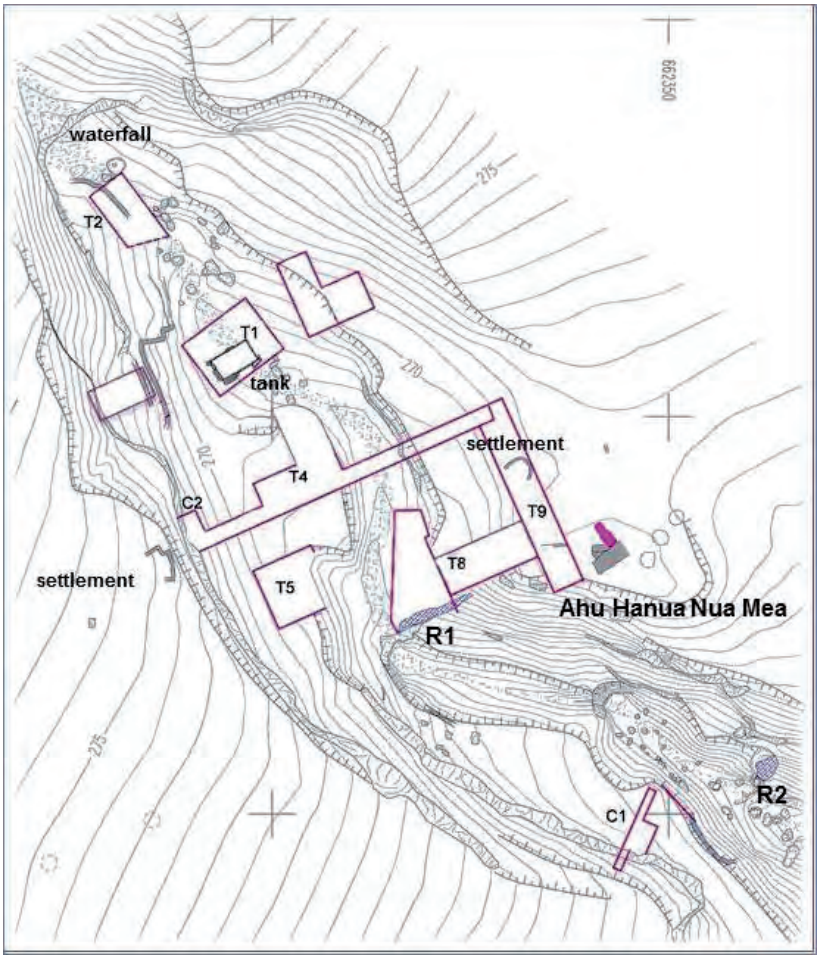


Fig. 3 – Map of the Ava Ranga Uka A Toroke Hau site. T: Trench; C: Cave; R: earthwork (map C. Hartl-Reiter).
Fig. 3 *– Carte du site d'Ava Ranga Uka A Toroke Hau. T : tranchée ; C : grotte ; R : ouvrage en terre (carte C. Hartl-Reiter).*

Fig. 4 – Succession of pavements and anthropogenic layers.
Fig. 4 *– Séquence de dallages et de couches anthropiques.*

sediment indicated that they were intensively used floors. The fact that they covered the pavement beneath points towards a possible ritual function through which layers of sediment were used to seal off prior structures and thus remove them from sight. This might be the manifestation of a certain kind of *tapu*, as proposed by N. Cauwe for some *ahu* (Cauwe, 2011).

A similar situation has been documented by N. Cauwe and his team from the excavation of Ahu Motu Toremo on the Poike peninsula. Here, a large ramp was built from sediment that was anthropogenically transported to the site for sealing off the underlying monument (Cauwe et al., 2006).

Pavements

The uppermost of the three pavements in the embankment profile was excavated over an extended area and displayed some outstanding features never documented before on Rapa Nui (fig. 7a). The pavement is elaborately laid and consists mainly of flat-lying stones. It is noteworthy that the vast majority of pavements on Rapa Nui occur in elite or ritual architecture contexts—namely in front of the *ahu* or the boat-shaped houses *(hare paenga)* of the chiefly families. This further contributes to the interpretation that the installations at ARUTH served a ritual purpose and were under the influence of the Rapa Nui elites.

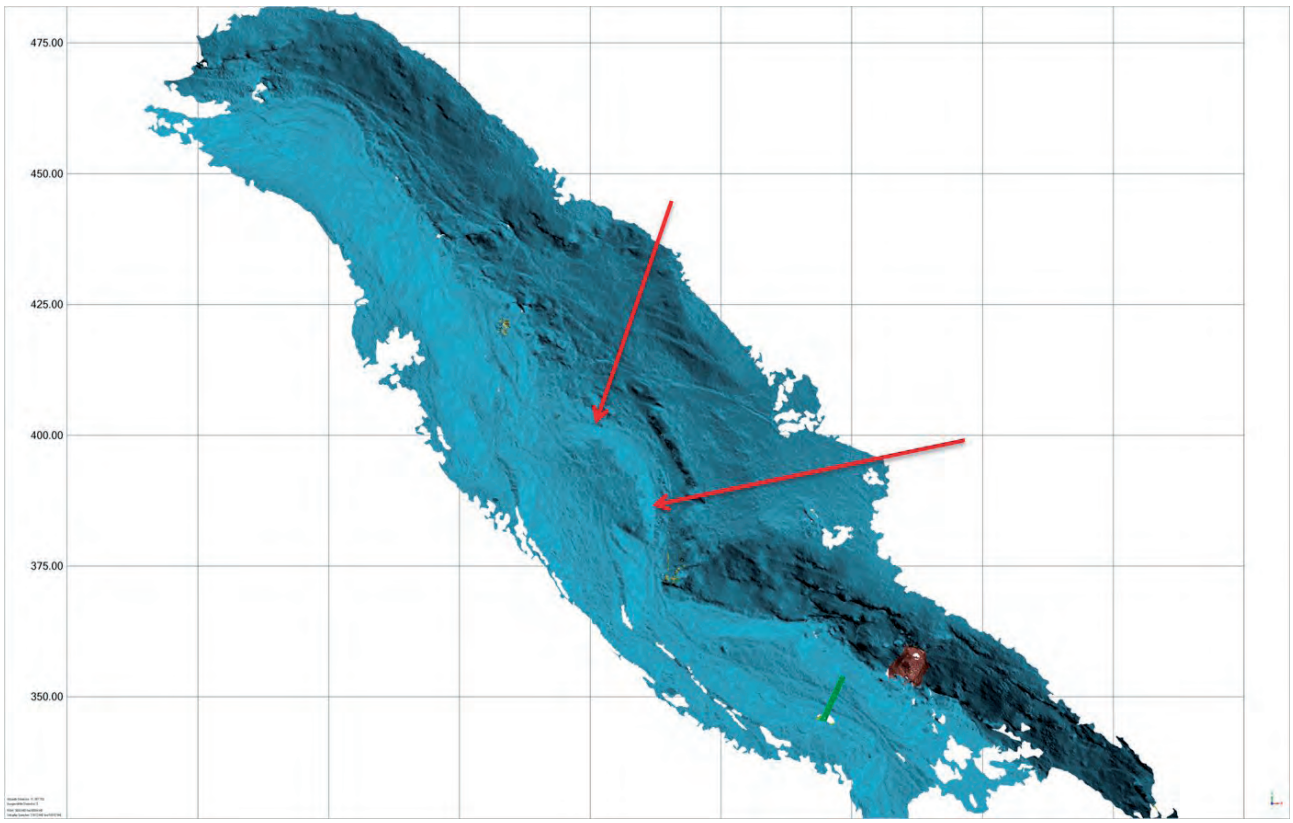


Fig. 5 – Man-made sediment island (scan HafenCity, University of Hamburg).
Fig. 5 *– Île artificielle constituée de sédiments (scan HafenCity, université de Hambourg).*

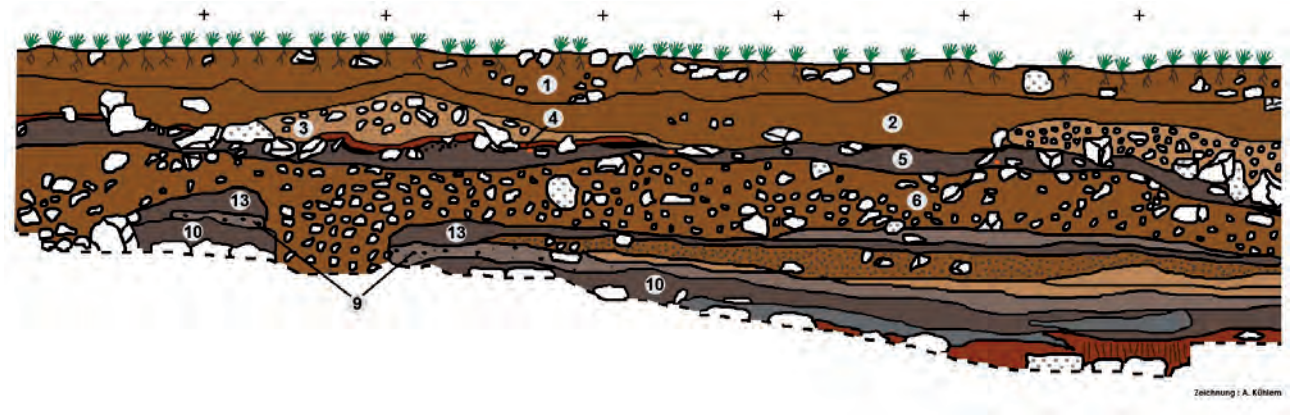


Fig. 6 – Profile of the central part of the site.
Fig. 6 *– Coupe de la partie centrale du site.*

Water canals

Amidst the pavement, two parallel canals were found. The grain texture analysis of the filling left no doubt that they were used for channeling water (Hans-Rudolph Bork, pers. comm., 2011). They are lined with big stone blocks and one of them is partially covered by stone slabs, probably to avoid evaporation. This canal seems to have run underground for some time. Stratigraphic evidence shows that after sealing off the pavement with the previously mentioned compacted layer, the course of the canal was excavated in several places, probably to repair damages or clear obstructions. Since the amount of water seems to have been quite small during most of the year, it is possible that the entire efflux of the Vaipú creek was channeled in those anthropic canals, thus controlling the flow of water.

Palm tree planting pits

Besides these canals, the pavement yielded planting pits of a distinctly different nature than the ones in the upper

layers. These circular pits are also evenly spaced and stone-rimmed (fig. 7b). The filling shows small channels that have been identified to be the imprints of the roots of the now extinct *Jubaea* sp. that initially covered most of the island (Bork and Mieth, 2003; Mieth and Bork, 2004). Thus the pits could be identified as planting pits for palm trees. In the plaza of the neighboring Ahu Hanua Nua Mea, another such planting pit was discovered. Here it was carved into the bedrock and filled with garden soil that showed the same root channels. The fact that the palm trees were intentionally planted indicates that they formed part of the landscape transformation of ARUTH and that they were an integral component of the ritual architecture of the site. Most importantly, it demonstrates that the ancient Rapanui did not only cut down palm trees but also planted them. This indicates that the trees must have had a certain spiritual value and must have been cherished for them to be used in such a meticulously planned and structured ritual complex as ARUTH.

Nicolas Cauwe found further evidence for the planting of palm trees as a part of ritual architecture in Ahu te Niu. At this site, the planting pit displaying its diagnostic root channels was surrounded by a stone pavement as well (Cauwe, 2011).

The stone basin

Another indicator for the importance of palm trees was found inside a stone basin upstream of the paved areas in the center of the site (fig. 8a). The megalithic basin measures approximately 5 m by 2.75 m and has a maximum depth of 1.5 m. It is built with big well-fitted *paenga*-slabs and has a small annex in the eastern corner that conducted the water into the basin through a small triangular opening. The basin is founded on the bedrock of the riverbed that shows three petroglyphs: a double-hull canoe, a sea horse, and a footprint (fig. 8b).

A depression in the rock was covered with pavement. Under it, a sealed-off cache was discovered (fig. 8c). It contained offerings including three wooden awls and a great number of plant remains such as twigs, leaves and seeds of calabash. The lithic inventory includes many beach pebbles *(poro)* as well as basalt and obsidian tools. Among the tools were various miniaturized basalt and obsidian *toki* of 3 to 4 cm in length, which are too small and delicate for having been used as percussion tools.

The most outstanding finds however were over 220 uncharred nutshells of the now-extinct *Jubaea* sp. palm tree (fig. 8d). Their deposition in the cache as part of the offerings shows once again the value of the palm trees for the ancient Rapanui. Moreover, they could be directly ^{14}C-dated. The dates indicate that the basin was constructed between the late 15th and the early 17th century, at a time when the deforestation of the island had already reached its maximum extent (Mieth and Bork, 2004 and 2010) and when certainly the effects on erosion and soil depletion were already evident to the Rapanui.

Assuming that the nuts from the cache grew on the same palm trees planted on the site, ARUTH site would have been one of the last locations where palm trees kept growing as the rest of the island was already severely deforested. In that case, ARUTH could be interpreted as a sanctuary dedicated not only to water but also to palm trees, where the last of their kind survived.

‘CONTROLLING THE ELEMENTS’

The Rapanui transformed their island to a vast degree. The most impacting transformation was certainly the complete deforestation and all its subsequent effects on erosion and soil depletion. However, excavations in Ava Ranga Uka showed that other factors were part of this transformation and the control of the different natural elements:

Fig. 7 – a: the pavement with canals and planting pits; b: detailed view of a palm tree planting pit with small root holes.
***Fig. 7** – a : le dallage avec des canaux et des fosses de plantation ; b : vue détaillée d’une fosse de plantation d’un palmier avec des traces de racines.*

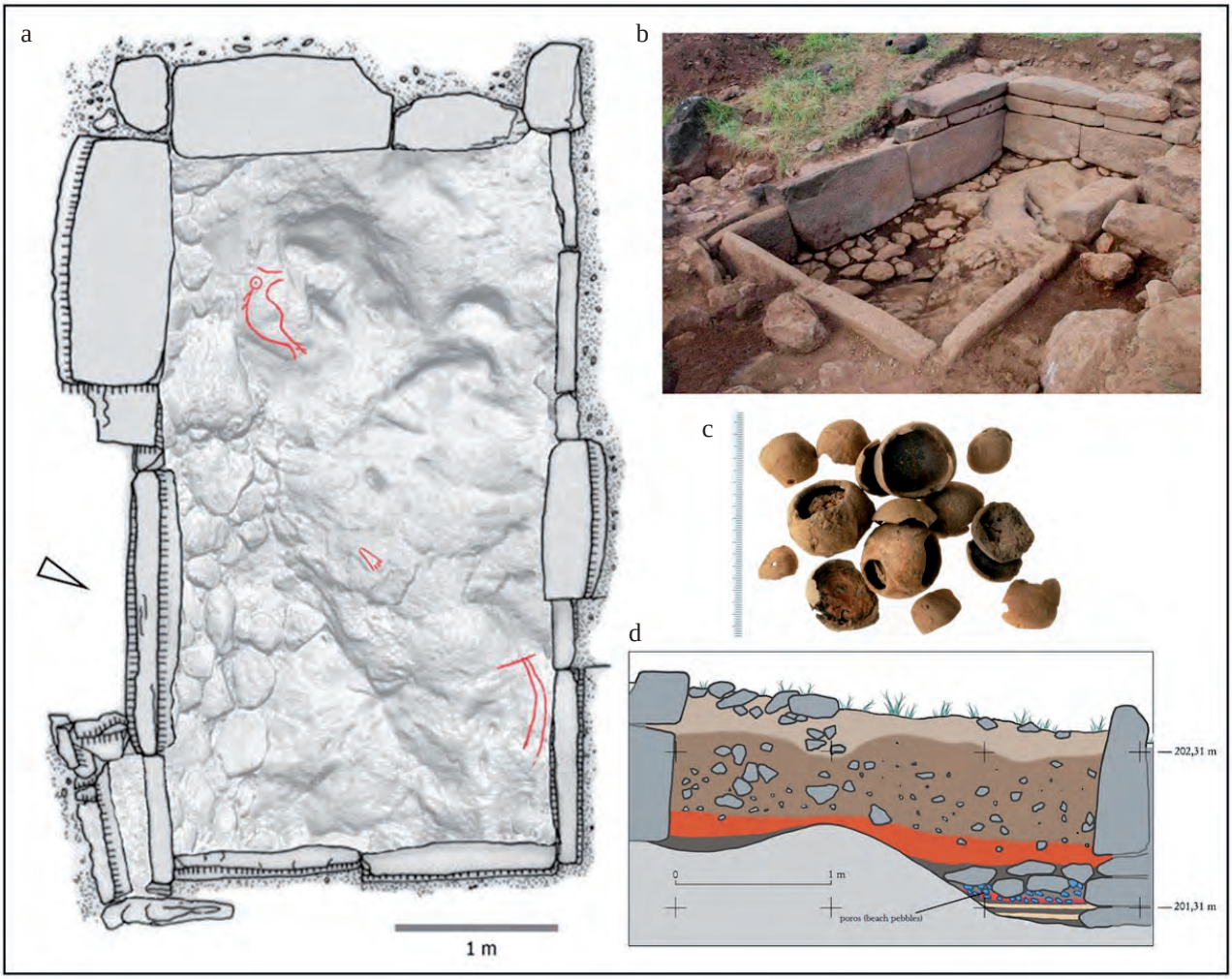


Fig. 8 – a: the megalithic basin; b: the petroglyphs at the base of the stone basin (scan HafenCity, University of Hamburg, drawing B. and M. Vogt); c: nutshells of *Jubaea* sp. found inside the cache; d: cross-section of the cache.
***Fig. 8** – a : bassin mégalithique ; b : pétroglyphes à la base du bassin en pierre (scan HafenCity, université de Hambourg ; dessin B. et M. Vogt) ; c : coquilles de noix de* Jubaea *sp. retrouvées dans la cache ; d : coupe de la cache.*

– hydraulically active structures were built to retain and conduct the flow of water;

– extensive pavements were laid out, covering large areas; massive earthworks and new use-surfaces were created, for which large amounts of sediment had been moved, spread out and compacted;

– palm trees were planted as part of the ritual architecture;

– in the upper layers, garden crops were cultivated;

– numerous fire pits were arranged; some of them possibly for the production of pigment, undoubtedly affecting the fourth element—the air—in the valley of Ava Ranga Uka A Toroke Hau.

All the natural elements were controlled by the Rapanui in pre-contact times to a wide extent. While many aspects of this can certainly be considered active counter-measures against the effects of erosion and soil depletion due to the prior deforestation, there seems to also have been a ritual component that manifested itself in the creation of a new kind of water cult that was practiced at the site of Ava Ranga Uka A Toroke Hau.

A WATER CULT AT THE VAIPÚ CREEK?

Water was the dominating element at ARUTH. The location of the site in the center of the island and at one of the few seasonal streams highlights the importance of the site. The fact that water was a scarce and therefore certainly valuable resource makes it plausible that it was controlled by the elites and only accessible to certain people. Bearing in mind that in Polynesian societies limited resources were often placed under *tapu*, this might explain the absence of denser settlements along the course of the Vaipú creek. The water seems to have been reserved for special purposes. The existence of the Ahu Hanua Nua Mea as integral part of the hydraulically active structures in the creek bed is a further indicator that the site had a strong ritual component. Possibly, the installations constituted the architectonical framework to worship Hiro, the Polynesian god of fertility. Ethnographic accounts relate how, in times of drought, the high priest went to the hills (the Terevaka volcano is the high-

est elevation on the island) to conduct fertility rituals and pray for rain (Metraux, 1940, p. 330).

The water basin with its unique cache and the marine-related petroglyphs point towards the same interpretation that water was of utmost importance. The fact that palm tree nuts had been placed in the cache and that palm trees had been planted as part of the architectonical ensemble highlights the significance of the *Jubaea* even—or especially—at a time when the effects of the deforestation must have been clear to the ancient inhabitants of Rapa Nui. In that sense the domesticated landscape of ARUTH can be understood as a sanctuary—for water and for trees—and as the setting for a unique kind of water cult.

Acknowledgements: The field work at Ava Ranga Uka A Toroke Hau is a joint project under the direction of the German Archaeological Institute cooperating with the Consejo de Monumentos Nacionales Santiago and Hanga Roa, the Museo Anthropológico Padre Sebastian Englert, Hanga Roa, and its director Francisco Torres Hochstetter, the Consejo National Forestal, Hanga Roa, the Mata Ki Te Rangi Foundation, Hanga Roa, the HafenCity Universität Hamburg, the Christian-Albrecht-Universität Kiel, the Bayrisches Landesamt für Denkmalpflege Munich, and the Fachhochschule Potsdam (all Germany). The people involved have all greatly contributed to the insight and interpretation of the site. My warmest thanks go to the many Rapanui professionals, students, and fieldworkers, who have worked with us over the years, especially to local archaeologist Sonia Haoa Cardinali, who is always willing to help and advice in matters on the island and to our foreman, the late Sorobabel Fati Teao for sharing his wisdom and his life-long experiences on Rapa Nui.

BIBLIOGRAPHICAL REFERENCES

Atam M. (2010) – *Desde el mito a la evidencia arqueológica: analisis de microrestos vegetales adheridos en artefactos de obsidiana*, licence thesis, Universidad SEK, Santiago de Chile, 186 p.

Bork H.-R., Mieth A. (2003) – The Role of *Jubaea* Palm Trees in the History of Rapa Nui: A Provocative Interpretation, *Rapa Nui Journal*, 17, 2, p. 119–22.

Cauwe N. (2011) – *Easter Island: The Great Taboo*, Brussels, Versant Sud (New Archaeological Discoveries), 160 p.

Cauwe N., Huyge D., De Meulemeester J., De Dapper M., Coupé D., Claes , W., De Poorter A. (2006) – New Data from Poike (Rapa Nui - Easter Island): Dynamic Architecture of a Series of Ahu, *Rapa Nui Journal*, 20, p. 31–36.

Cristino C., Vargas P., Izaurieta R. (1981) – *Atlas Arqueológico de Isla de Pascua*, Santiago, Corporación Toesca, 21 p.

Englert S. (1948) – *La Tierra de Hotu Matu´a. Historia, etnología y lengua de la isla de Pascua*, San Francisco, Padre Las Casas, 361 p.

Fassbinder J. W. E., Bondar K., Vogt B., Moser J. (2009) – Magnetometerprospektion und magnetische Eigenschaften von Basalt-Böden am Beispiel der Osterinsel (Isla de Pasqua) Chile, *Metalla*, 2, p. 1–44.

Kersten T., Lindstaedt M., Vogt B. (2009) – Preserve the Past for the Future: Terrestrial Laser Scanning for the Documentation and Deformation Analysis of Easter Island’s Moai, *Photogrammetrie Fernerkundung Geoinformation*, 1, p. 79–90.

Kühlem A., Hartl-Reiter C., Vogt B. (2015) – Landschaftsüberformung und Wasserkult auf der Osterinsel, in H.-J. Przybilla, T. P. Kersten and F. Boochs (eds.), *Denkmäler 3.de. Von Low-Cost bis High-Tech: 3D-Dokumentation in Archäologie und Denkmalpflege*, proceedings of the conference (Dortmund, 16–18 October, 2013), Hamburg, Labor für Photogrammetrie und Laserscanning, p. 53–59.

Martinsson-Wallin H. (1994) – *Ahu: The Ceremonial Stone Structures of Easter Island*, Uppsala, Societas Archaeologica Upsaliensis (Archaeologica Upsaliensis AUN, 19), 188 p.

Metraux A. (1940) – *Ethnology of Easter Island*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 160), 432 p.

Mieth A., Bork H.-R. (2004) – *Easter Island - Rapa Nui: Scientific Pathways to Secrets of the Past*, Kiel, University of Kiel (Man and Environment, 1), 109 p.

Mieth A., Bork H.-R. (2010) – Humans, Climate, or Introduced Rats - Which Is to Blame for the Woodland Destruction on Prehistoric Rapa Nui (Easter Island)?, *Journal of Archaeologial Science*, 37, 2, p. 417–26.

Vogt B. (2009) – Osterinsel: Wasserbau unterm Regenbogen, *Archäologie in Deutschland*, 4, p. 12–16.

Vogt B. (2013) – Archäologische Forschungen zur voreuropäischen Wassernutzung in Ava Ranga Uka A Toroke Hau, Osterinsel (Rapa Nui/Isla de Pascua, Chile) 2007–2009, *Zeitschrift für Archäologie Außereuropäischer Kulturen*, 5, p. 7–45.

Vogt B., Kühlem A., (in press) – By the Creek of Ava Ranga Uka A Toroke Hau – about Landscape Transformation and the Significance of Water and Trees, in S. Haoa Cardinali, D. W. Ingersoll, K. Butler Ingersoll and C. M. Stevenson (eds.), *Beyond the Moai. New Archaeological, Cultural, and Historical Perspectives on Rapa Nui*.

Vogt B., Moser J. (2010a) – Ancient Rapanui Water Management: German Archaeological Investigations in Ava Ranga Uka A Toroke Hau, *Rapa Nui Journal*, 24, 2, p. 18–26.

Vogt B., Moser J. (2010b) – Feldforschungen 2007 und 2008 auf der Insel Rapa Nui (Osterinsel/Isla de Pascua), Chile, *Zeitschrift für Archäologie Außereuropäischer Kulturen*, 3, p. 244–52.

Annette Kühlem
Kommission für Archäologie
Außereuropäischer Kulturen
des Deutschen Archäologischen Instituts
Dürenstr. 35-37, D-53173 Bonn (Germany)
annette@kuehlem.de

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 101-110
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Rapa Nui (île de Pâques)

Nouvelles données sur la gestion de l'espace

Nicolas Cauwe et Morgan De Dapper

Résumé: À Rapa Nui, l'occupation du territoire semble assez simple, avec des segments établis depuis les côtes vers les pentes des volcans. Sur ces langues de terres, différentes activités se retrouvent étagées : architecture cultuelle dans le bas, maisons aux belles fondations un peu plus en hauteur, activités agricoles encore plus loin sur les pentes. Cependant, des éléments nouveaux, apparus lors de fouilles récentes, permettent d'affirmer que l'usage des plates-formes à statues *(ahu-moai)* fut discontinu, l'occupation des maisons proches de ces monuments aussi, tandis que des activités agricoles étaient maintenues plus en amont, malgré la désertion temporaire des aires basses. À la division de l'espace, il est donc nécessaire d'ajouter une dimension diachronique et dynamique.

Mots-clés : Rapa Nui, île de Pâques, gestion du territoire.

Rapa Nui (Easter Island): New Data on Land-Use Patterns

Abstract: On Rapa Nui, land use seems to be relatively simple. Starting from the sea to higher up along the slopes of the volcanoes, a regular organization of the different activities is observed: along the coast the cult platforms; a little higher the houses with nice stone foundations; agriculture further on the slopes. Nevertheless, thanks to new data from recent excavations, we know that the use of the image-platforms *(ahu-moai)* was discontinuous, as was the case for the occupation of the houses built in their vicinity. However, the maintenance of the fields continued higher on the slopes despite the desertion of low areas. As a consequence, on Rapa Nui, the structure of the landscape use has not only a spatial, but also a dynamic and a diachronic dimension.

Keywords: Rapa Nui, Easter Island, land use.

TERRITOIRES ET HIÉRARCHIE SOCIALE

William Thomson fut assurément le premier à avoir tenté une description scientifique de l'île de Pâques (Rapa Nui). Concernant l'habitat ancien, il repéra, en décembre 1886, les traces d'un village aux abords d'un monument cultuel abandonné (Ahu Akapu, sur la côte occidentale, légèrement au sud d'Ahu te Peu), association dont il ne tira aucun profit, se contentant de décrire la forme et les moyens des vestiges subsistants (Thomson, 1891, p. 486-487). Quelques années plus tard, l'anthropologue britannique Katherine Routledge ne donnera guère plus de commentaires sur la nature de l'occupation de l'espace, se référant également à la seule description de l'apparence et de l'usage des maisons et des monuments encore visibles (Routledge, 1919, p. 215-216). Alfred Métraux n'eut pas plus d'intérêt pour une approche dynamique de l'occupation du territoire (Métraux, 1940), l'expédition norvégienne de 1955 (Heyerdahl et Ferdon, 1961) non plus. Longtemps donc, ethnologues et archéologues travaillant sur l'île de Pâques ne furent en rien intéressés par ce type de considérations, préoccupés qu'ils étaient par la description des productions humaines, chacune envisagée individuellement et de façon statique. On ne fera pas le procès de cet état des choses, alors que ces explorations ont formé la phase pionnière et indispensable des études scientifiques de Rapa Nui.

Les premiers véritables commentaires sur la structure de l'occupation de l'espace ont été établis à la fin du xxe siècle (Bahn et Flenley, 1992 et 2011, p. 152-153 ; Flenley et Bahn, 2002). Les installations furent alors classées en deux ensembles : d'une part, des petites structures (habitats, jardins horticoles, grottes) qui apparaissent sur les pentes des volcans et semblent

former les unités de base de la production alimentaire ; d'autre part, des sites aux maisons plus sophistiquées et installées assez près des monuments cultuels. Il y aurait donc eu un étagement des activités : les habitats riches et les grands monuments occupaient les zones basses, sur les bords des falaises côtières ou sur les rivages ; la production alimentaire était établie plus haut sur les pentes des volcans, là où le sol se prêtait mieux à l'agriculture. Des considérations d'ordre hiérarchique ont aussitôt été tirées de ce constat, pourtant établi essentiellement sur la base de vestiges de surface rarement fouillés. Mais ces réflexions sur la stratification sociale seraient justifiées par la qualité et le prix prêtés aux maisons *(hare)* les plus proches des autels cultuels, dont les fondations sont faites de blocs *(paenga)* de basalte finement bouchardés (d'où le nom, pour ces habitations, de *hare paenga*). Les notables, prêtres et personnages de haut rang auraient donc occupé les hare paenga, construites à une distance de 50 à 100 m des grands autels à statues, la « plèbe » devant se contenter des étages supérieurs (entre 100 et 200 m plus à l'intérieur des terres), afin d'être à proximité immédiate des installations agricoles (Bahn et Flenley, 2011, p. 153). Quoi qu'il en soit, il parait assuré que les activités étaient dispersées dans un certain ordre : les côtes, souvent dénudées et infertiles, étaient consacrées aux nécessités religieuses ou au prestige ; quant aux pentes plus loin devant les monuments, elles étaient mises à profit pour l'agriculture. Il ressort de tout cela que chaque groupe (clan, tribu, famille élargie, famille nucléaire… ?) possédait une bande territoriale perpendiculaire aux côtes et aux courbes de niveau, afin d'avoir accès à différents microenvironnements : côtes semi désertiques, pentes des volcans, grottes, bassins fertiles entre les coulées de basalte, etc. (fig. 1).

Les nombreuses prospections menées à travers l'île n'ont jamais pu démentir les grandes lignes de cette hypothèse sur la manière d'occuper l'espace. S'il existe quelques monuments bâtis à l'intérieur des terres, on retrouve face à eux les mêmes vestiges dans le même

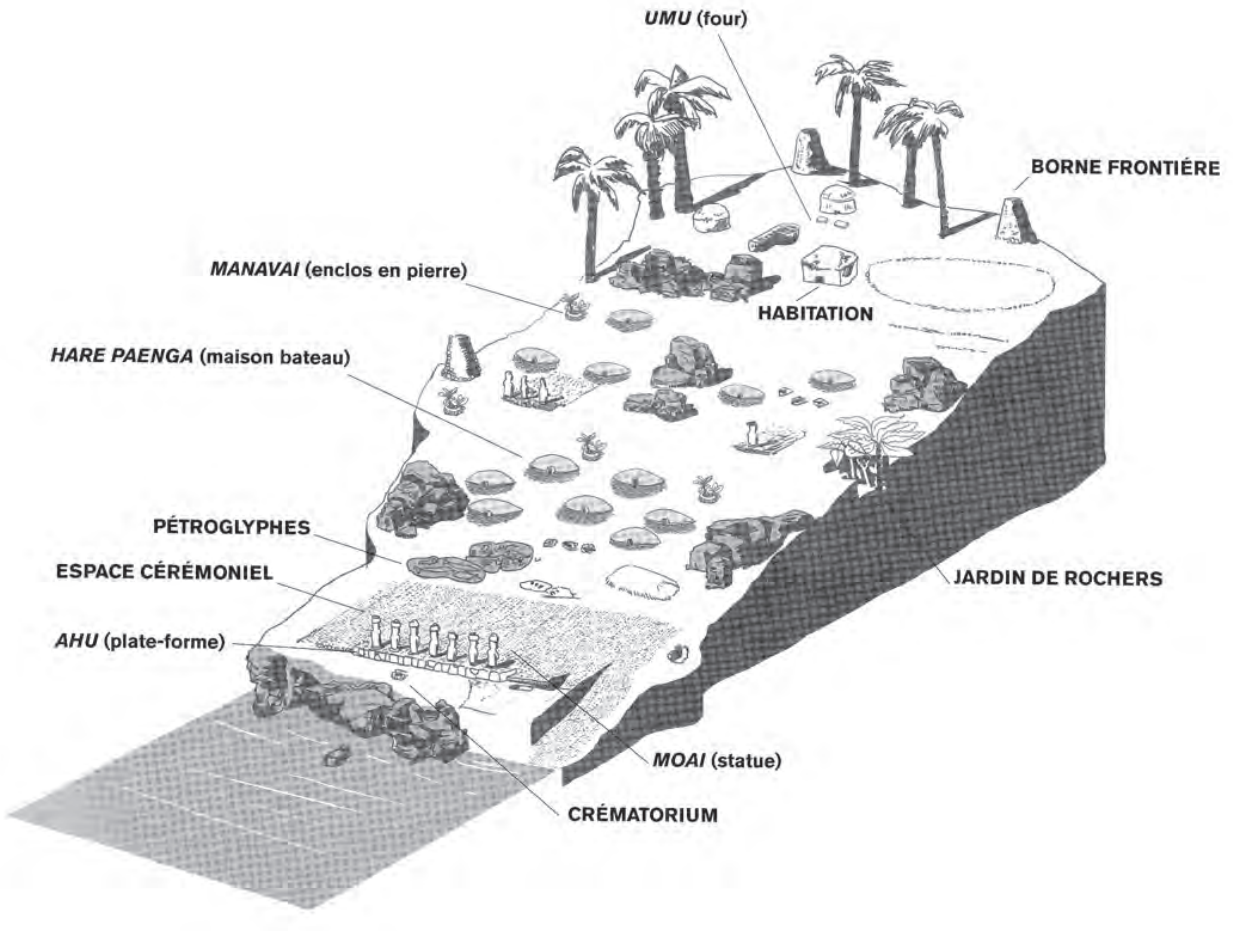


Fig. 1 – Schéma traditionnel de l'organisation de l'espace à Rapa Nui. Sur le rivage le monument cultuel *(ahu)* dont les statues ont le regard porté vers les maisons « riches » (*hare paenga)* ; plus haut sur les pentes, les jardins horticoles (dont certains avec agencements en pierre, les *manavai*) et les habitations de second rang (d'après Pelletier, 2012, p. 87)..

***Fig. 1** – Traditional pattern of spatial organization on Rapa Nui. On the shore, the ceremonial stone structure* (ahu) *with the statues looking towards the 'wealthy' houses* (hare paenga)*; upslope, the gardens (some of which enclosed by stone walls, the* manavai*) and the second-class houses (after Pelletier, 2012, p. 87).*

ordre. Ceci dit, peu (ou pas) de fouilles ont été menées sous la forme d'un transept permettant d'estimer les relations chronologiques entre les secteurs d'un territoire ainsi reconstitué. La question peut paraître dérisoire, puisqu'il est question de la répartition spatiale de vestiges. Pourtant, dès les travaux de Katherine Routledge, des indices sont apparus tendant à démontrer que les autels à statues avaient connu des réfections et/ou des reconstructions régulières (Routledge, 1919, p. 171-172), situation largement confirmée par les fouilles de l'expédition norvégienne, ce qui permit d'ailleurs à cette équipe de proposer une structure ternaire à l'histoire de l'île de Pâques (phases ancienne, moyenne et récente ; Ferdon, 1961, p. 527-533). Pareilles réfections ou reconstructions de l'habitat de « prestige » semblent également avoir été à l'œuvre (Mulloy, 1961, p. 135). Par ailleurs, il y aurait aussi des liens temporels entre *hare paenga* et *ahu-moai*, des blocs de fondation des premières ayant parfois été mis à profit pour édifier les seconds (Métraux, 1940, p. 285-291 et fig. 52A). Paradoxalement, aucune hypothèse ne fut tirée de ces faits. Au contraire, on insiste plus volontiers sur l'absence de solution de continuité dans l'occupation de chaque territoire, dont l'organisation est en bonne adéquation avec la morphologie de l'île et les potentialités d'exploitation des sols. Les aléas du temps qui auraient parfois entraîné des reconstructions ou des restaurations de monuments ou des demeures de l'élite, semblent plutôt relever de l'anecdote.

CÉRÉMONIES DE FERMETURE ET ALTERNANCE DES ACTIVITÉS

Hélas !, les travaux de terrain et la collecte de nouvelles données ne riment pas toujours avec les hypothèses préétablies. Des contradictions, non tant dans l'organisation de l'appropriation du paysage, mais dans la contemporanéité de fonctionnement des différents pôles de cette occupation, sont apparues sur deux sites fouillés au début du xxi[e] siècle par la mission archéologique belge [(1)]. Ces travaux de terrain, menés à Ahu Motu Toremo Hiva, sur le flanc septentrional de Poike (Cauwe *et al.*, 2006 et 2010), et à Ahu te Niu (Cauwe, 2011), sur la côte occidentale, avaient pour but premier de reconnaître des séquences stratigraphiques, afin d'affiner nos connaissances sur l'inscription dans le temps des différentes phases de construction des *ahu* ; il était également question de reconnaître les modalités de la fin de l'usage des monuments les plus récents, réputés détruits lors de guerres tribales (Cauwe, 2009).

Les histoires ne sont pas partout les mêmes. Sur Poike, trois plates-formes cultuelles ont été reconnues, les deux premières construites l'une à côté de l'autre, la troisième usant des vestiges des deux précédentes comme fondations (fig. 2). Une série de datations par le radiocarbone ont permis de cerner le délai temporel dans lequel prirent place toutes ces constructions. Le monument le plus ancien fut érigé au plus tôt à la fin

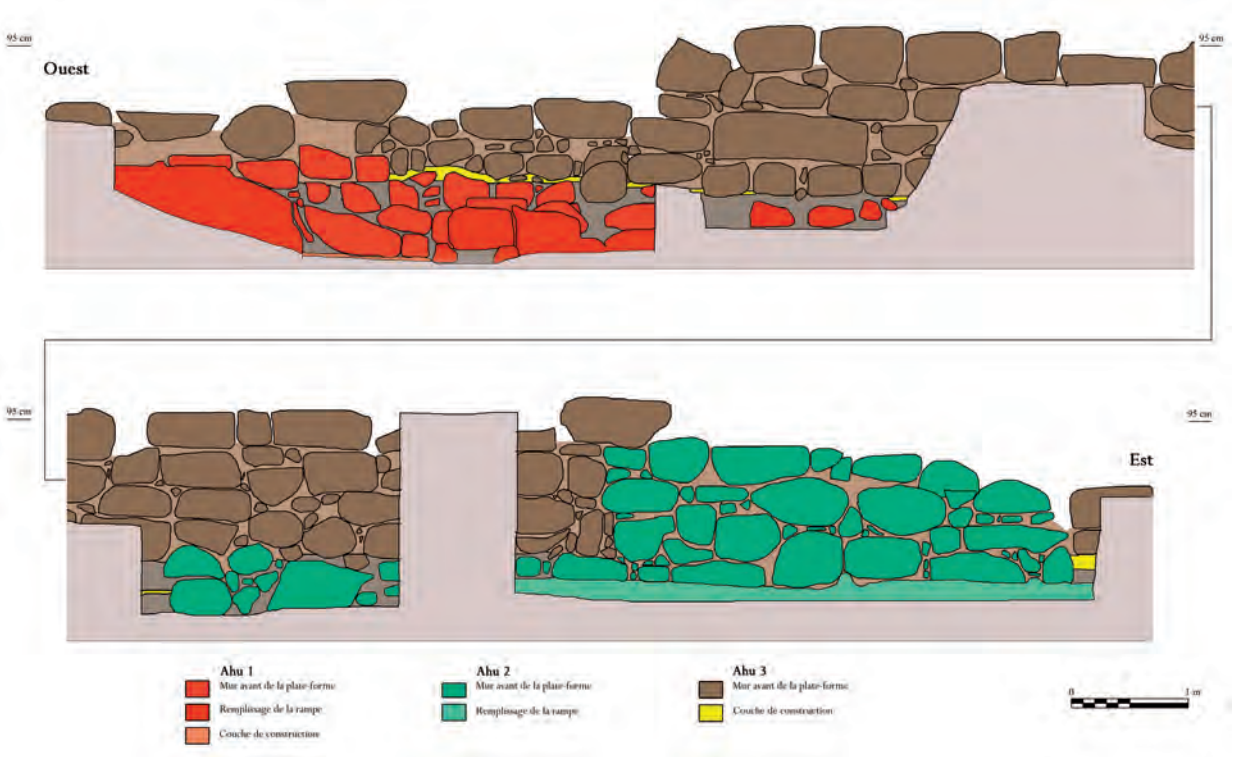


Fig. 2 – Mur côté terre de l'Ahu Motu Toremo Hiva (Poike). Trois plates-formes sont superposées entre lesquelles des épisodes stratigraphiques ont été repérés qui montrent la discontinuité d'occupation du site (d'après Cauwe *et al.*, 2006).
***Fig. 2** – Landward stone wall of the Ahu Motu Toremo Hiva (Poike). Three platforms were superimposed between which stratigraphic deposits were recorded showing the discontinuous occupation of the site (after Cauwe et al., 2006).*

du XIIIe siècle, le plus récent fut abandonné au plus tard au milieu du XVIIe siècle, soit une séquence d'un maximum de 350 ans (Cauwe *et al.*, 2006, p. 35). À Ahu te Niu, la situation était quelque peu différente. Là, quatre autels ont été mis au jour sous la forme de deux paires de monuments superposés. Il s'agit en réalité de quatre édifices construits à autant de moments différents, le plus ancien (le *ahu* inférieur sud) à la fin du XIVe siècle au plus tard, le plus récent (l'*ahu* supérieur le plus septentrional) dans le courant du XVe siècle au plus tôt, tandis qu'on est sûr qu'on clôtura l'usage de ce site religieux dans le courant des XVIIe ou XVIIIe siècles. Ici, la séquence prend donc place à l'intérieur d'un espace-temps de plus ou moins deux à trois siècles.

Par ailleurs, les stratigraphies de ces deux sites ont livré une série de données jusque-là inédites. Le point le plus particulier est certainement la mise en évidence de procédés de fermeture des *ahu*, avec le prélèvement de galets *(poro)* des terrasses cérémonielles *(tahua)*, le saupoudrage de poussières de scorie rouge *(hani hani)* sur les mêmes *tahua* et l'enlèvement ou le basculement des *moai* (fig. 3), le tout selon une ordonnance bien définie et un étalement dans le temps de l'ordre du demi-siècle, voire plus encore (Cauwe, 2012). La reconnaissance de ces « cérémonies » est essentielle, car elle assure le caractère prémédité et organisé de la fin de l'usage des monuments religieux, y compris pour les plus récents d'entre eux, pourtant réputés avoir été saccagés lors de rivalités consécutives à la dégradation de l'environnement (Diamond, 2005 ; Bahn et Flenley, 1992 et 2011). Tout aussi intéressant est la présence de phases sédimentaires naturelles entre la fermeture des monuments et leur reconstruction. Ce dernier point écorne définitivement l'impression de continuité de fonctionnement des sites cultuels. La permanence des lieux « consacrés » est plutôt affaire de va-et-vient, stigmatisés par des stratigraphies où les niveaux anthropiques alternent avec les épisodes naturels.

On se rappellera que les « villages » connurent aussi des phases de reconstruction (Mulloy, 1961, p. 135). Était-ce selon la même cadence que les *ahu* ? Le seul fait archéologique à verser au dossier est le recyclage occasionnel de fondations de maison (les fameux *paenga* des habitats attribués à l'élite) dans le remplissage de quelques plates-formes à statues. Le cas le plus flagrant est certainement celui de l'Ahu te Peu, dont un effondrement partiel a révélé la chose (Métraux, 1940, p. 286 ; ici : fig. 4). Mais on peut observer le même phénomène à Ahu Maitiki te Moa, à Ahu o Toki ou à Ahu Papa Tekena pour ne citer que quelques exemples parmi les plus remarquables. Des entrées de grottes ont aussi été aménagées avec les *paenga* de « belles demeures », ainsi à Vai Mata au nord de l'île.

Tout ceci malmène quelque peu le modèle de l'occupation du paysage : il y a manifestement discontinuité d'usage, tant des plates-formes à statues que des maisons « aristocratiques ». Ce fait, désormais dûment certifié, ne peut aller de pair qu'avec la gestion, pour chaque groupe, de territoires plus larges que prévu et permettant des rotations. Il serait donc extrêmement intéressant, dans les prochaines années, de tester les éventuelles corrélations entre sites plus ou moins voisins (remontage d'objets lithiques et d'éléments architectoniques, chronologie, génétique des restes humains, etc.), bien que ce type de données soient extrêmement compliquées à mettre en évidence.

Mais, peut-on généraliser le propos à tous les secteurs de Rapa Nui ? Il serait péremptoire de le faire. Néanmoins, des indices assez forts vont en ce sens. Toutes les fouilles conduites jusqu'ici, dans et autour de plates-formes à statues, ont systématiquement révélé des séquences de reconstruction. Lors des travaux menés par Carlyle Smith à Ahu te Peu, Ahu Nau Nau, Ahu te Piko Kura ou Ahu Heki'i, il ne fut guère question de traces de cérémonies de fermeture des plates-formes à statues ; néanmoins, il fut clairement fait écho à des « intervalles de destruction ou d'abandon » (Smith, 1961, p. 215). Dans les années 1960 et 1970, William Mulloy fut aussi amené à reconnaître des superpositions d'*ahu*, notamment lors de ses travaux sur la côte ouest (secteur de Tahai) et à l'intérieur des terres (Ahu Akivi et Ahu Huri a Urenga ; Mulloy, 1961, 1968, 1970 et 1973). La même situation a été repérée lors d'explorations plus récentes (entre 1986 et 1988) à Ahu Nau Nau ou celles conduites quelques années plus tard (1996-1997) dans la baie de La Pérouse par Helene Martinsson-Wallin et Paul Wallin (Martinsson-Wallin et Wallin, 2000).

RUISSELLEMENTS DIFFUS ET AGRICULTURE

Si les témoignages matériels de « cérémonies de fermeture » des *ahu-moai* (prélèvement de galets des *tahua* et épandage de poussière rouge) sont loin d'être systématiques, il n'en va pas de même concernant la présence d'épisodes stratigraphiques naturels intercalés entre les monuments. Si ces formations sont généralement qualifiées « d'érosion » (Martinsson-Wallin et Wallin, 2000, p. 29-30) ou de « colluvions », une étude plus détaillée menée par l'un de nous (Morgan De Dapper) a permis de préciser la nature de ces dépôts qui sont effectivement d'origine colluviale. Tant à Poike qu'à Ahu te Niu, ils sont composés d'une multitude de microlentilles à la granulométrie variable. Chaque petite unité relève d'un événement pluviométrique particulier, dont la force et l'intensité est traduite par le diamètre des éléments qui ont été transportés. Ce type de colluvions (*sheet wash deposits* ou ruissellements diffus), sont tributaires de phénomènes climatiques réguliers et souvent de faible ampleur (pluie, orage, etc. ; fig. 5).

L'arrachage de particules et leur transport par écoulement ne sont pourtant concevables que s'il existe des sources, c'est-à-dire des zones mises à nu. Dans le cas de l'île de Pâques, il est des secteurs où la perte de la végétation tient au travail de sape de l'océan qui « rafraichit » continuellement les falaises et provoque ainsi de fortes érosions à hauteur des corniches sans cesse repoussées.

Les flancs aigus de certains volcans engendrent également des événements du même ordre. Rien là qui soit anormal. Mais, pour l'essentiel, c'est l'activité humaine qui est la cause majeure de la mise à nu des sols, en particulier, les déboisements opérés afin de dégager la place nécessaire à l'agriculture (Mann *et al.*, 2008). Aujourd'hui, en amont d'Ahu Motu Toremo Hiva (péninsule de Poike) et d'Ahu te Niu (côte occidentale), les prairies naturelles (steppes) retiennent aisément les sédiments lors de fortes pluies ou d'orages. Mais il n'en a pas toujours été de même : les pentes qui s'élèvent vers l'intérieur des terres portent de nombreux reliquats d'une agriculture ancienne, notamment de larges étendues sur lesquelles se pratiquait le *lithic mulch* (surface agricole volontairement encombrée de fragments de basalte noir, afin de pourvoir aux nutriments minéraux, d'éviter les chocs thermiques entre le

Fig. 3 – Ahu te Niu (côte ouest), traces matérielles des cérémonies de fermeture d'un *ahu*. La première étape est l'enlèvement de quelques galets de la terrasse (en haut), puis le saupoudrage de la même terrasse de poussière de scorie rouge (au centre) et, enfin, le basculement de la ou des statues (en bas ; clichés N. Cauwe).
***Fig. 3** – Ahu te Niu (west coast), material traces of the closing ceremonials of an* ahu*. The first stage corresponds to the removal of some pebbles of the terrace (on the top), then the terrace was powdered with red scoria dust (center) and lastly the statue or statues were brought down (at the bottom; photographs N. Cauwe).*

Fig. 4 – Ahu te Peu (côte ouest). À quelque chose, malheur est bon : l'effondrement partiel du mur arrière de l'*ahu* a permis de constater la présence de *paenga* (pierres de fondation de maisons) dans le remplissage de la plate-forme (cliché N. Cauwe).
Fig. 4 *– Ahu te Peu (west coast). Every cloud has a silver lining: the partial collapse of the rear stone wall of the* ahu *revealed the presence of* paenga *(foundation stones of the houses) within the filling of the platform (photograph N. Cauwe).*

jour et la nuit grâce à la rétention de la chaleur dans le basalte et d'assurer un taux d'humidité suffisant par la captation de la rosée ou de l'eau de pluie à la base de ces petits blocs ; Baer *et al.*, 2008 ; Stevenson et Ayres, 2000 ; Stevenson *et al.*, 2002). Des carottages à la tarière ont également été réalisés par Morgan De Dapper sur les mêmes versants, dont il ressort que les ruissellements diffus n'apparaissent qu'en aval des zones avec *lithic mulch*, jamais en amont ou à l'emplacement même de ces derniers, qui reposent directement sur de minces formations de type steppique surmontées sur quelques dizaines de centimètres de terres labourées. L'origine des *sheet wash deposits* est donc bien à situer dans ces zones de labour couvertes de *lithic mulch*.

Si des ruissellements diffus s'accumulent contre les plates-formes, y compris pendant les phases de leur non-utilisation, cela implique que les activités agricoles se poursuivaient imperturbablement, quoi qu'il en soit du fonctionnement des *ahu-moai*. Les carottages effectués à travers les anciens jardins ne montrent d'ailleurs pas d'interruption significative de leur entretien, soit que la production alimentaire fut continue pendant plusieurs siècles, soit que les phases d'arrêt furent trop brèves pour être imprimées dans le sol, soit que l'échantillonnage au moyen d'une tarière manuelle est trop grossier pour appréhender certains épisodes stratigraphiques fugaces. On le voit, si les architectures religieuses étaient provisoires, car régulièrement « fermées », puis restaurées ou rebâties, les exigences économiques auraient profité de plus de stabilité : à Rapa Nui, le monumental fut sans doute plus éphémère que les modestes jardins horticoles !

Quelle que soit la signification de tout cela, la continuité de la production agricole a eu pour conséquence involontaire la dilatation stratigraphique des gestes de fermetures des *ahu-moai*. On en conclut que l'accomplissement de ces derniers se déroulait au cours d'un laps de temps relativement long, entaché de discontinuités, ces dernières démontrées par l'alternance entre les gestes anthropiques et les épisodes plus ou moins développés de ruissellements diffus. On observe ainsi qu'un délai sépare l'enlèvement de galets des terrasses cérémonielles du dépôt de *hani hani*, lui-même décalé dans le temps par rapport au dépôt au sol des statues, qui, plusieurs stades de ruissellements diffus plus tard, furent enfin partiellement cachées sous des cairns. Le délai de tout cela n'est pas mesurable en termes précis ; on peut seulement assurer que les interfaces naturelles relèvent d'événements climatiques, au minimum de l'ordre de plusieurs saisons, non de quelques journées.

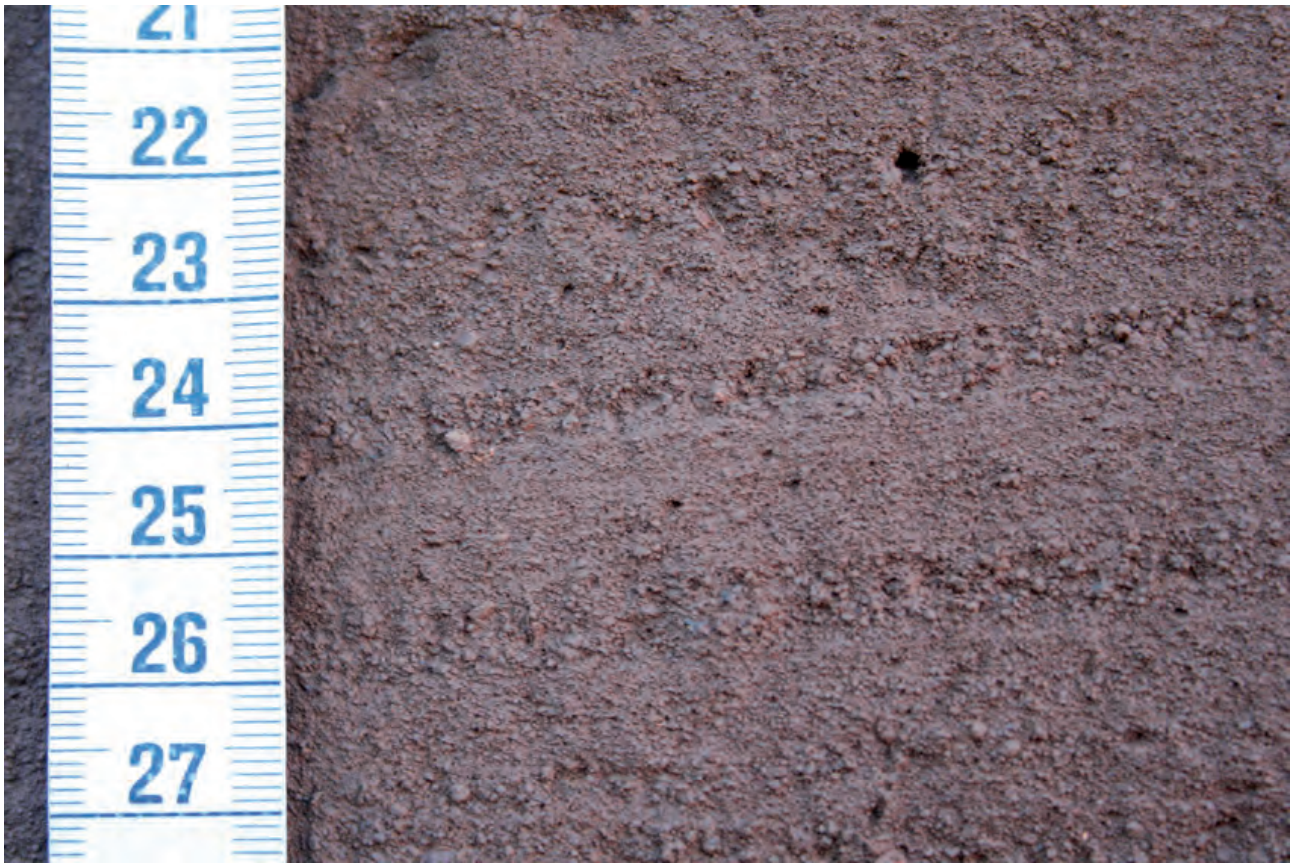


Fig. 5 – Ahu Motu Toremo Hiva (Poike). Exemple de colluvions de type « ruissellements diffus », caractérisées par une fine stratification d'épisode à la granulométrie variable (cliché N. Cauwe).
***Fig. 5** – Ahu Motu Toremo Hiva (Poike). Example of sheet wash deposits, characterized by thin stratification of a deposit with varying grain size (photograph N. Cauwe).*

LA SYMBOLIQUE DES ARBRES

Ces signaux anthropiques qui entrecoupent les accumulations naturelles au-dessus des *tahua* sont suffisants pour assurer que l'arrêt de l'usage d'une plate-forme à statue n'était pas une entreprise insignifiante, que des précautions étaient nécessaires, y compris en les étalant dans le temps (Cauwe, 2012). Aussi, en vient-on à penser qu'il n'y avait sans doute pas de « désacralisation » au sens rigoureux du terme, mais plutôt l'entretien, par des cérémonies épisodiques, d'un potentiel, dont on savait qu'il serait tôt ou tard remis à l'honneur par une restauration ou une reconstruction du monument.

À Ahu te Niu, en particulier, un geste supplémentaire a été repéré, qui ne manque pas d'une certaine envergure. Il est intervenu au cours de la sédimentation naturelle du secteur méridional du site, alors que la plate-forme la plus ancienne était déjà hors d'usage, avec démontage partiel de son *tahua*, l'enlèvement de son ou ses *moai* (s'il y en a jamais eu, mais une pupille en obsidienne a cependant été découverte sur le *tahua* de cet *ahu*) et, plus tard, le saupoudrage de *hani hani*. On aperçoit par-dessus tout cela, à l'exact aplomb de l'ancienne terrasse, un vaste empierrement circulaire, d'un diamètre estimé à un peu plus de 3 m. Lors de la fouille la structure n'a pas été dégagée dans sa totalité, mais a été observée au cours du décapage d'une tranchée de 2 m de largeur. Au centre de cette structure composée de multiples petits blocs de basalte, un espace vide, également circulaire et d'un diamètre d'un peu moins de 1 m, était réservé. Ce type d'aménagement est relativement bien connu à Rapa Nui, bien que jamais mis en évidence sur une ancienne plate-forme. Il s'agit de ce qu'on nomme un *manavai*, construction en pierre dont le but est de protéger les racines et la base de plantes et de leur fournir également un taux d'humidité minimum. Dans ce cas-ci, la lacune au centre du dispositif était caractérisée par une multitude de petites perforations, cernées par des précipitations de manganèse ; en coupe, cet horizon vermiculé avait la forme d'un dôme. Tout cela est caractéristique de la présence ancienne d'un palmier dont les « racines » sont composées de multiples « radicelles ». Ainsi, au cours de la période de non-utilisation de l'*ahu*, un palmier put croître tout contre cet ancien autel. L'acte n'est pas innocent, puisque tributaire d'un *manavai* (construction anthropique) ; par ailleurs, si le *tahua* n'était plus visible au moment où le palmier fut semé ou planté, la plate-forme proprement dite émergeait toujours des sédiments ; elle servira d'ailleurs, un peu plus tard, de fondations pour un nouvel autel. La présence de

ce palmier est donc un acte prémédité et sa promiscuité avec un *ahu-moai* provisoirement hors d'usage tout-à-fait volontaire (fig. 6).

La valeur symbolique de ce geste n'est cependant plus accessible, d'autant qu'il est sans précédent. Il existe, cependant, une comparaison assez spectaculaire. Au centre de l'île, sur le versant méridionale du volcan Terevaka, une équipe de l'Institut archéologique allemand (Deutsches Archäologisches Institut, Bonn), dirigée par Burkhard Vogt a récemment découvert, au lieu-dit Ava Ranga Uka A Toroke Hau, les vestiges de deux barrages et de bassins de rétention, soit toute une panoplie d'aménagements qui semblent lié à une gestion de l'eau potable (Vogt, 2013 ; Kühlem, ce volume). Des datations radiométriques permettent de situer l'usage de ces installations au cours du XVI^{e} siècle, voire jusqu'au début du suivant (Vogt et Moser, 2010, p. 21 ; Vogt, 2013, p. 44-48). Mais, il est remarquable d'observer que ces constructions furent fermées par des transports conséquents de sédiments (dépôts anthropiques) et que des palmiers furent plantés par-dessus un des barrages (Kühlem, ce volume). Dès lors, l'observation enregistrée à Ahu te Niu échappe-t-elle quelque peu à son isolement : des arbres étaient-ils parfois utilisés pour participer aux systèmes de fermeture des monuments périmés ou pour contribuer, par-delà ces fermetures, au maintien d'une efficience symbolique, religieuse ou magique ? L'interrogation est fondée puisqu'il est acquis que les plantations repérées à Te Niu et à Ava Ranga Uka A Toroke Hau ne sont pas le fruit de la générosité spontanée de la nature : des aménagements anthropiques les entourent, ce qui assure le caractère décidé de leur présence. Autre point certifié : il n'y a sans doute pas de rapport entre ces plantations au-dessus de monuments et la disparition de la forêt. En effet, à Te Niu, l'installation d'un palmier intervient largement avant le maximum de la crise écologique.

CONCLUSION

Les faits enregistrés lors de fouilles récentes donnent une nouvelle image de l'implantation dans le paysage des anciens Pascuans, qui ne peut plus se résumer à un simple découpage du territoire, symbolisé par des plates-formes à statues qui dominent les installations des vivants et les jardins maraîchers. Cette vision statique, si elle n'est pas erronée, ne reflète qu'une part de la réalité. Les territoires étaient également gérés dans le temps, autels cultuels et une partie de l'habitat étant régulière-

Fig. 6 – Ahu te Niu (côte ouest). Empierrement agricole *(manavai)*, destiné à la protection d'un palmier planté devant un *ahu* lors d'une phase de non-utilisation (cliché N. Cauwe)..
***Fig. 6** – Ahu te Niu (west coast). Stone wall enclosure* (manavai) *erected for the protection of a palm tree planted in front of an* ahu *during a period of non-use (photograph N. Cauwe).*

ment délaissés, puis recyclés dans de nouvelles architectures. Concernant l'agriculture, une seule certitude : l'entretien des jardins maraîchers était effectif pendant les phases de non-usage des *ahu-moai*. L'était-il aussi lorsque les plates-formes étaient reconstruites et en fonction ? Rien ne l'affirme ou le contredit, mais une alternance entre le pôle religieux et celui de la production alimentaire n'est pas impossible ; le fait n'est pourtant pas documenté à l'heure actuelle.

Quoi qu'il en soit, il y a des discontinuités dans l'occupation des petits segments de territoire déterminés par la répartition des vestiges. Si ces segments trahissent réellement une unité territoriale, alors celle-ci doit être envisagée à une échelle plus vaste, afin de permettre les va-et-vient des habitants et des autels religieux. Par ailleurs, il n'existe quasi aucun élément qui permettrait d'estimer la synchronie ou la diachronie entre l'occupation des maisons aux fondations en pierre *(hare paenga)* et l'usage des plates-formes cultuelles. Les villages bas, dits de prestige, étaient-ils ceux qui étaient occupés alors que les *ahu-moai* étaient reconstruits ou restaurés. De même, les villages hauts, apparemment associés aux activités agricoles, étaient-ils en fonction en même temps que les villages bas ? Le seul indice à disposition est le recyclage de pierres de fondation de maisons *(paenga)* dans plusieurs *ahu-moai* : cet élément va dans le sens du démantèlement de l'habitat au moment de la reconstruction des monuments. Mais opérait-on des prélèvements sur un habitat depuis longtemps à l'abandon ou sur des maisons qu'on venait de quitter ?

Il est clair, cependant, qu'on ne peut plus être affirmatif quant à la simultanéité d'usage et d'occupation de l'ensemble des vestiges dont la dispersion régulière dans le paysage a permis de justifier la reconnaissance d'unités territoriales. Aussi, les belles maisons, aux fondations de pierre soignées, bâties presque aux pieds des *ahu-moai*, étaient-elles vraiment celles des chefs et des prêtres, alors qu'il n'est pas assuré qu'elles furent synchrones des monuments religieux ? L'habitat de hauteur était-il celui de la classe laborieuse ? À moins qu'il n'y ait eu alternance entre les maisons du haut et du bas, les unes fonctionnant avec les autels, les autres avec les jardins, le groupe passant d'une extrémité à l'autre sans qu'il soit question de hiérarchie dans l'habitat. En tout état de cause, les découvertes de ces dernières années montrent le caractère volontairement éphémère des monuments religieux et leur fermeture par des procédés organisés, le cas échéant par la plantation de palmiers. Tout ceci ouvre de nouvelles questions qui nécessiteront des explorations de terrain pour tenter d'y répondre. En attendant il est déjà établi que l'occupation du territoire n'est pas seulement tributaire d'une division de l'espace, mais aussi d'une dynamique temporelle.

NOTE

(1) Mission organisée par les Musées royaux d'Art et d'Histoire de Bruxelles, avec la collaboration de l'université de Gand (département de géographie), de la Corporacion National Forestal - Parque Nacional Rapa Nui (Conaf), du Consejo de Monumentos Nacionales de Rapa Nui et de l'Institut royal des sciences naturelles de Belgique (section d'anthropologie). Le financement de ces travaux a été entièrement supporté par le ministère fédéral belge de la Politique scientifique (SPP-Politique scientifique / Belspo).

RÉFÉRENCES BIBLIOGRAPHIQUES

Baer A., Ladefoged T. N., Stevenson C. M., Haoa S. (2008) – The Surface Rock Gardens of Prehistoric Rapa Nui, *Rapa Nui Journal*, 22, 2, p. 102-109.

Bahn P. G., Flenley J. (1992) – *Easter Island, Earth Island: A Message from Our Past for the Future of Our Planet*, London, Thames and Hudson, 240 p.

Bahn P. G., Flenley J. (2011)v*Easter Island, Earth Island: A Message from Our Past for the Future of Our Planet*, Santiago de Chile, Rapa Nui Press, 376 p.

Cauwe N. (2009) – Rapa Nui : destruction ou déconstruction ?, *Bulletin des s*éances de l'Académie royale des *sciences d'outre-mer*, 55, 2, p. 123-133.

Cauwe N. (2011) – *Easter Island. The Great Taboo: Rebuilding Its History after Ten Years of Excavations*, Louvain-la-Neuve, Versant Sud (New Archaeological Discoveries), 160 p.

Cauwe N. (2012) – Cérémonies de fermeture des autels à statues de l'île de Pâques, *in* M. Cavalieri (dir.), *Industria Apium. L'archéologie : une démarche singulière, des pratiques multiples. Hommages à Raymond Brulet*, Louvain-la-Neuve, Presses universitaires de Louvain (Fervet Opus, 1), p. 95-106.

Cauwe N., Huyge D., De Meulemeester J., De Dapper M., Coupé D., Claes W., De Poorter A. (2006) – New Data from Poike (Rapa Nui - Easter Island): Dynamic Architecture of a Series of Ahu, *Rapa Nui Journal*, 20, 1, p. 31-36.

Cauwe N., Huyge D., Coupé D., De Poorter A., Lemaitre S., Claes W., De Dapper M., De Meulemeester J., Al-Sqhour R. (2010) – Ahu Motu Toremo Hiva (Poike Peninsula, Easter Island): Dynamic Architecture of a Series of Ahu, *in* P. Wallin et H. Martinsson-Wallin (dir.), *The Gotland Papers: Selected Papers from the VII International Conference on Easter Island and the Pacific: Migration, Identity, and Cultural Heritage*, actes du colloque international (Visby, 20-25 août 2007), Visby, Gotland University Press (Gotland University Press, 11), p. 47-56.

Diamond J. (2005) – *Collapse. How Societies Choose to Fail or Succeed*, New York, Viking Books, 592 p.

Ferdon E. N. (1961) – A Summary of the Excavated Record of Easter Island Prehistory, *in* T. Heyerdahl et E. N. Ferdon (dir.), *Archaeology of Easter Island, Reports of the Nor-*

wegian Archaeological Expedition to Easter Island and the East Pacific, 1, Londres, George Allen and Unwin Ltd. (Monographs of the School of American Research and the Museum of New Mexico, 24, 1), p. 527-535.

Flenley J., Bahn P. G. (2002) *The Enigmas of Easter Island*, Oxford, Oxford University Press, 256 p.

Heyerdahl T., Ferdon E. N. (1961) *Archaeology of Easter Island, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 1, Londres, George Allen and Unwin Ltd. (Monographs of the School of American Research and the Museum of New Mexico, 24, 1), p. 559 p.

Mann D., Edwards J., Chase J., Beck W., Reanier R., Mass M., Finney B., Loret J. (2008) – Drought, Vegetation Change, and Human History on Rapa Nui (Isla de Pascua, Easter Island), *Quaternary Research*, 69, 1, p. 16-28.

Martinsson-Wallin H., Wallin P. (2000) – Ahu and Settlement: Archaeological Excavations at 'Anakena and La Pérouse, *in* C. M. Stevenson et W. S. Ayres (dir.), *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, p. 27-43.

Métraux A. (1940) – *Ethnology of Easter Island*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 160), 432 p.

Mulloy W. (1961) – The Ceremonial Center of Vinapu, *in* T. Heyerdahl et E. N. Ferdon (dir.), *Archaeology of Easter Island, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 1, Londres, George Allen and Unwin (Monographs of the School of American Research and the Museum of New Mexico, 24, 1), p. 93-167.

Mulloy W. (1968) –*Preliminary Report of Archaeological Field Work, February-July, 1968, Easter Island*, New York, International Fund for Monuments (Easter Island Bulletin, 1), 44 p.

Mulloy W. (1970) – *Preliminary Report of the Restoration of Ahu Vai Uri, Easter Island*, New York, International Fund for Monuments (Easter Island Bulletin, 2), 39 p.

Mulloy W. (1973) – *Preliminary Report of the Restoration of Ahu Huri a Urenga and two Unnamed* Ahu *at Hanga Kio'e, Easter Island*, New York, International Fund for Monuments (Easter Island, Bulletin, 3), 47 p.

Pelletier M. (2012) – *Île de Pâques, Terra incognita*. Paris, La Martinière, 192 p.

Routledge K. (1919) – *The Mystery of Easter Island: The Story of an Expedition*, Londres, Hazell, Watson and Viney, 404 p.

Smith C. S. (1961) – A Temporal Sequence Derived from Certain Ahu, *in* T. Heyerdahl et E. N. Ferdon (dir.), *Archaeology of Easter Island, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 1, Londres, George Allen and Unwin (Monographs of the School of American Research and the Museum of New Mexico, 24, 1), p. 181-219.

Stevenson C. M., Ayres W. S.(2000) – *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, 224 p.

Stevenson C. M., Ladefoged T., Haoa S. (2002) – Productive Strategies in an Uncertain Environment: Prehistoric Agriculture on Easter Island, *Rapa Nui Journal*, 16, 1, p. 17-22.

Thomson W. J. (1891) – Te Pito te Henua or Easter Island, *National Museum. Annual Report (Washington)*, 1889, p. 447-552.

Vogt B. (2013) – Archäologische Forschungen zur voreupäischen Wassernutzung in Ava Ranga Uka A Toroke Hau, Osterinsel (Rapa Nui/Isla de Pascua, Chile) 2007-2009, *Zeitschrift für Archäologie Aussereuropäischer Kulturen*, 5, p. 11-49.

Vogt B., Moser J. (2010) – Ancient Rapanui Water Management: German Archaeological Investigations in Ava Ranga Uka A Toroke Hau, 2008-2010, *Rapa Nui Journal*, 24, 2, p. 18-26.

Nicolas Cauwe
conservateur aux Musées royaux
d'Art et d'Histoire,
chargé de cours à l'université catholique
de Louvain,
10, Parc du Cinquantenaire,
B-1000 Bruxelles
nicolas.cauwe@uclouvain.be

Morgan De Dapper
professeur honoraire à l'université de Gand,
département de géographie,
Krijgslaan, 281 (S8),
B-9000 Gent
morgan.dedapper@ugent.be

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 111-124
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

The impact of gender, age, social status and spatial distribution on the ancient Easter Islanders' diet

Caroline Polet

Abstract: Easter Island (or Rapa Nui), famous worldwide for its gigantic stone statues, is the most isolated inhabited island in the Pacific. Yet the history of its inhabitants has been far from peaceful: they have faced deforestation, slave raids, epidemics and colonialism. This paper aims to study the diet of the ancient Easter Islanders and focuses on dietary reconstruction through the analysis of human teeth and bones, more particularly, on the impact of gender, age, social status and spatial distribution. However, retrieving information on their dietary habits is difficult, due to the absence of written archives and the disappearance of most of the bearers of the indigenous culture during the slave raids and epidemics of the nineteenth century. Therefore our primary source of direct information are food remains (animal bones and plant remnants) and human bones. The individuals studied came from twenty sites, which date mainly from the seventeenth to the nineteenth centuries. The greater part had been buried in monuments (funerary stone platforms called *ahu*), or caves. These individuals are currently stored at the Royal Belgian Institute of Natural Sciences and the Father Sebastian Englert Anthropological Museum of Easter Island. Dietary reconstruction is based on stress indicators, dental microwear and stable carbon and nitrogen isotope analyses. Stress indicators are skeletal markers which reveal poor living conditions during growth. Two indicators were studied: dental enamel hypoplasia (localised defects in the tooth crown generally expressed in the form of horizontal depressions) and *cribra orbitalia* (porotic lesions in the bony orbital roof). Dental microwear is the study of the microscopic features that form on the teeth's surfaces as a result of use. Their density, dimensions, and orientation are a direct result of diet. Stable isotope analyses are based on the fact that the isotopic composition of an individual's tissues is determined by the proportion of the various foods consumed. Carbon and nitrogen stable isotope composition were analysed in the bone collagen. Dental microwear patterns indicated a large proportion of tubers in the Easter islanders' diet. Additionally, the stable isotopes showed that, on average, one third of the dietary proteins were of marine origin and that children were breastfed until three years of age. Stress indicators suggest that infantile malnutrition was not severe. Our results also demonstrated gender disparity in access to food resources. Furthermore, the isotopic signatures clustered according to the place of burial *(ahu)*, indicating family dietary specificities. Finally, our study revealed the influence of social status on food intake: individuals from Ahu Nau Nau, which is said to be the royal ahu, displayed the highest value of nitrogen and carbon isotopes and the lowest number of microwear features. A greater consumption of marine products may explain this distinction.

Keywords: Polynesia, Easter Island, diet, stress indicators, dental microwear, stable isotopes.

L'impact du genre, de l'âge, du statut social et de la répartition spatiale sur l'alimentation des anciens Pascuans

Résumé : L'île de Pâques (ou Rapa Nui), célèbre dans le monde entier pour ses gigantesques statues de pierre, est l'île habitée la plus isolée du Pacifique. L'histoire de ses habitants, les Pascuans, fut des plus tourmentée. Ils durent tour à tour faire face à la déforestation, aux raids esclavagistes, aux épidémies et au colonialisme. Les fouilles archéologiques menées à partir de la fin du xixe siècle ont permis la mise au jour de restes humains appartenant à plusieurs centaines d'individus. L'attribution chronologique des squelettes, est cependant problématique, car la plupart des monuments ont été utilisés pendant de longues périodes. En outre, les datations ont été effectuée principalement sur des objets en obsidienne mais rarement directement sur des restes humains. Cet article traite du régime alimentaire des anciens Pascuans. Collecter des informations sur leurs habitudes alimentaires n'est pas une tâche facile compte tenu de l'absence d'archives écrites et de la disparition de la majorité des détenteurs de la culture ancestrales au cours des raids d'esclavagistes et des épidémies du xixe siècle. Les principales sources d'information directe sur le régime des anciens habitants de l'île sont les déchets alimentaires (restes animaux et végétaux) et les restes humains. Notre étude concerne ces derniers : nos reconstitutions alimentaires sont basées sur l'étude de leurs dents et de leurs ossements et, portent plus particulièrement, sur l'impact du sexe, de l'âge, du statut social et de la répartition spatiale.
Les individus étudiés proviennent de vingt sites datant principalement du xviie au xixe siècle. La majorité de ces individus ont été inhumés dans des monuments (plates-formes funéraires en pierre appelées *ahu*) ou dans des grottes. Ce matériel anthropologique fait partie des collections de l'Institut royal des sciences naturelles de Belgique et du musée anthropologique Père-Sébastien-Englert de l'île de

Pâques. Les reconstitutions du régime alimentaire sont basées sur l'analyse des indicateurs de stress, de la micro-usure dentaire et des isotopes stables du carbone et de l'azote. Les indicateurs de stress sont des marqueurs osseux ou dentaires qui révèlent de mauvaises conditions de vie pendant la croissance. Deux indicateurs ont été étudiés: l'hypoplasie de l'émail dentaire (défauts localisés dans la couronne de la dent généralement exprimés sous forme de dépressions horizontales) et les *cribra orbitalia* (lésions porotiques localisées dans le toit de l'orbite). La micro-usure dentaire consiste en des altérations microscopiques (stries et puits) qui se forment à la surface des dents suite à leur utilisation. Leur densité, leurs dimensions et leur orientation sont fonction du type d'aliment consommé. Les analyses des isotopes stables sont basées sur le fait que la composition isotopique des tissus d'un individu reflète la proportion des différents aliments qu'il a consommés. La composition isotopique du carbone et de l'azote a été mesurée dans le collagène osseux. Le *pattern* de micro-usure dentaire indique une forte proportion de tubercules dans l'alimentation des Pascuans. Les isotopes stables montrent que, en moyenne, un tiers des protéines alimentaires étaient d'origine marine et que les enfants étaient allaités jusqu'à l'âge de 3 ans. Les indicateurs de stress suggèrent que la malnutrition infantile n'était pas sévère. Nos résultats mettent également en évidence des disparités entre les hommes et les femmes dans l'accès aux ressources alimentaires : les hommes consommaient davantage de protéines d'origine animale. En outre, les signatures isotopiques des individus varient en fonction de leur lieu d'inhumation *(ahu)* indiquant des spécificités alimentaires familiales. Enfin, notre étude révèle une influence du statut social sur la consommation alimentaire : les individus de l'Ahu Nau Nau, connu comme étant l'*ahu* royal, présentent des valeurs des isotopes de l'azote et du carbone les plus élevées et un nombre plus réduit de microtraces d'usure dentaire. Une plus grande consommation de produits d'origine marine pourrait expliquer cette distinction..

Mots-clés : Polynésie, île de Pâques, régime alimentaire, indicateurs de stress, micro-usure dentaire, isotopes stables.

Easter Island (or Rapa Nui), famous worldwide for its gigantic stone statues, is the most isolated inhabited island in the Pacific (fig. 1). It is located at 27°09'30" S and 109°26'14" W, 3,600 km from the Chilean coast and 4,200 km from Tahiti. Today, its closest populated neighbour is Pitcairn Island, 2,075 km to the west. Easter Island is of volcanic origin with a land area of 160.5 km^2 (Fischer and Love, 1993).

According to some authors, the first human settlements on Easter Island took place between the eighth and the tenth century AD (Bahn, 1993). For others, it occurred more recently, during the twelfth century (Hunt and Lipo, 2006). Anthropological (Turner and Scott, 1977; Gill and Owsley, 1993), palaeogenetic (Hagelberg et al., 1994), ethnographic (Métraux, 1940) and linguistic (Du Feu and Fischer, 1993) research agrees that the Easter Islanders were of Polynesian origin.

The population of the island continued to expand and had reached 9,000 islanders by 1550, according to Patrick Kirch (Kirch, 1984). A demographic decline then began at about 1650 accompanied by great upheavals in the social organisation, including religious and funerary practices. This may have been related to the disappearance of available resources. The palynological (Flenley and King, 1984) and anthracological analyses (Orliac and Orliac, 1998) show that Easter Island definitely had, until the beginning of the seventeenth century, a forest cover where palm trees dominated. However, when the European navigators visited the island in the eighteenth century [(1)], there were estimated to be no more than 1,000 or 2,000 inhabitants and the forests had completely disappeared.

Three main theories have been used to explain this deforestation. The first is the 'ecocide' theory, which suggests that the Rapa Nui society destroyed itself by overexploiting its own resources destroying their forests, degrading the island's topsoil, wiping out their plants and driving the animals to extinction (Heyerdahl and Ferdon, 1961; McCoy, 1979; Kirch, 1984; Bahn and Flenley, 1992). The second gives priority to climate change and more particularly to the Little Ice Age droughts (McCall, 1993; Orliac and Orliac, 1998). The third involves the impact of the Polynesian rat with its predation of the *Jubea* palm nuts (Hunt, 2007).

For many scholars (e.g. Heyerdahl and Ferdon, 1961; Young, 1991; Ponting, 1992, p. 1–7; Bahn and Flenley, 1992), the result of this environmental devastation, was the pre-contact collapse of the Rapa Nui complex society. Based on stories collected by early twentieth century ethnographers (Routledge, 1919; Métraux, 1940), they specified that the Easter Islanders descended into civil war, starvation, cannibalism and finally self-destruction. This scenario was popularized by the best-selling environmentalist author Jared Diamond in his 2005 book Collapse: *How Societies Choose to Fail or Survive*. Recent studies, however, demonstrate that the Easter Islanders had already successfully struggled against natural environmental modifications, and that the real collapse only occurred in the nineteenth century (Stevenson et al., 2015; Boersema, 2015) when several tragic episodes did indeed decimate the population (Lavachery, 1935; Fischer, 2005). Between December 1862 and March 1863, Peruvian slave traders captured approximately 1,400 natives (men, women and children) to work on farms and to harvest the guano, primarily on the Chincha Islands, Peru (Maude, 1981). Among those captured was the island's paramount chief *(ariki-mau)*, his heir and many of the bearers of the indigenous culture. More than ninety percent of them perished due to bad working conditions, maltreatment and disease. In August 1863, international protests put an end to slave trade, and the survivors, carrying smallpox and tuberculosis, were repatriated back to the island. An epidemic of smallpox then decimated over a thousand islanders. Several years later, in 1868, Jean-Baptiste Dutrou-Bornier, a French adventurer, established himself on the island and began a reign of terror. However, by 1873, due to a disagreement with the Frenchman, his missionaries evacuated all the remaining inhabitants to the Gambier Islands and Tahiti. The only inhabitants

that were forced to stay were the 111 Rapa Nui people who J.-B. Dutrou-Bornier had requisitioned as labourers (Métraux, 1940). His subjugation finally came to an end when he was assassinated in 1876. In 1888, the island was annexed by Chile and exploited from 1897 by a Chilean businessman. In 1903, the lands were rented to a Scottish sheep breeding company (Williamson-Balfour Company). Until 1954, this small Polynesian island became no more than a large farm with the Rapa Nui people being forced to live in a single village: Hanga Roa, the capital of the Chilean province of Easter Island (Fischer, 2005).

Throughout this tumultuous history, the Rapa Nui people lived within strict 'kinship groups' called *mata* (tribes; McCall, 1979) made up of the descendants of a common ancestor (Métraux, 1940, p. 123). During her stay on the island, in 1913–1915, the British archaeologist Katherine Routledge recorded ten tribes (she called them 'clans') which were associated with different parts of the island (Routledge, 1919, p. 221–224; fig. 1). One tribe, named Miru, ranked above all the other tribes (Routledge, 1919, p. 240–243). Its 'territory' was a strip of land located on the north of the island. The *ariki-mau* or king of Easter Island was a member of the Miru tribe and possessed a supernatural power *(mana)*, which was manifested through a system of restrictions *(tapu)* governing the right to use various resources (Métraux, 1940, p. 130–132).

Given the absence of written archives and the disappearance of most of the bearers of the indigenous culture during the slave raids and epidemics of the nineteenth century (Lavachery, 1935; Maude, 1981; Fischer, 2005), retrieving information on the Easter islanders' dietary habits was difficult. Therefore, we focused on the only main source of direct information on the ancient Easter islanders' diet: food remains (middens) and human bones. This study focuses on dietary reconstruction through the analysis of human teeth and bones and, more particularly, on the impact of gender, age, social status and spatial distribution.

MATERIAL

Archaeological surveys undertaken from the end of the nineteenth century on Easter Island uncovered the remains of several hundred individuals, the greater part of which had been buried in monuments *(ahu)*. In most cases, only the skulls were collected. In ancient periods (thirteenth–fifteenth centuries), the dead were generally cremated and their ashes gathered in stone-lined cists located at the rear of the *ahu* (Ayres and Saleeby, 2000; Huyge et al., 2002; Polet, 2003). After the period of deforestation, the progressive abandonment (and eventual destruction) of the giant statues *(moai)* cult, the Easter Islanders continued to bury their dead in the *ahu*, though

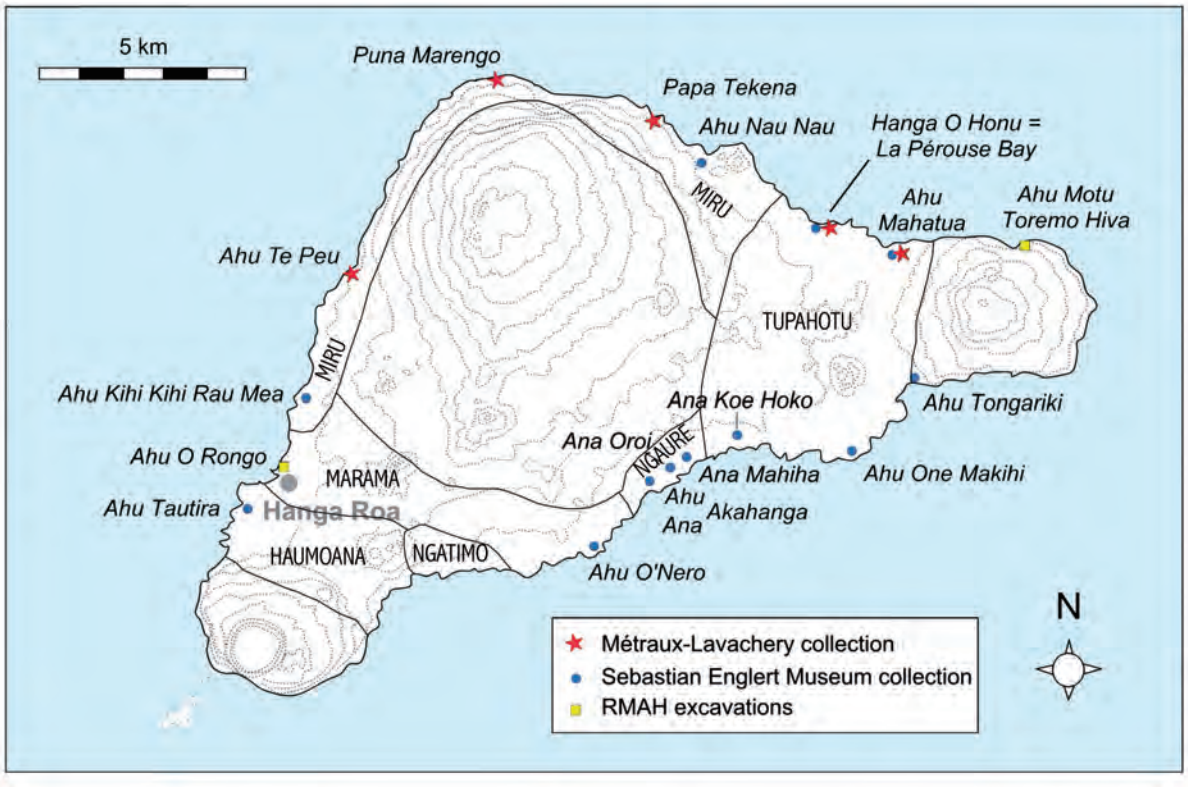


Fig. 1 – Easter Island and its tribal divisions (after Routledge, 1919), and the location of the different sites studied. RMAH = Royal Museums of Art and History.

***Fig. 1** – L'île de Pâques, les limites territoriales des tribus (d'après Routledge, 1919) et la localisation des différents sites étudiés. RMAH = Musées Royaux d'Art et d'Histoire.*

they mostly favoured niches dug into the platform or under lying *moai* (Seelenfreund, 2000; Cauwe, 2011). In addition, there were also cave burials that seem to have started after the discovery of the island by the Europeans (Shaw, 2000). Indeed, some may have contained individuals who died during the great epidemics of the nineteenth century.

However, the chronological attribution of the skeletons is problematic as most of the monuments were used over a long period of time. Moreover, dating was mainly carried out on obsidian artefacts (Seelenfreund, 2000; Shaw, 2000) or wood charcoal (Mulrooney, 2013) but rarely directly on human remains, though a total of twenty-six ^{14}C dates do exist (Commendador et al., 2014).

The samples studied here came from twenty sites (mainly *ahu* and caves) which date principally from the seventeenth to the nineteenth century (fig. 1 and table 1). They were composed of:

– skulls and long bones brought back to Europe in 1935 by A. Métraux and H. Lavachery (Lavachery, 1935). These come from the north of the island and belong to the collections of the Royal Belgian Institute of Natural Sciences (RBINS);

– skeletons exhumed at the end of the 1970s by G. Gill (Gill and Owsley, 1993). These skeletons are stored at the Father Sebastian Englert Anthropological Museum, Easter Island which contains the greater part of the recently excavated anthropological material;

– fragmentary human remains collected in 1996 by C. M. Stevenson and S. Haoa from cult and settlement sites at La Pérouse Bay (Stevenson and Haoa, 1998). These are also kept at the Father Sebastian Englert Anthropological Museum;

– skeletons recently discovered by N. Cauwe and D. Huyge (Huyge et al., 2002; Cauwe et al., 2006; Cauwe, 2011). Again, these are stored at the Father Sebastian Englert Anthropological Museum (except for the individual from Ahu Motu Toremo Hiva, who was reburied in accordance with a request from the local authorities).

METHODS

In order to obtain information on the dietary habits of ancient Easter Islanders, we recorded stress indicators and applied dental microwear and stable isotope analyses.

Site		Excavated by	Antiquity	N microwear	N stress indicators	N stable isotopes
Ahu	Nau Nau	G	15th–19th c.	28	41	19
	Tautira	G	?	1		
	Tongariki	G	17th–20th c.	4		
	Kihi Kihi Rau Mea	G	17th–20th c.	1	14	14
	O'Nero	G	end 17th–19th c.	2	12	9
	Akahanga	G	17th–19th c.	5	8	8
	One Mahiki	G	18th–19th c.	2	3	2
	Mahatua	G	19th–20th c.	6		13
	Hanga O Onu = La Pérouse Bay	LM	19th c.?	3		7
	Papa Tekena	LM	19th c.?	1		3
	Tepeu	LM	19th c.?			2
	O Rongo	CH	end 13th c.–beginning 14th c.	2		3
	Motu Toremo Hiva	CH	end 19th c.–beginning 20th c.	1		
Caves	Akahanga	G	18th–19th c.	1	4	4
	Koe Hoko	G	18th–19th c.	2	8	8
	Mahiha	G	18th–19th c.	3	6	6
	Oroi	G	18th–19th c.	6	17	11
Other	Puna Marengo	LM	19th c.?	2		
	La Pérouse	SH	1700–1850	1		
TOTAL				**71**	**113**	**109**

Table 1 – Composition of the samples studied for stress indicators, dental microwear and stable isotopes. G = Gill, LM = Lavachery and Métraux, SH = Stevenson and Haoa, CH = Cauwe and Huyge. Data come from Lavachery, 1935; Gill and Owsley, 1993; Stevenson and Haoa, 1998; Huyge et al., 2002; Cauwe et al., 2006; Cauwe, 2011; Commendador et al., 2013.

Tabl. 1 *– Composition de l'échantillon étudié pour les indicateurs de stress, la micro-usure dentaire et les isotopes stables. G = Gill ; LM = Lavachery et Métraux ; SH = Stevenson et Haoa ; CH = Cauwe et Huyge. Les données proviennent de Lavachery, 1935 ; Gill et Owsley, 1993 ; Stevenson et Haoa, 1998 ; Huyge* et al., *2002 ; Cauwe* et al., *2006 ; Cauwe, 2011 ; Commendador* et al., *2013.*

Stress indicators

To assess the general health status of the ancient Easter Islanders, we studied two skeletal markers in order to reveal poor living conditions during growth (stress indicators): dental enamel hypoplasia and cribra orbitalia.

Dental enamel hypoplasia consists of localised defects in the tooth crown (fig. 2a). It is generally expressed in the form of horizontal depressions due to a temporary disturbance in amelogenesis (Goodman and Rose, 1990). In most cases, hypoplasia originates from malnutrition and/or health problems (i.e. high fever or infection). The formation of a defect requires several weeks, at least, of continuous stress. As enamel does not remodel once it is formed, hypoplasia leaves permanent markers on the tooth. We recorded the presence of hypoplasia on the deciduous and permanent incisors and canines (Polet, 2006).

Cribra orbitalia is a porotic lesion in the bony orbital roof (fig. 2). For a long time, it was strictly associated with iron deficiency anaemia (Stuart-Macadam, 1992) but recent studies show that it can also be related to a vitamin-B12-deficiency, scurvy or chronic infections (Walker et al., 2009; Oxenham and Cavill, 2010). We recorded the presence of cribra orbitalia in individuals who presented at least one complete orbital roof (Polet, 2006).

Dental microwear

Dental microwear is the study of the microscopic scratches and pits formed on the surface of teeth as a result of use (Teaford, 1994). The density, dimensions, and the orientation of these microstructures, are dependent on the type of food consumed and its preparation (Molleson et al., 1993; Lalueza et al., 1996). On the vestibular surface of the teeth, the vertical and long striations are caused by meat being chewed quickly; while the short horizontal and oblique striations result from crushing harder (more abrasive) vegetal food. Vegetarians exhibit more striations than carnivores.

Dental microwear was examined on the buccal (vestibular) surface of the first and second permanent molars with scanning electron microscopy at × 178 magnification (Philips SEM 515 of the RBINS; Polet et al., 2008). The total number of striations, their length and their orientation in relation to the cement-enamel junction were recorded in a circular area of 300 µm diameter (fig. 2a),

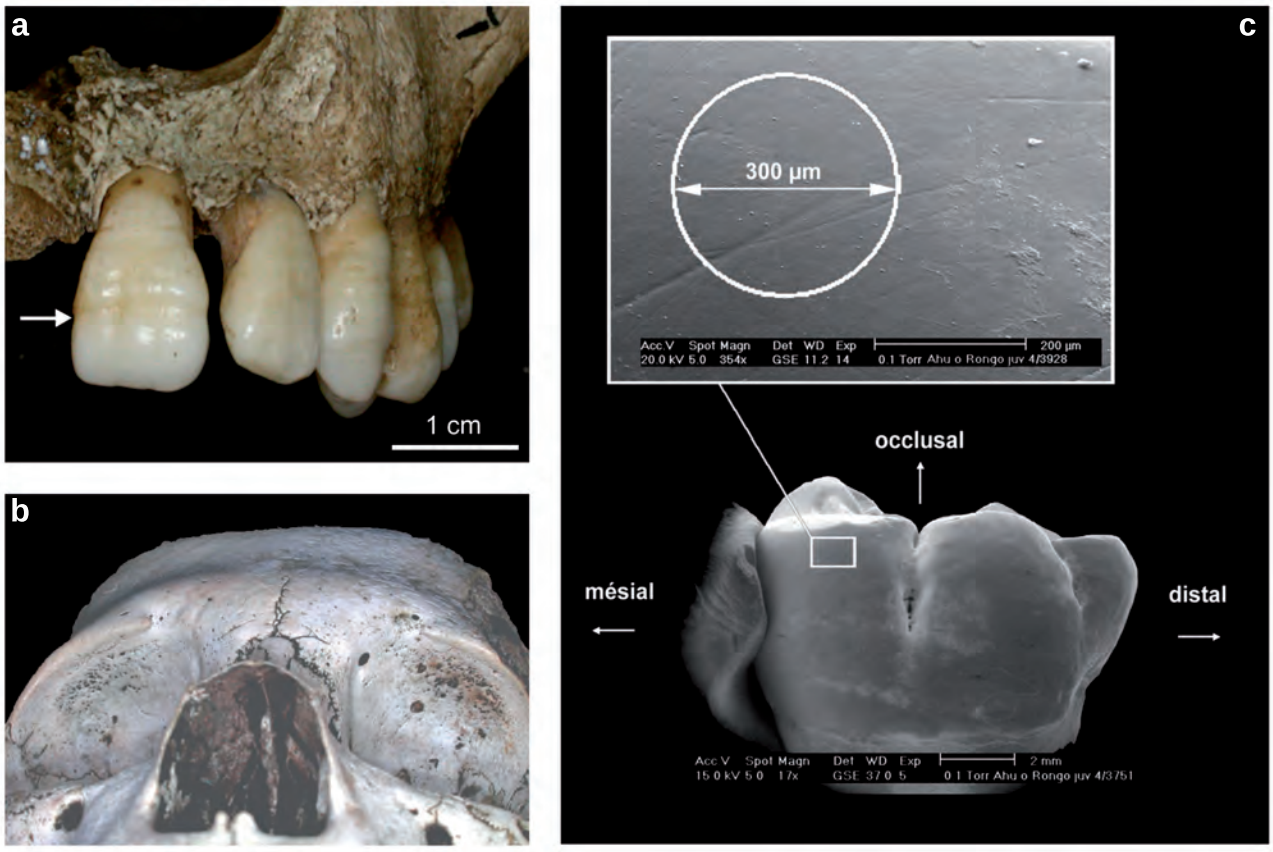


Fig. 2 – a: enamel hypoplasia in a child of approximately 12 years from Ahu O Nero; b: *cribra orbitalia* in a young woman from Oroi cave; c: positive replica of a molar from Ahu O Rongo seen from its buccal side. The selected zone (rectangle) is located on the mesio-buccal cusp near the occlusal surface. Microwear was recorded in a circular area of 300 µm diameter.

Fig. 2 *– a : hypoplasie de l'émail dentaire chez un enfant de l'Ahu O Nero âgé d'environ 12 ans ; b :* cribra orbitalia *chez une jeune femme de la grotte Oroi ; c : réplique positive d'une molaire de l'Ahu O Rongo, vue de sa face vestibulaire. La zone sélectionnée (rectangle) est localisée sur le cuspide mésio-vestibulaire à proximité de la surface occlusale. La micro-usure a été relevée dans une aire circulaire de 300 µm de diamètre.*

using the software Microware 4.02 of P. Ungar (Ungar, 1995). The lengths were divided into ten classes with increments of 30 µm (L1 to L10) and the orientations into four classes: horizontal (0–20° and 160–180°), horizontal/oblique (20–40° and 140–160°), oblique (40–60° and 120–140°) and vertical (60–120°).

Carbon and nitrogen stable isotope analyses

Carbon (C) and nitrogen (N) stable isotope analyses have proved to be efficient methods for reconstructing palaeodiets (Tykot, 2004; Bocherens and Drucker, 2005), based on the fact that the differences in chemical composition between different categories of food are reflected in the bones or teeth of the consumer. Consequently, they can give a direct measure of long term diets at an individual level, enabling associations to be highlighted between diet and other attributes such as social status, age or sex (Polet, 2008).

C and N stable isotope compositions are chiefly measured in bone (and dentine) collagen, the main component of their organic fraction. Results are expressed as isotopic ratios (= ratio of abundance of the heavy to light isotope) relative to an international standard. They are reported as a delta (δ) notation in units per mil (‰). δ is calculated in the following way for carbon and nitrogen stable isotopes:

$$\delta^{13}C\ (‰) = [(^{13}C/^{12}C)\ \text{sample} / (^{13}C/^{12}C)\ \text{standard} - 1] \times 1000$$

$$\delta^{15}N\ (‰) = [(^{15}N/^{14}N)\ \text{sample} / (^{15}N/^{14}N)\ \text{standard} - 1] \times 1000$$

δ is positive if the sample is enriched in heavy isotopes compared to the standard, a negative δ indicates the opposite. For carbon isotopes, the internationally defined standard is V-PDB (for Vienna Pee Dee Belemnite). The nitrogen isotopes are reported relative to AIR (for atmospheric air).

We sampled 200–300 mg of compact bone with a drill. Collagen was extracted by acidic demineralization followed by a treatment to remove the contaminants (Bocherens et al., 1991). The carbon and nitrogen isotopic compositions were measured with a NC 2500 Elemental Analyzer connected to a Thermo Quest Delta + XL isotopic ratio mass spectrometer at the Geochemistry department of the University of Tübingen, Germany.

RESULTS

Stress indicators

No enamel hypoplasia was observed in the seven deciduous dentitions of Easter Island. On the island of Guam, however, 12.7% (17/134) of the individuals displayed this stress indicator in their primary teeth (Stodder, 1997). This pathology concerned 18% of the permanent teeth of Rapa Nui (table 2).

Cribra orbitalia was present in 12.7% of our Easter Island samples (table 2).

The percentage of permanent teeth with enamel hypoplasia and the percentage of *cribra orbitalia* are in the range of variation of other historic and prehistoric Pacific samples (Polet, 2006; here: fig. 3). However, these are much lower than European medieval populations from the sixth to the fifteenth century AD (Polet, 2006).

Within the Rapa Nui sample, women showed significantly higher hypoplasia frequencies than men (table 2 and fig. 4a). The percentage of *cribra orbitalia* was higher in children than in adults (table 2). The Ahu Nau Nau individuals are characterized by a lower rate of *cribra orbitalia* than the other Easter Islanders (Polet, 2006).

Dental microwear

In the sampled circular area, the total number of microscratches on the Easter Islanders' teeth varied between 21 and 119 with an average of 53.9 features (or 77 scratches/mm²). Their average length was 50.9 µm. Most of the scratches belonged to the classes L1 and L2 (1 to 60 µm). The first two classes alone accounted for 75% of all the features. A horizontal orientation predominated (33%; fig. 5). The horizontal, horizontal-oblique and oblique striations totalized 82%.

As there are no corresponding dental microwear studies for alternative Polynesian populations, we thus decided to compare our group to the prehistoric and medieval samples studied by C. García-Martín (García-Martín, 2000). Compared to these samples, Easter Islanders displayed a small total number of striations. Fur-

	Freq. enamel hypoplasia			Freq. *cribra orbitalia*	
	Absolute	Relative (%)		Absolute	Relative (%)
> 20 yrs	6/31	19.4	> 20 yrs	3/51	5.9
13–20 yrs	1/8	12.5	< 20 yrs	6/21	28.6
Male	1/19	5.3	Male	1/28	3.6
Female	4/11	36.4	Female	5/25	20.0
Total	**7/39**	**18.0**	**Total**	**9/71**	**12.7**

Table 2 – Proportion of individuals affected by enamel hypoplasia (on permanent teeth) and by *cribra orbitalia* amongst Easter Islanders.

Tabl. 2 *– Proportion d'individus atteints d'hypoplasie de l'émail (pour les dents permanents) et de* cribra orbitalia *chez les Pascuans.*

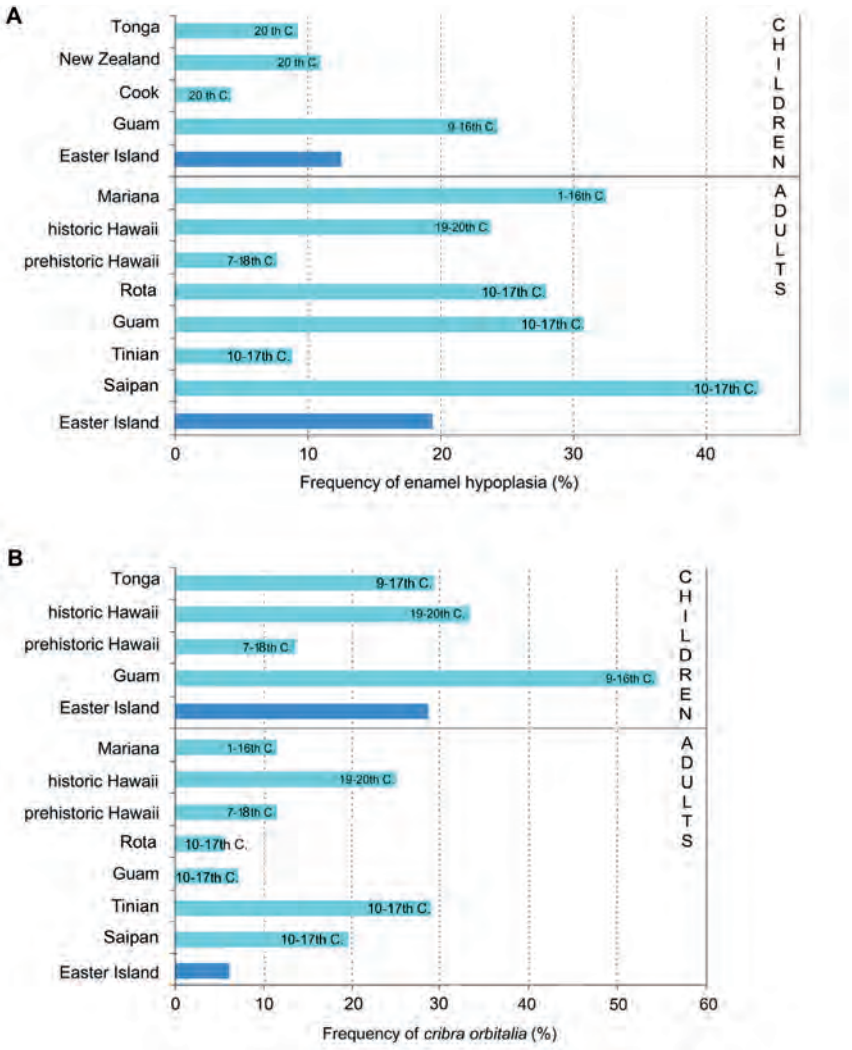


Fig. 3 – A: frequencies of enamel hypoplasia on permanent teeth from the Easter Island sample compared to those collected from eight archaeological and three extant Polynesian samples (see references in Polet, 2006; Pietrusewsky et al., 2014); B: frequencies of *cribra orbitalia* in the Easter Island sample compared to those collected from five archaeological Polynesian samples (see references in Polet, 2006; Pietrusewsky et al., 2014).

***Fig. 3** – A : fréquences d'hypoplasie de l'émail pour les dents permanents de l'échantillon pascuan comparées à celles relevées dans huit échantillons polynésiens archéologiques et trois échantillons actuels (les références sont dans Polet, 2006 ; Pietrusewsky* et al.*, 2014) ; B : fréquences de* cribra orbitalia *pour l'échantillon pascuan comparées à celles relevées dans cinq échantillons polynésiens archéologiques (les références sont dans Polet, 2006 ; Pietrusewsky* et al.*, 2014).*

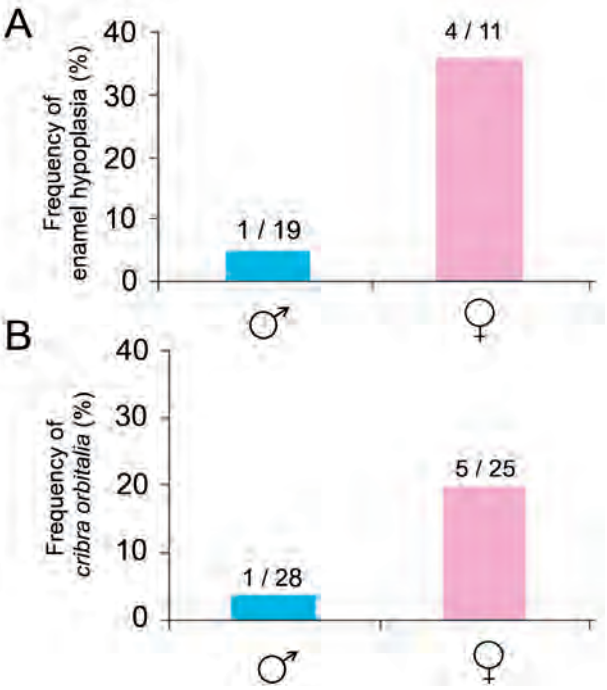


Fig. 4 – A: frequencies of enamel hypoplasia on permanent teeth in male and female Easter Islanders; B: frequencies of *cribra orbitalia* in male and female Easter Islanders.

***Fig. 4** – A : fréquences d'hypoplasie de l'émail pour les dents permanents des Pascuans de sexe masculin et féminin ; B : fréquences de* cribra orbitalia *chez des Pascuans de sexe masculin et féminin.*

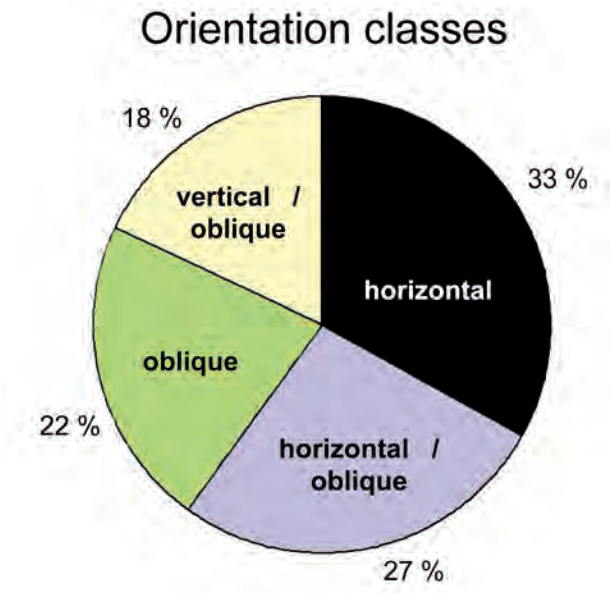


Fig. 5 – Distribution (pie-chart) of the Easter Islanders micro-striations over four orientation classes (horizontal, horizontal/oblique, oblique and vertical/oblique).
***Fig. 5** – Répartition des micro-stries des Pascuans dans quatre classes d'orientation (horizontale, horizontale/oblique, oblique and verticale/oblique).*

thermore, multivariate statistical analyses, based on the length and orientation of the scratches, revealed that the microwear pattern of the Easter Islanders were most similar to those of the coastal medieval sample of Coxyde (Polet et al., 2008).

Within our adult sample, we did not observe any sex or age-related differences in microwear pattern (Polet et al., 2008). With regard to social status, our study showed that Ahu Nau Nau, the royal *ahu*, was distinguishable from the other sites on the basis of its dental microwear (Polet et al., 2008): it was characterized by a lower number of striations and fewer short features (0–30 µm).

We also observed that the individuals dated to before the deforestation presented significantly less horizontal scratches than those dated after this event (Polet et al., 2008).

Carbon and nitrogen stable isotope analyses

The results for the 109 Rapanui individuals analysed produced the following results: their bone collagen δ ^{15}N ranged from 10.6‰ to 16.9‰ with an average of 13.4‰; and their δ ^{13}C ranged from −21.0‰ to −15.5‰ with an average of −18.4‰. (Polet and Bocherens, 2016).

We also tried to identify trends within our sample by comparing the individuals buried in the *ahu* to the individuals buried in caves, but they did not display any significant differences in their isotopic signals (table 3).

Regarding sex differences in adult individuals, males displayed higher carbon and nitrogen isotopic values than females (fig. 6 and table 3).

We also studied the isotope distribution according to age at death (fig. 7). The sample was divided into four age classes: 0–3 years, 4–11 years, 12–18 years and adults. The first category produced the most individuals with the highest value of nitrogen isotopes, aside from two young children: a two-year old child and a baby.

The spatial distribution of the isotopic signatures also provided interesting results with individuals clustered according to their place of burial (fig. 8).

The individuals from Ahu Nau Nau, displayed the highest value of nitrogen and carbon isotopes (except for one male individual).

DISCUSSION

Stress and malnutrition

The enamel hypoplasia and *cribra orbitalia* study revealed that the stress level of Easter Islanders during childhood was not higher than that of other ancient populations of the Pacific, but was lower than that of European

	Ahu			Caves			Student's t-test	
	N	Average	Standard deviation	N	Average	Standard deviation	p	Significance level
δ^{13}C	79	−18.3	0.87	28	−18.2	1.09	0.36	NS
δ^{15}N	79	13.4	1.23	28	13.3	1.02	0.32	NS
	Males			Females			Student's t-test	
	N	Average	Standard deviation	N	Average	Standard deviation	p	Significance level
δ^{13}C	32	−18.2	0.98	30	−18.6	0.73	0.0407	*
δ^{15}N	32	13.5	0.95	30	12.8	0.46	0.00016	***

Table 3 – Statistical parameters of the comparison of isotopic signatures (δ^{13}C and δ^{15}N in ‰) between individuals buried in *ahu* and individuals buried in caves, between males and females. NS = not significant; * = significant; *** = highly significant.
***Tabl. 3** – Paramètres statistiques des comparaisons de signatures isotopiques (δ^{13}C et δ^{15}N en ‰) entre individus inhumés dans les* ahu *et ceux inhumés dans les grottes, entre les hommes et les femmes. NS = non significatif; * = significatif; *** = très hautement significatif.*

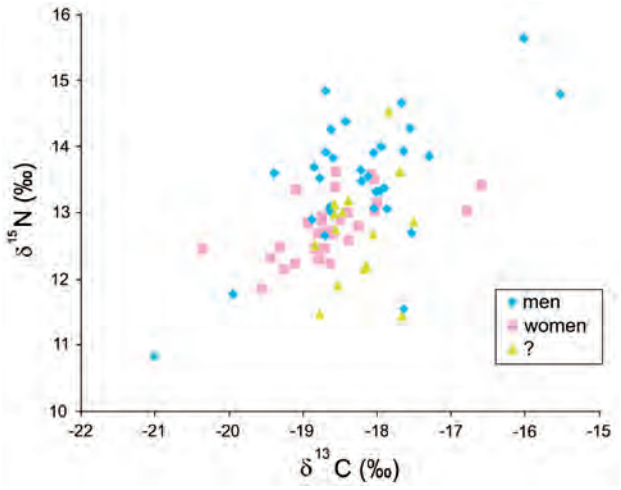


Fig. 6 – Bivariate plot of $\delta^{15}N$ and $\delta^{13}C$ values from males, females and adults of unspecified sex from Easter Island.
Fig. 6 *– Graphique bivarié présentant les valeurs de $\delta^{15}N$ et de $\delta^{13}C$ des hommes, des femmes et des adultes de sexe indéterminé de l'île de Pâques.*

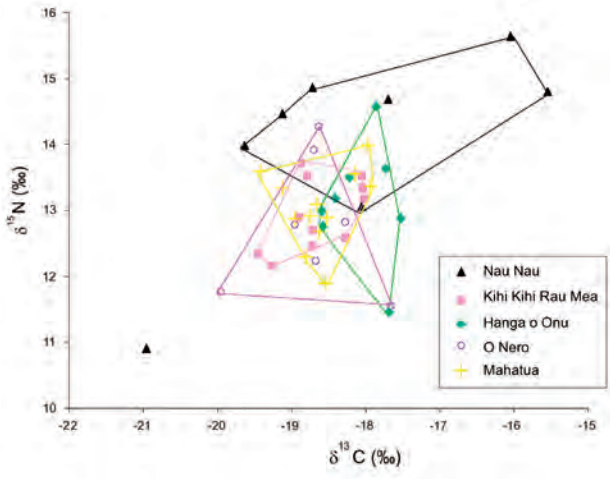


Fig. 8 – Bivariate plot of $\delta^{15}N$ and $\delta^{13}C$ values from Easter Islanders aged over 12 years and buried in different *ahu*.
Fig. 8 *– Graphique bivarié présentant les valeurs de $\delta^{15}N$ et de $\delta^{13}C$ de Pascuans âgés de plus de 12 ans et inhumés dans différents* ahu.

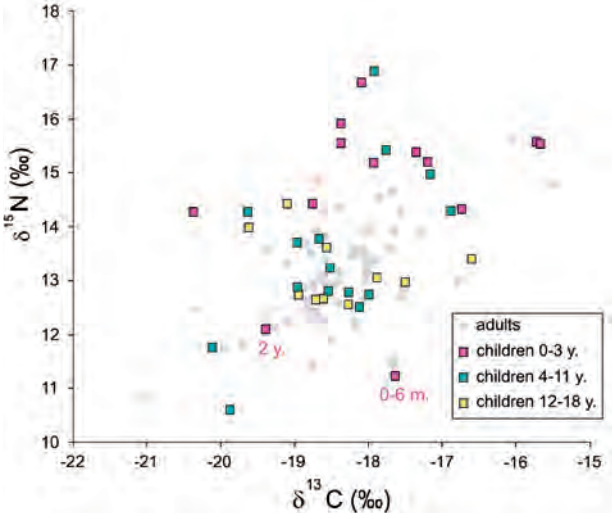


Fig. 7 – Bivariate plot of $\delta^{15}N$ and $\delta^{13}C$ values from Easter Islanders belonging to different age categories. The individuals that displayed the highest nitrogen isotope signatures belong to the category 0–3 years. Two children were exceptions: a 2-year old child and a baby who died between 0 and 6 months.
Fig. 7 *– Graphique bivarié présentant les valeurs de $\delta^{15}N$ et de $\delta^{13}C$ de Pascuans appartenant à différentes catégories d'âge. Les individus qui présentent les signatures isotopiques de l'azote les plus élevées appartiennent à la catégorie d'âge 0-3 ans. Font exception : un enfant âgé de 2 ans et un bébé mort entre 0 et 6 mois.*

medieval populations. Therefore, we can state that child malnutrition on Rapa Nui was far from severe. This result is in direct opposition to the catastrophist theories (i.e. chaos, war and famine following deforestation) popularised by Jared Diamond (Diamond, 2005, p. 79–119).

General composition of the diet

The Easter Islanders' microwear was characterized by few features: short and mainly horizontal or oblique scratches. These results can be related to the dominance of sweet potato *(Ipomoea batatas)* in their daily meals as stated by historical (Pollock, 1993; Flenley, 1993), ethnographical (Routledge, 1919, Métraux, 1940) and archaeobotanical (Flenley, 1993; Cummings, 1998) data. The high percentage of caries recorded by D. Owsley and colleagues (Owsley et al., 1983 and 1985) also confirms this hypothesis as the sweet potato and the other tubers consumed by the inhabitants of Rapa Nui (i.e. taro, yam and arrow-root) are rich in starches and are highly cariogenic (Lingström et al., 2000).

The microwear pattern of the Easter Islanders is most similar to that of the Cistercians of Coxyde (Polet et al., 2008), a medieval coastal population where marine fish consumption has already been attested to. The ichthyophagy of the Rapa Nui people is also confirmed by the marine faunal remains (Steadman et al., 1994; Ayres et al., 2000) and fishing implements (e.g. Lavachery, 1935; Ayres, 1985) discovered in Easter Island archaeological sites.

To estimate the proportion of marine food in their diet, we applied the linear mixing model of S. Mays (Mays, 1997) based on carbon isotopes. In this model, an entirely terrestrial diet leads to a value of −21.5‰ and a wholly marine-based one to −12‰. The contribution in marine products for Easter Islanders varied between 4.8 and 57%, with an average of 29.5%.[(2)] Moreover, A. Commendador and coworkers (Commendador et al., 2013) compared the carbon and nitrogen isotopic ratios of forty-one Rapa Nui human teeth coming from seven archaeological sites

(i.e. Ahu Tongariki, Ahu Kihi Kihi Rau Mea, Ahu Nau Nau, Ahu Akahanga, Ahu One Makihi, Ahu Mahatua, and Ana Oroi) with 132 animal remains from one archaeological site on Easter Island (Anakena Beach) and came to the conclusion that their diet was predominantly terrestrial.

A. Commendador and colleagues (Commendador et al., 2013) compared their data with twelve other Pacific islands. They observed that their Rapa Nui material was within a similar range of $\delta^{13}C$ but consistently higher in $\delta^{15}N$. They suggested that the Easter Islanders' diet was more focused on terrestrial resources than the other Pacific islanders. We reached the same conclusion with our 109 isotopic dataset (Polet et Bocherens, 2016).

Gender effect

Women of Rapa Nui showed significantly higher hypoplasia frequencies than men (table 2 and fig. 4A), which leads to the assumption of a preferential investment in boys (Guatelli-Steinberg and Lukacs, 1999): as the tooth crown records stress events that occurred during its formation (i.e. childhood).

These sex differences continued during adulthood with males displaying higher carbon and nitrogen isotopic values than females (fig. 6 and table 3). This result indicates they had a higher intake in animal protein than the women.

There is little mention of gender difference in diet in the ancient population of Rapa Nui. A. Métraux (Métraux, 1940, p. 164) quotes a description of a banquet by Father Zumbohm in 1879, which details the order in which the guests received their food: the best pieces were given to the missionaries, then the chief and his friends were served, the commoners helped themselves, and the women and children were served last. "From a delicacy like chicken or fish all they got was the bones to chew and these bones were already chewed once or twice".

Age effect

A higher percentage of *cribra orbitalia* in children, compared to adults (table 2), has already been recorded in numerous other populations (Polet and Orban, 2001, p. 120; Pietrusewsky et al., 1997) and can be explained by the healing and disappearance of the lesions with age.

The higher nitrogen isotopes for the 0–3 year class can be explained by the fact that they were breastfed. Prior to and immediately after birth, the $\delta^{15}N$ values of babies are the same as those of their mothers (Fuller et al., 2006). Afterwards, by exclusively consuming their mother's milk, a human product, babies are one trophic level higher than their mother: they show 2–3‰ higher $\delta^{15}N$ values (Fogel et al., 1997). After the introduction of supplementary foods, infant $\delta^{15}N$ values decrease and gradually approach the values found in adults.

The low $\delta^{15}N$ values in two of the young children can be explained by the fact that the 2-year old child was probably already weaned, and that the baby probably died at birth without consuming any of its mother's milk.

The diet of the children from 4 years up was more or less similar to that of adults, indicating that they were fully weaned.

Spatial distribution effect

On the basis of the stable isotope analysis, we can state that there was no noteworthy difference in diet between individuals buried in the *ahu* or individuals buried in caves. Leslie Shaw (Shaw, 2000) mentioned that burial patterns were very similar in both caves and *ahu* tombs, which may indicate that we are probably dealing with the same groups, each with its own dietary habits, burying their dead in both structures.

We observed clusters of individuals according to their place of burial as this can often indicate family or tribe dietary specificities. However, the isotopic variations did not match the tribal land divisions recorded by Katherine Routledge (Routledge, 1919, p. 221–224). For example, the individuals from Ahu Nau Nau and those from Ahu Kihi Kihi Rau Mea, both located on the Miru tribe land (fig. 1), displayed quite different nitrogen and carbon isotopic values (fig. 8). It should also be mentioned that these land divisions were recorded as late as the twentieth century, and they may have changed over time.

A greater consumption of marine products may explain the dental microwear pattern in Ahu Nau Nau and its higher value of nitrogen and carbon isotopes. This 'privileged' diet is probably related to the taboos *(tapu)* they imposed on the other islanders (Métraux, 1940, p. 130–132). Fishing *tapu* was applied from May to October but did not apply to the nobles. During these months, only the royal canoe could be used for fishing, with a crew composed of important men (Métraux, 1940, p. 173). All the fish caught from the royal canoe were presented to the king, who kept them for his own use or, more often, distributed them among the elders (this may have also played a role in dietary gender difference). Other arguments also support a dietary difference between the individuals buried in Ahu Nau Nau and those buried elsewhere: the remains of offshore fishing hooks were more prevalent in the west and north of the island, which is where the royal *ahu* was (Ayres, 1979): the only harpoon head was discovered in Anakena Bay (Wallin, 1996) and the majority of petroglyphs depicting marine organisms, canoes or implements relating to deep-water fishing activities are located in the north of the island (Lee, 1992, p. 74–96, 104–112, and 113–115).

Furthermore, Ahu Nau Nau individuals are characterized by a lower rate of *cribra orbitalia* than the other Easter Islanders (Polet, 2006). Suggesting that they were less anaemic or less vitamin B12 deficient (Walker et al., 2009), probably thanks to a higher intake of iron- and/or cobalamin rich foods, such as meat and seafood.

Temporal changes in diet

The dental microwear data (orientation and length of scratches) indicated a decrease in the consumption of ani-

mal products post deforestation (Polet et al., 2008). However, the small number of individuals analyzed clearly date to the second half of the seventeenth century, which prevents us from drawing firm conclusions.

Nevertheless, the stable isotopes study of A. Commendador and coworkers (Commendador et al., 2013) demonstrated a decline in nitrogen isotopes ratios through time during the pre-contact period. They interpreted this result as a chronological decrease of the consumption of terrestrial animal proteins. Surprisingly though they did not observe changes after the historic contact.

As most of the burial sites we studied were used over long periods of time, we can assume that the dietary differences between genders and lineages continued during the post-contact period or at least until the disappearance of most of the population following the Peruvian slave trade and subsequent epidemics.

CONCLUSION

This study aimed to document the diet of ancient Easter Islanders from the seventeenth to the nineteenth century.

The dental microwear data confirmed that tubers were their staple food. Stable isotopes indicated that on average one third of their proteins originated from the sea. Stress indicators showed that child malnutrition was far from severe. The dental microwear data also suggested a decrease of animal product consumption related to deforestation, which was confirmed by the stable isotopes data of A. Commendador and coworkers (Commendator et al., 2013). Similarly, we deduced that the Easter Islanders relied more on terrestrial food resources than other Pacific islanders.

Within our sample, we observed sex differences in stable isotopes revealing that women ate significantly less animal products. Stress indicators also suggested gender disparities in the access to basic resources, resulting from a preferential investment in sons. We showed that children were breastfed until three years old. The clustering of isotopic signatures according to the place of burial *(ahu)* may indicate family dietary specificities. However, no difference in diet was observed between individuals buried in the ahu or individuals buried in caves, suggesting the same groups of people used both structures for funerary purpose. With regard to social status, our study showed that the royal *ahu* can be distinguished from other ahu on the basis of the stable isotopes data, the dental microwear pattern and the frequency of cribra orbitalia. A greater consumption of marine products could be the origin of this distinction.

Acknowledgements: The Belgian Federal Science Policy financially supported the Belgian expeditions to Easter Island. I am most indebted to Francisco Torres Hochstetter, director of the Father Sebastian Englert Anthropological Museum (Easter Island) for giving me access to the anthropological collections. I thank Nicolas Cauwe (RMAH) and Dirk Huyge (RMAH) for enabling my discovery of Easter Island and for inviting me to take part in their archaeological expeditions. Julien Cillis (RBINS) produced the SEM photographs. The analyses of stable carbon and nitrogen isotopes were performed by mass spectrometry at the Institut für Geowissenschaften, Eberhard-Karls Universität Tübingen (Germany) under the supervision of Hervé Bocherens. My thanks go to Eric Dewamme (RBINS) and Patrick Semal (RBINS) for the photographs of the skeletons. I am especially thankful to Rosine Orban (RBINS) and Serge Lemaitre (RMAH) for helpful discussions on drafts of the manuscript. I appreciate the help of Tara Chapman (ULB) for the correction of my English.

NOTES

(1) The Dutch explorer Jacob Roggeveen was the first European to discover the island in 1722 on Easter Day, hence its name.

(2) The actual proportion of marine food in their diet must have been lower since collagen is preferentially produced from dietary proteins (Ambrose and Norr, 1993)

BIBLIOGRAPHICAL REFERENCES

Ambrose S. H., Norr L. (1993) – Experimental Evidence for the Relationship of the Carbon Isotope Ratios of Whole Diet and Dietary Protein to Those of Bone Collagen and Carbonate, in J. B. Lambert. and G. Grupe (eds.), *Prehistoric Human Bone: Archaeology at the Molecular Level*, New York, Springer, p. 1–37.

Ayres W. S. (1979) – Easter Island Fishing, *Asian Perspectives*, 22, 1, p. 61–92.

Ayres W. S. (1985) – Easter Island Subsistence, *Journal de la Société des océanistes*, 41, 80, p. 103–24.

Ayres W. S., Saleeby B. (2000) – Analysis of Cremations from Ahu Ko Te Riku, in C. M. Stevenson and W. S. Ayres (eds.), *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, p. 125–31.

Ayres W. S., Saleeby B., Levy C. (2000) – Late Prehistoric-Early Historic Easter Island Subsistence Patterns, in C. M. Stevenson and W. S. Ayres (eds.), *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, p. 191–203.

Bahn P. G. (1993) – The History of Human Settlement on Rapanui, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books (Oxbow Monograph, 32), p. 53–55.

Bahn P. G., Flenley J. (1992) – *Easter Island, Earth Island: A Message from Our Past for the Future of Our Planet*, London, Thames and Hudson, 240 p.

Bocherens H., Drucker D. (2005) – Biogéochimie isotopique et reconstitution de l'alimentation des humains

anciens et des hominidés fossiles, in O. Dutour, J.-J. Hublin and B. Vandermeersch (eds.), *Origine et évolution des populations humaines*, Paris, CTHS (Orientations et méthodes, 8), p. 343–61.

Bocherens H., Fizet M., Mariotti A., Lange-Badré B., Vandermeersch B., Borel J.-P., Bellon G. (1991) – Isotopic Biogeochemistry (^{13}C, ^{15}N) of Fossil Vertebrate Collagen: Application to the Study of a Past Food Web Including Neandertal Man, *Journal of Human Evolution*, 20, p. 481–92.

Boersema J. J. (2015) – *The Survival of Easter Island: Dwindling Resources and Cultural Resilience*, Cambridge, Cambridge University Press, 308 p.

Cauwe N. (2011) – *Île de Pâques. Le grand tabou : dix années de fouilles reconstruisent son histoire*, Louvain-la-Neuve, Versant-Sud, 160 p.

Cauwe N., Huyge D., De Meulemeester J., De Dapper M., Claes W., Coupé D., De Poorter A. (2006) – Ahu Motu Toremo Hiva. Vie et mort de monuments cultuels sur 1'île de Pâques, *Anthropologica et Præhistorica*, 117, p. 89–114.

Commendador A. S., Dudgeon J. V., Finney B. P., Fuller B. T., Esh K. S. (2013) – A Stable Isotope ($\delta^{13}C$ and $\delta^{15}N$) Perspective on Human Diet on Rapa Nui (Easter Island) ca. AD 1400–1900, *American Journal of Physical Anthropology*, 152, 2, p. 173–85.

Commendador A. S., Dudgeon J. V., Fuller B. T., Finney B. P. (2014) – Radiocarbon Dating Human Skeletal Material on Rapa Nui: Evaluating the Effect of Uncertainty in Marine-Derived Carbon, *Radiocarbon*, 56, 1, p. 277–94.

Cummings L. S. (1998) – A Review of Recent Pollen and Phytolith Studies from Various Contexts on Easter Island, in C. M. Stevenson, G. Lee and F. J. Morin (eds.), *Easter Island in Pacific Context, South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, proceedings of the international conference (Albuquerque, 5–10 August 1997), Los Osos and Bearsville, The Easter Island Foundation and Cloud Mountain Press, p. 100–06.

Diamond J. (2005) – *Collapse: How Societies Choose to Fail or Succeed*, New York, Viking Books, 592 p.

Du Feu V. M., Fischer S. R. (1993) – The Rapanui Language, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books (Oxbow Monograph, 32), p. 165–68.

Fischer S. R. (2005) – *Island at the End of the World: The Turbulent History of Easter Island*, London, Reaktion Books, 304 p.

Fischer S. R., Love C. M. (1993) – Rapanui: the Geological Parameters, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books (Oxbow Monograph, 32), p. 1–6.

Flenley J. R. (1993) – The Present Flora of Easter Island and Its Origins, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books, (Oxbow Monograph, 32), p. 7–15.

Flenley J. R., King S. M. (1984) – Late Quaternary Pollen Records from Easter Island, *Nature*, 307, p. 47–50.

Fogel M. L., Tuross N., Johnson B. J., Miller G. H. (1997) – Biogeochemical Record of Ancient Humans, *Organic Geochemistry*, 27, 5-6, p. 275–87.

Fuller B. T., Fuller J. L., Harris D. A., Hedges R. E. M. (2006) – Detection of Breastfeeding and Weaning in Modern Human Infants with Carbon and Nitrogen Stable Isotope Ratios, *American Journal of Physical Anthropology*, 129, p. 279–93.

García-Martín C. (2000) – *Reconstitution du régime alimentaire par l'étude des micro-traces d'usure dentaire*, master thesis, université libre de Bruxelles, 131 p.

Gill G. W., Owsley D. W. (1993) – Human Osteology of Rapanui, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books (Oxbow Monograph, 32), p. 56–62.

Guatelli-Steinberg D., Lukacs J. R. (1999) – Interpreting Sex Differences in Enamel Hypoplasia in Human and Nonhuman Primates: Developmental, Environmental, and Cultural Considerations, *Yearbook of Physical Anthropology*, 42, p. 73–126.

Goodman A. H., Rose J. C. (1990) – Assessment of Systemic Physiological Perturbations from Dental Enamel Hypoplasias and Associated Histological Structures, *Yearbook of Physical Anthropology*, 33, p. 59–110.

Hagelberg E., Quevedo S., Turbo D., Clegg J. B. (1994) – DNA from Ancient Easter Islanders, *Nature*, 369, p. 25–26.

Heyerdahl T., Ferdon E. N. (1961) – *Archaeology of Easter Island, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 1, London, George Allen and Unwin (Monographs of the School of American Research and the Museum of New Mexico, 24), 559 p.

Hunt T. L. (2007) – Rethinking Easter Island's Ecological Catastrophe, *Journal of Archaeological Science*, 34, p. 485–502.

Hunt T. L., Lipo C. P. (2006) – Late Colonization of Easter Island, *Science*, 311, p. 1603–06.

Huyge D., Cauwe N., Forment F., Haoa S. (2002) – The Ahu 'o Rongo Project: Archaeological Research on Rapa Nui, *Rapa Nui Journal*, 16, 1, p. 11–16.

Kirch P. (1984) – *The Evolution of Polynesian Chiefdoms*, Cambridge, Cambridge University Press (New Studies in Archaeology), 328 p.

Lalueza C., Pérez-Pérez A., Turbón D. (1996) – Dietary Inferences through Buccal Microwear Analysis of Middle and Upper Pleistocene Human Fossils, *American Journal of Physical Anthropology*, 100, 3, p. 367–87.

Lavachery H. (1935) – La mission franco-belge dans l'île de Pâques (juillet 1934-avril 1935), *Bulletin de la Société royale belge d'anthropologie et de Préhistoire*, 50, p. 228–64.

Lingström P., van Houte J., Kashket S. (2000) – Food Starches and Dental Caries, *Critical Reviews in Oral Biology and Medicine*, 11, 3, p. 366–80.

Maude H. E. (1981) – *Slavers in Paradise: The Peruvian Labour Trade in Polynesia, 1862–1864*, Stanford, Stanford University, 244 p.

Mays S. A. (1997) – Carbon Stable Isotope Ratios in Mediaeval and Later Human Skeletons from Northern England, *Journal of Archaeological Science*, 24, 6, p. 561–67.

McCall G. (1979) – Kinship and Environment on Easter Island: Some Observations and Speculations, *Mankind*, 12, 2, p. 119–37.

McCall G. (1993) – Little Ice Age: Some Speculations for Rapanui, *Rapa Nui Journal*, 7, 4, p. 65–70.

McCoy P. (1979) – Easter Island, in J. Jennings (ed.), *The Prehistory of Polynesia*, Cambridge, Harvard University Press, p. 135–66.

Métraux A. (1940) – *Ethnology of Easter Island*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 160), 432 p.

Molleson T., Jones K., Jones S. (1993) – Dietary Change and the Effects of Food Preparation on Microwear Patterns in the Late Neolithic of Abu Hureyra, Northern Syria, *Journal of Human Evolution*, 24, 6, p. 455–68.

Mulrooney M. A. (2013) – An Island-Wide Assessment of the Chronology of Settlement and Land Use on Rapa Nui (Easter Island) Based on Radiocarbon Data, *Journal of Archaeological Science*, 40, p. 4377–99.

Orliac C., Orliac M. (1998) – The Disappearance of Easter Island's Forest: Over-Exploitation or Climatic Catastrophe?, in C. M. Stevenson, G. Lee and F. J. Morin (eds.), *Easter Island in Pacific Context, South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, proceedings of the international conference (Albuquerque, 5–10 August 1997), Los Osos and Bearsville, The Easter Island Foundation and Cloud Mountain Press, p. 129–34.

Owsley D. W., Miles A.-M., Gill G. W. (1983) – Caries Frequency in Deciduous Dentitions of Protohistoric Easter Islanders, *Bulletin of the Indo-Pacific Prehistory Association*, 4, p. 143–48.

Owsley D. W., Miles A.-M., Gill G. W. (1985) – Carious Lesions in Permanent Dentitions of Protohistoric Easter Islanders, *The Journal of the Polynesian Society*, 94, 4, p. 415–22.

Oxenham M. F., Cavill I. (2010) – Porotic Hyperostosis and *Cribra Orbitalia*: the Erythropoietic Response to Iron-Deficiency Anaemia, *Anthropological Science*, 118, 3, p. 199–200.

Pietrusewsky M., Douglas M. T., Swift M. K., Harper R. A., Fleming M. A. (2014) – Health in Ancient Mariana Islanders: A Bioarchaeological Perspective, *The Journal of Island and Coastal Archaeology*, 9, p. 319–40.

Pietrusewsky M., Douglas M. T., Ikehara-Quebral R. M. (1997) – An Assessment of Health and Disease in the Prehistoric Inhabitants of the Mariana Islands, *American Journal of Physical Anthropology*, 104, 3, p. 315–42.

Polet C. (2003) – Study of Human Remains Discovered in 2001 at Ahu 'o Rongo, Rapa Nui, *Rapa Nui Journal*, 17, 2, p. 114–18.

Polet C. (2006) – Indicateurs de stress dans un échantillon d'anciens Pascuans, *Antropo*, 11, p. 261–70.

Polet C. (2008) – Apport des isotopes stables à la paléoanthropologie, in P. Charlier (ed.), *Ostéo-archéologie et techniques médico-légales : tendances et perspectives. Pour un « Manuel pratique de paléopathologie humaine »*, Paris, De Boccard (Pathographie, 2), p. 151–63.

Polet C., Bocherens H. (2016) – New Insights into the Marine Contribution to Ancient Easter Islanders' Diet, *Journal of Archaeological Science: Reports*, 6, p. 709–19.

Polet C., Bourdon C., Vercauteren M., Slachmuylder J.-L. (2008) – Apport de la micro-usure dentaire à la reconstitution du régime alimentaire des anciens Pascuans, *Bulletins et mémoires de la Société d'anthropologie de Paris*, 20, 3-4, p. 165–87.

Polet C., Orban R. (2001) – *Les dents et les ossements humains. Que mangeait-on au Moyen Âge ?*, Turnhout, Brepols (Typologie des sources du Moyen Âge occidental, 84), 188 p.

Pollock N. J. (1993) – Traditional Foods of Rapanui, in S. R. Fischer (ed.), *Contributions to the History of Rapanui in Memory of William T. Mulloy*, Oxford, Oxbow Books (Oxbow Monograph, 32), p. 153–57.

Ponting C. (1993) – *A Green History of the World: The Environment and the Collapse of Great Civilisations*, London, Penguin, 448 p.

Routledge K. (1919) – *The Mystery of Easter Island: The Story of an Expedition*, London, Hazell, Watson and Viney, 404 p.

Seelenfreund A. (2000) – Easter Island Burial Practices, in C. M. Stevenson and W. S. Ayres (eds.), *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, p. 81–102.

Shaw L. C. (2000) – Human Burials in the Coastal Caves of Easter Island, in C. M. Stevenson and W. S. Ayres (eds.), *Easter Island Archaeology: Research on Early Rapanui Culture*, Los Osos, Easter Island Foundation, p. 125–31.

Steadman D. W., Casanova P. V., Ferrando C. C. (1994) – Stratigraphy, Chronology and Cultural Context of an Early Faunal Assemblage from Easter Island, *Asian Perspectives*, 33, 1, p. 79–96.

Stevenson C., Haoa S. (1998) – Prehistoric Gardening Systems and Agricultural Intensification in the La Perouse Area of Easter Island, in C. M. Stevenson, G. Lee and F. J. Morin (eds.), *Easter Island in Pacific Context, South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, proceedings of the international conference (Albuquerque, 5–10 August 1997), Los Osos and Bearsville, The Easter Island Foundation and Cloud Mountain Press, p. 205–13.

Stevenson C. M., Puleston C. O., Vitousek P. M., Chadwick O. A., Haoa S., Ladefoged T. N. (2015) – Variation in Rapa Nui (Easter Island) Land Use Indicates Production and Population Peaks Prior to European Contact, *Proceedings of the National Academy of Sciences*, 112, 4, p. 1025–30.

Stodder A. L. (1997) – Subadult Stress, Morbidity, and Longevity in Latte Period populations on Guam, Mariana Islands, *American Journal of Physical Anthropology*, 104, 3, p. 363–80.

Stuart-MacAdam P. (1992) – Porotic Hyperostosis: A New Perspective, *American Journal of Physical Anthropology*, 87, 1, p. 39–47.

Teaford M. F. (1994) – Dental Microwear and Dental Function, *Evolutionary Anthropology*, 3, 1, p. 17–30.

Turner C. G., Scott G. R. (1977) – Dentition of Easter Islanders, in A. A. Dahlberg and T. M. Graber (eds.), *Orofacial Growth and Development*, Berlin, De Gruyter Mouton (World Anthropology), p. 229–49.

Tykot R. H. (2004) – Stable Isotopes and Diet: You Are What You Eat, in M. Martini, M. Milazzo and M. Piacentini (eds.), *Physics Methods in Archaeometry*, Amsterdam, IOS Press (Proceedings of the International School of Physics 'Enrico Fermi', 154), p. 433–44.

Ungar P. S. (1995) – A Semiautomated Image Analysis Procedure for the Quantification of Dental Microwear II, *Scanning*, 17, p. 57–59.

Walker P. L., Bathurst R. R., Richman R., Gjerdrum T., Andrushko V. A. (2009) – The Causes of Porotic Hyperostosis and *Cribra Orbitalia*: A Reappraisal of the Iron-Deficiency-Anaemia Hypothesis, *American Journal of Physical Anthropology*, 139, 2, p. 109–25.

Wallin P. (1996) – A Unique Find on Easter Island, *Rapa Nui Journal*, 10, 4, p. 99–100.

Young L. B. (1991) – Easter Island: Scary Parable, *World Monitor*, 4, 8, p. 40–45.

Caroline Polet
Direction opérationnelle Terre et Origine de la Vie,
Institut royal des sciences naturelles de Belgique,
29, rue Vautier,
B-1000 Bruxelles, Belgium
caroline.polet@sciencesnaturelles.be

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 125-140
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Variabilité des espaces dunaires dans l'archipel des Marquises

Approche comparative des séquences d'occupation littorale sur l'île de Ua Huka

Guillaume Molle et Éric Conte

Résumé : Les travaux archéologiques conduits sur les îles Marquises s'inscrivent dans deux types d'espaces complémentaires propres aux paysages de l'archipel et tendent à considérer séparément les zones intérieures des vallées et les systèmes dunaires. Véritables interfaces entre les milieux maritimes et terrestres répondant au modèle de « distribution libre idéale », ces derniers ont, depuis le début des recherches, été vus comme des secteurs privilégiés susceptibles de livrer des traces de premier peuplement, hypothèse qui, par ailleurs, a souvent été confirmée. Pourtant, les investigations menées sur plusieurs secteurs dunaires de l'île de Ua Huka, dans le groupe nord, ont montré que les occupations humaines anciennes qui leur sont associées variaient tant du point de vue de leur profondeur chronologique que de leur nature. L'ouverture de larges surfaces de fouilles a notamment permis de mettre en évidence des transformations successives des activités à travers le temps, allant de hameaux de pêcheurs à des cimetières ou des postes de guet, voire des sites cérémoniels *tapu*. Nous proposons ici une approche comparative de plusieurs sites dunaires de Ua Huka dont les séquences sont documentées archéologiquement afin de mettre en évidence une variabilité chronologique et fonctionnelle de leur occupation permettant une réévaluation de ce type de paysage dans l'environnement insulaire marquisien pré-européen.

Mots-clés : Marquises, complex dunaires, stratigraphie, datations radiocarbone, séquence culturelle.

Variability of Dune Systems in the Marquesas Archipelago: Comparative Approach of Coastal Occupation Sequences on Ua Huka Island

Abstract : Archaeological fieldwork in the Marquesas took place in two types of landscapes complementary to each other: the interior valleys and the coastal dunes. Located between sea and terrestrial environments, the dunes participate in the 'ideal free distribution' model and, as such, they have been considered by archaeologists as favorable places for recovering ancient remains from the first human settlements. However, our investigations on Ua Huka Island, in the northern group, demonstrate that the nature of human occupation on the dunes has changed through time. By excavating large areas, we recovered many remains that testified to various human activities: fishing hamlets, cemeteries, observation posts, and ceremonial sites. In this article, we propose a comparative approach of several dune systems on Ua Huka with chronological sequences that are now well-documented. We highlight their temporal and functional variability, which allow us to assess the nature of these locations in the Marquesas environment.

Keywords: Marquesas, coastal dunes, stratigraphy, radiocarbon dating, cultural sequence.

L'évocation des îles polynésiennes a toujours, depuis leur redécouverte par les Occidentaux au xvie siècle et les descriptions que ceux-ci en donnèrent, renvoyé à l'image de rivages accueillants, de plages de sable blanc ou noir bordées par les lagons des îles hautes et des atolls. La pérennité de ce tableau idyllique, partie prenante du mythe de la Nouvelle-Cythère par lequel Bougainville décrivait Tahiti, en vint parfois à limiter la vision de ces environnements insulaires à ces seuls espaces. L'origine et l'évolution des îles volcaniques ont toutefois contribué à dessiner des lignes de rivage aux aspects variés sur lesquelles, il y a plus de mille ans, les communautés ont posé le pied et commencé à bâtir leur histoire. Parmi ces espaces littoraux,

les complexes dunaires représentent des lieux privilégiés où l'archéologie se confronte à une réalité passée, révélant de ces sociétés une manière de vivre et d'éprouver leur territoire. Nous souhaitons étudier ici comment les sociétés pré-européennes des îles Marquises (Polynésie française) s'appropriaient ce type d'espace, véritable interface entre terre et mer.

Les dunes constituent des structures biogéographiques dont la formation résulte de l'action conjointe de la mer et du vent sur un trait de côte présentant des caractéristiques topographiques, géomorphologiques et végétales particulières. Leur processus général de formation est bien documenté (voir Davidson-Arnott, 2010), bien que les paramètres pris en compte doivent souvent être appréciés au cas par cas. Parmi ceux-ci, la dérive littorale apportant le sédiment depuis le large, l'amplitude des marées, l'intensité de la déflation éolienne ou encore la largeur de l'estran constituent les facteurs principaux. Les dunes bordières évoluent ainsi en arrière des plages selon un rythme d'engraissement soumis à ces paramètres mais aussi aux phénomènes saisonniers d'accrétion et d'érosion. Enfin, le développement d'une végétation adaptée au contexte sableux (psammophile), permet de fixer le sédiment et de stabiliser la dune grâce à un système racinaire développé tant en surface qu'en profondeur. Ajoutons aussi que les phénomènes météorologiques paroxystiques tels que les cyclones ou les tsunamis, par ailleurs assez fréquents dans la zone Pacifique, participent de l'évolution des complexes littoraux en perturbant ou détruisant l'accumulation sédimentaire (Goff *et al.*, 2009).

Les conditions environnementales de la zone Pacifique sont globalement favorables à la formation de complexes dunaires. Bon nombre d'entre eux ont livré des vestiges archéologiques témoignant d'une occupation ancienne. Ainsi, la zone côtière de Sigatoka sur l'île de Viti Levu à Fidji, le plus grand système dunaire du Pacifique après les complexes de la côte est australienne, fut fréquenté dès l'époque Lapita (Dickinson *et al.*, 1998). En Polynésie orientale, outre les sites marquisiens dont certains seront étudiés plus loin, on rencontre des espaces semblables anciennement occupés dans l'archipel de Hawaii, à Halawa, Molokai (Kirch et McCoy, 2007), Bellows, O'ahu (Tuggle et Spriggs, 2000), et Pu'u Ali'i, Hawaii (Emory et Sinoto, 1969), à l'île de Pâques, sur le site de Anakena (Hunt et Lipo, 2006) ou encore en Nouvelle-Zélande, à Houhura (Furey, 2002)..

Néanmoins, d'un point de vue géomorphologique, il semble que le terme de « dune » ait souvent été employé à tort pour désigner certains des systèmes côtiers sur lesquels des traces d'occupation humaine ancienne ont été mises en évidence. Dans la plupart des cas, il semble plus approprié de parler de crêtes de plage *(beach ridges)* limitant en arrière de simples accumulations sableuses (Dickinson, 2014, p. 249 ; Paulmier, 2013, p. 30). C'est ainsi le cas de sites initialement désignés comme des dunes tels que Taitapu-Rivnac à Tahiti, îles de la Société (Eddowes et Dennison, 1996), ou encore Atiahara à Tubuai, îles Australes (Hermann, 2013 ; Dickinson, 2014). À l'exception de l'archipel des Gambier où quelques sites ont été étudiés, comme à Onemea sur l'île de Taravai (Kirch *et al.*, 2010), la majorité des systèmes dunaires en Polynésie française sont localisés aux Marquises où un ensemble de paramètres (absence de récif corallien, déclivité marquée et profondeur des baies, amplitudes de marées plus fortes de 0,5 à 1 m, zones d'estran plus larges) favorisent leur développement.

À la différence des îles de la Société, les îles Marquises ne présentent pas de plaine côtière et les crêtes rayonnant depuis le sommet des anciens volcans plongent directement dans l'océan en des falaises à l'aspect parfois impressionnant. De fait, l'environnement marquisien offre une distinction marquée entre deux principaux types de paysage représentés par les zones littorales souvent occupées par des systèmes dunaires et les vallées intérieures qui constituent à elles seules des entités géographiques à part entière. L'expérience archéologique acquise depuis maintenant près de 60 ans dans l'archipel a montré que ces deux types d'espace répondaient à des problématiques chronologiques et historiques différentes bien que complémentaires.

CONSIDÉRATIONS À PROPOS DES ESPACES LITTORAUX MARQUISIENS : DES ESPACES ARCHÉOLOGIQUES PRIVILÉGIÉS

L'histoire de la recherche archéologique dans l'archipel des Marquises témoigne d'un grand intérêt porté à la fouille et à l'étude des complexes dunaires. Il est certain que d'un point de vue pratique, la qualité de préservation des vestiges archéologiques (tant les traces d'habitat que les restes mobiliers et fauniques) dans ce type d'environnement est remarquable. Il s'agit d'ailleurs d'une caractéristique déjà relevée par R. C. Suggs lors de ses travaux pionniers sur la dune de Ha'atuatua, à Nuku Hiva, et qu'il mettait en exergue en introduction de sa monographie (Suggs, 1961, p. 16). Le drainage naturel qu'offre un volume de sable, en comparaison des sols humides et acides des vallées, permet en effet une meilleure conservation du matériel, notamment coquillier et osseux, en milieu sec. De plus, les phénomènes de recouvrement éolien inhérents aux dunes conduisent à un ensablement rapide qui protège naturellement les vestiges des détériorations extérieures lors des phases d'abandon des sites.

Mais si les dunes ont fait l'objet d'une attention particulière, c'est aussi et surtout en raison des problématiques de recherche inhérentes aux espaces littoraux, ces derniers occupant une place privilégiée dans la réflexion historique relative à l'occupation humaine des îles polynésiennes. En effet, la nature des espaces côtiers révèle aux archéologues la perception, comme l'usage, qu'en avaient les Marquisiens autrefois. Les dunes littorales représentent avant tout les points d'atterrage des pirogues de voyage amenant à leur bord les colons désireux

de s'installer sur ces terres nouvellement découvertes. Les plages constituaient ainsi les points de contact entre les groupes humains et leur nouvel environnement qu'ils commencèrent dès lors à s'approprier. Ce temps de la découverte n'est pas moins dépourvu de risques. Ces arrivants se retrouvent dans une situation momentanée de fragile équilibre au cours de laquelle leur survie dépendra essentiellement de la manière dont ils gèreront les ressources immédiatement disponibles, tout en développant les bases d'une économie de subsistance locale plus durable (Anderson, 1996). Dans ces tout premiers moments de l'installation humaine, on considère que les schémas d'occupation répondent théoriquement au modèle de la « distribution libre idéale » *(ideal free distribution)*. Ce modèle, initialement développé par les écologues (Fretwell et Lucas, 1970 ; Fretwell, 1972), prédit qu'un groupe d'individus se répartira de manière privilégiée dans les milieux les plus à mêmes de lui procurer les ressources nécessaires à sa survie. Ils opèrent ainsi une sélection de la niche écologique à occuper, c'est-à-dire ici leur habitat, en fonction de sa plus grande viabilité. Un tel postulat s'avère particulièrement utile pour penser l'occupation de territoires aussi limités que les îles et, à ce titre, fut appliqué à divers cas dans le Pacifique (Kennett *et al.*, 2006 ; Winterhalder *et al.*, 2010). Dans un tel modèle, les zones littorales constituent des espaces privilégiés favorables à la survie des premières communautés en cela qu'elles jouent le rôle de véritables interfaces entre terre et mer, deux milieux écologiques dont l'exploitation conjointe explique la réussite de l'entreprise humaine. À ce titre, les dunes pourraient être assimilées à des écotones (Bellwood, 1979, p. 317). Leur position, géographiquement stratégique dans un environnement marquisien dépourvu de plaine côtière, offre un accès direct tant aux secteurs de basse vallée, pour la mise en culture de plantes alimentaires et utiles et l'essentielle collecte de bois, qu'à la mer et ses ressources (pêche, collecte de coquillages et d'algues). La fréquentation des zones littorales par les communautés de pêcheurs ne cessera d'ailleurs jamais au cours de l'histoire marquisienne, même après l'installation définitive des villages dans les moyennes vallées, plus favorables au développement intensif de l'horticulture.

Si elles furent les points d'atterrage et les premiers lieux de vie des nouveaux migrants, les dunes bordières sont aussi les lieux d'où partent et reviennent les voyages vers « l'extérieur », quelle que soit la manière dont on définit celui-ci : les vallées voisines, les îles proches ou lointaines, accueillant les communautés avec lesquelles le groupe entretient un ensemble de rapports, tantôt pacifiques lorsqu'ils s'inscrivent dans les réseaux d'échanges qui ont cours jusqu'au milieu du XV^e^ siècle (Rolett, 2002 ; Rolett *et al.*, 1997), tantôt belliqueux lorsqu'il s'agit des conflits guerriers parfois violents qui agitent l'archipel à l'arrivée des Occidentaux (Thomas, 1990). Ce besoin d'interaction, appelant par ailleurs des modalités d'occupation spatiale variées, s'avérait d'autant plus nécessaire que le développement des chefferies marquisiennes était circonscrit à l'entité géographique de la vallée, limitée de part et d'autre par des crêtes élevées difficilement franchissables et formant de véritables frontières avec les territoires voisins, ennemis ou alliés (Ottino-Garanger et De Bergh, 1990 ; Ottino-Garanger, 1993 ; Ottino-Garanger et Ottino-Garanger, 2010).

Enfin, la fonction d'interface attribuée aux secteurs côtiers reste valable au-delà des limites chronologiques des archéologues. En redéfinissant la notion de rivage, l'historien G. Dening (Dening, 1999) portait de nouveau un intérêt sur cet espace où s'opérait, plusieurs siècles après la découverte des îles, la rencontre entre les marquisiens *enata* et les *hao'e*, ces étrangers occidentaux qui, débarquant de leurs navires, intégraient ces territoires à l'histoire européenne. Les nécessités colonialistes, commerciales et missionnaires conduiront au cours du XIX^e^ siècle à un abandon progressif des zones d'habitat traditionnelles situées à l'intérieur des terres au profit de regroupements villageois autour des principales baies de l'archipel, réaffirmant de la sorte la vocation d'interface de ces dernières.

Les secteurs littoraux présentent donc des intérêts multiples qui justifient, du moins de manière théorique, leur fréquentation continue tout au long de l'histoire. Une telle assertion impliquerait pour les archéologues l'existence sur ces dunes de séquences stratigraphiques de longue durée et bien préservées. Pourtant, loin de projets de recherche initialement dirigés vers l'exploration de ces espaces, la découverte du potentiel archéologique des dunes marquisiennes fut en réalité en grande partie due au hasard. En 1946, un tsunami détruisit le front de la dune de Ha'atuatua sur la côte est de Nuku Hiva, mettant accidentellement au jour des vestiges d'habitat ainsi que des sépultures humaines. Il en fut de même quelques années plus tard à Hane, sur l'île voisine de Ua Huka où, en 1960, le sommet de la dune fut lessivé par un autre raz-de-marée, faisant ainsi apparaître en surface les restes de pavages autour duquel étaient éparpillés des fragments d'herminettes, de pilons en pierre et d'hameçons en nacre (Sinoto et Kellum, 1965). Les travaux entrepris alors par R. C. Suggs et Y. Sinoto sur ces deux sites côtiers révélèrent des stratigraphies complexes dans lesquelles les niveaux d'occupation anthropique se succédaient parfois sur des profondeurs importantes, témoignant d'une étendue temporelle rare en contexte archéologique polynésien. Outre la reconnaissance de ces niveaux et le riche matériel qui leur était associé, ces travaux bénéficièrent des développements alors très récents de la méthode de datation par le radiocarbone, offrant ainsi à la communauté scientifique les premières datations jamais effectuées en Polynésie française. Même si les datations obtenues à l'époque présentaient des différences de plusieurs siècles, c'est à Ha'atuatua et à Hane que furent obtenues les plus anciennes. Dès lors, et malgré les débats et dissensions relatifs à la chronologie qui apparurent au cours des années 1980, ces complexes dunaires devinrent des sites-clefs intégrés aux divers modèles de peuplement qui furent successivement proposés (Suggs, 1961 ; Sinoto, 1970a et 1970b ; Kirch, 1986 ; Allen, 2004 et 2014 ; Allen et McAlister, 2010).

La mise en évidence de ces séquences dunaires, à la fois anciennes et relativement longues, tendrait donc à confirmer l'importance des espaces littoraux dont il était question auparavant. La multiplication des travaux archéologiques au cours des deux dernières décennies a néanmoins apporté un ensemble d'informations qu'il nous semble aujourd'hui nécessaire d'appréhender non seulement dans une perspective élargie mais également à une échelle plus grande que celle du site lui-même. Au travers d'une approche comparative des séquences d'occupation littorales mises en évidence sur l'île de Ua Huka, cet article cherche à définir plus précisément la valeur historique de ce type d'espace : l'intensité supposée des occupations est-elle réelle ou à nuancer ? Peut-on identifier d'autres fonctions accordées à ces secteurs que celles précédemment supposées ? Ces fonctions évoluent-elles à travers le temps de manière semblable à l'échelle d'une île, révélant ainsi des trajectoires historiques similaires, ou au contraire varient-elles d'un site à l'autre selon des modalités d'adaptation culturelle propres à chaque groupe social ?

SÉQUENCES D'OCCUPATION SUR LES SITES DUNAIRES DE UA HUKA

L'approche comparative que nous souhaitons ici mettre en œuvre s'appuie sur un vaste ensemble de données archéologiques recueillies sur l'île de Ua Huka, située dans le groupe nord de l'archipel marquisien (fig. 1). Cette île, redécouverte en 1791 par Joseph Ingraham, est de taille relativement modeste puisqu'elle ne présente qu'une superficie de 81 km², bien moindre que sa voisine Nuku Hiva (387 km²). De fait, il est envisageable d'y conduire des recherches extensives à même de livrer des clés de compréhension à diverses problématiques qui se posent tant dans l'archipel que dans la région de Polynésie orientale. Pour cette raison, elle fut désignée comme une « île-test » sur laquelle É. Conte lança, au début des années 1990, un programme de recherche qui se poursuit aujourd'hui encore sous la direction des deux auteurs. Au travers de cette approche globale de la préhistoire marquisienne focalisée à l'échelle d'une île, de nombreuses missions de terrain, comprenant à la fois inventaires de surface et fouilles stratigraphiques, se sont succédées au cours des vingt dernières années (Conte, 2002 ; Molle, 2011a et 2011b ; Conte et Molle, 2012). Dans la perspective initiale de reconstituer la séquence chronoculturelle de Ua Huka, et nous basant sur les hypothèses précédemment énoncées quant à la nature et la fonction des espaces côtiers, une grande partie de notre attention s'est portée sur l'étude détaillée d'un ensemble de sites dunaires. En raison de la géologie de l'île, ces complexes dunaires sont localisés aux embouchures des vallées de la côte sud, celle-ci étant exposée aux alizés dominants venant du sud-est qui participent ainsi à leur formation. À l'inverse, la côte nord, par ailleurs extrêmement sèche et peu favorable à une implantation humaine durable, n'offre jamais de plage dans les petites vallées qu'elle comprend. Il n'est pas impossible que les baies de la côte orientale aient autrefois accueilli des systèmes dunaires plus ou moins développés mais, si tel fut le cas, ceux-ci ont été entièrement remodelés et recouverts par les débris rocheux apportés des fonds de vallée par les précipitations abondantes qui accompagnèrent les pas-

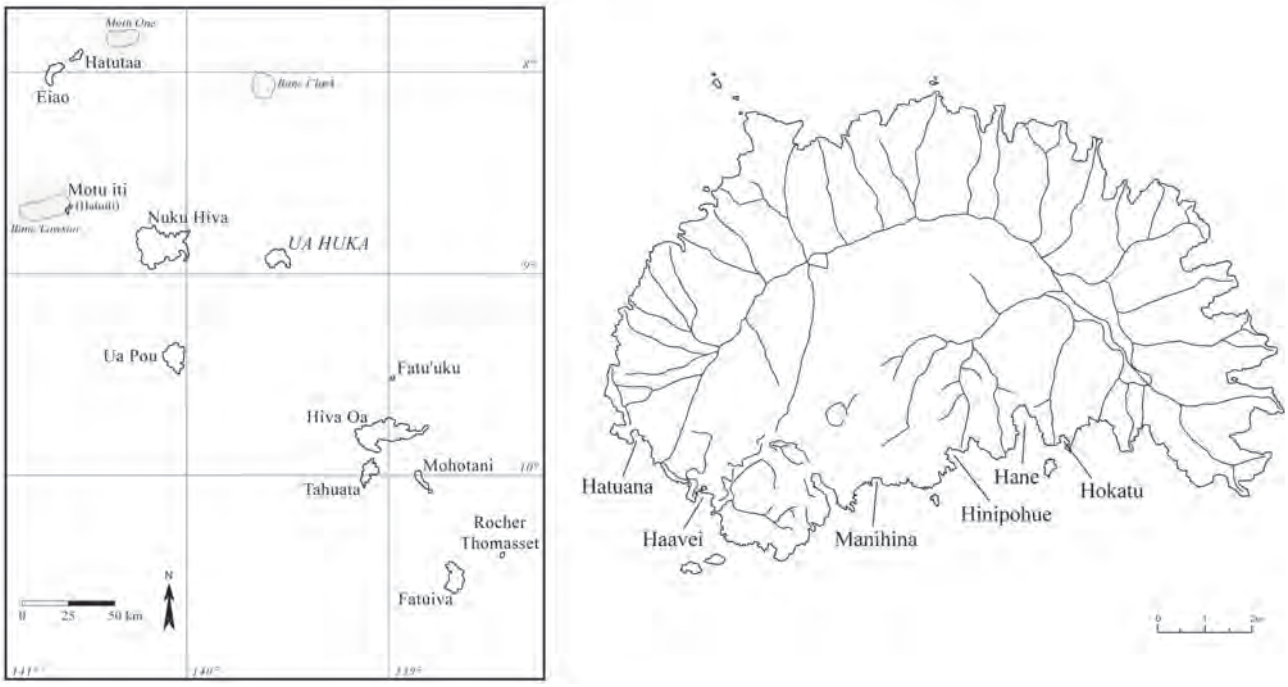


Fig. 1 – Carte de l'archipel marquisien et localisation des sites de Ua Huka mentionnés dans le texte.
Fig. 1 *– Map of the Marquesas archipelago and location of the Ua Huka sites mentioned in the texte.*

sages de cyclones. Sur les cinq principaux complexes dunaires connus de la côte sud, quatre ont fait l'objet de recherches intensives (Hane, Manihina, Hinipohue et Hatuana), tandis que le dernier, Haavei, n'a jusqu'à présent été sondé que de manière préliminaire. Ce site, tout comme celui de Hokatu, ne sera que brièvement présenté avant d'être intégré à notre réflexion finale.

Hane, un site-clef pour le peuplement et l'histoire des Marquises

Faisant suite à sa découverte fortuite par Y. Sinoto en 1963, le site de Hane (désigné alors sous la référence MUH-1 par l'archéologue) devint rapidement un site-clef pour la préhistoire des Marquises en raison de la richesse de son matériel et de la chronologie qu'il livra. La campagne de fouille menée en 1964-1965 mit en évidence, quelques années à peine après les travaux pionniers de R. C. Suggs à Ha'atuatua, le potentiel de ce site dunaire en révélant une stratigraphie complexe à laquelle était associée une collection de plus de deux mille objets (Sinoto et Kellum, 1965). Les résultats des datations par le radiocarbone conduisirent Y. Sinoto à développer un premier modèle de peuplement de la Polynésie orientale qualifié de « discontinu » (Sinoto, 1970a et 1970b). Ces dates furent cependant critiquées et remises en question par la suite, entraînant des débats parfois virulents entre les chercheurs engagés dans la région qui réinterprétèrent les résultats en vue de présenter des modèles alternatifs (Kirch, 1986 ; Spriggs et Anderson, 1993 ; Anderson *et al.*, 1994 ; Rolett, 1998 ; Anderson et Sinoto, 2002). Outre la question de la colonisation, Y. Sinoto s'appuya également sur les données recueillies à Hane pour proposer une séquence chrono-culturelle de l'histoire marquisienne (Sinoto, 1966).

Néanmoins, malgré l'intérêt indiscutable de ce site, force est de constater que très peu de données ont été réellement publiées, créant ainsi un manque d'information extrêmement dommageable quant à l'analyse stratigraphique, le nombre et la distribution des artefacts ainsi que la description précise des contextes dans lesquels furent recueillis les échantillons soumis à datation. Pour ces raisons, il apparaissait nécessaire de conduire une nouvelle fouille afin de pallier ces difficultés méthodologiques et de produire une synthèse générale. Une campagne fut menée en 2009 par les auteurs sur un secteur de la dune haute non impacté par les travaux antérieurs (zone B d'Y. Sinoto). Les fouilles, réalisées sur une surface de 18 m², livrèrent une succession de dix niveaux sur une profondeur de 2,3 m (fig. 2). Notre analyse

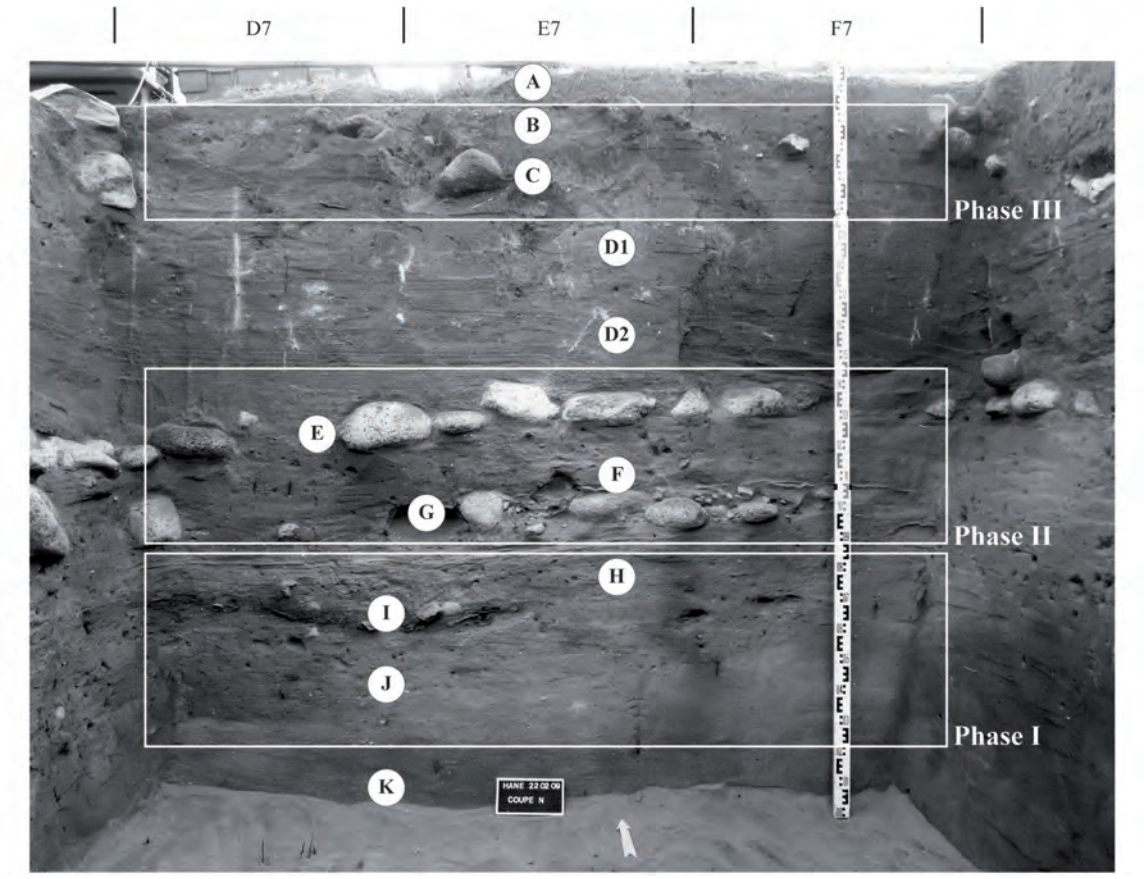


Fig. 2 – Synthèse des datations obtenues sur les sites côtiers de Ua Huka. Stratigraphie du site de Hane (paroi nord de la fouille de 2009).
***Fig. 2** – Overview of the radiocarbon dates obtained for the coastal sites on Ua Huka. Stratigraphic sequence of the Hane site (northern section of the 2009 excavation).*

stratigraphique, qui autant que possible fut rattachée à celle d'Y. Sinoto, est associée à un corpus de dix-sept datations (tabl. 1). Ces résultats nous permettent désormais d'établir une séquence chronologique de l'occupation humaine de cette dune sur une durée de près de six siècles (Conte et Molle, 2014). Celle-ci peut être divisée en trois grandes phases.

La première concerne les niveaux les plus profonds J, I et H. Les niveaux J et I sont identifiés comme des sols de piétinement témoignant d'une occupation initiale caractérisée notamment par la présence de structures de combustion, de fosses, mais aussi de plusieurs artefacts (herminettes et fragments d'hameçons) ainsi que d'une importante quantité de vestiges fauniques. Le niveau H est quant à lui assimilé à une zone de *midden* comportant énormément de restes osseux. Cette phase voit sans aucun doute les premières installations humaines sur la dune qui ont pu être datées par plusieurs échantillons comme remontant au x^e^ siècle apr. J.-C. Elles se poursuivent probablement tout au long du xi^e^ siècle et du début du xii^e^ siècle. Le niveau J à Hane présente à ce jour les traces anthropiques les plus anciennes attestées dans l'archipel marquisien, dans un contexte archéologique contrôlé.

La deuxième phase marque un changement dans le mode d'occupation. En effet, aux environs de 1200 apr. J.-C., apparaissent dans les niveaux G et E des pavages en pierre correspondant aux soubassements de maisons construites en matériaux périssables. Deux pavages se succèdent ici sur une période de temps très courte d'environ 50 ans, indiquant une probable destruction de la première maison (niveau G) par le feu (niveau F), immédiatement suivie par l'aménagement d'un deuxième sol (niveau E).

Vallée	N° site / information	N° laboratoire	Matériau	Date (BP)	Date calibrée (2 σ)	Références
Hane	Campagne 2009	Beta-260934	Charbon, indét.	790 ± 40 (AMS)	1174-1281	Conte et Molle, 2014
	Campagne 2009	Beta-260935	Charbon (bois de palmier)	1030 ± 40 (AMS)	895-925 (8,6 %) 936-1048 (79,2 %) 1 087-1123 (5,9 %) 1138-1150 (1,7 %)	Conte et Molle, 2014
	Campagne 2009	Beta-260936	Charbon (bois de palmier)	1000 ± 40 (AMS)	974-1155	Conte et Molle, 2014
	Campagne 2009	Beta-260937	Charbon (bois de palmier)	1070 ± 40 (AMS)	891-1024	Conte et Molle, 2014
	Campagne 2009	Beta-260938	Charbon, indét.	810 ± 40 (AMS)	1159-1278	Conte et Molle, 2014
	Campagne 2009	Wk-27328	Os humain	535 ± 30 (AMS)	1453-1549 (63 %)	Conte et Molle, 2014
	Campagne 2009	Wk-27329	Os humain	579 ± 30 (AMS)	1418-1514	Conte et Molle, 2014
	Campagne 2009	Wk-27330	Charbon, indét.	633 ± 30 (AMS)	1286-1398	Conte et Molle, 2014
	Campagne 2009	Wk-27331	Charbon, indét.	928 ± 30 (AMS)	1025-1173	Conte et Molle, 2014
	Campagne 2009	Wk-29716	Charbon, *aleurites / cerbera* ?	682 ± 25 (AMS)	1272-1310 (64,3 %) 1360-1388 (31,1 %)	Conte et Molle, 2014
	Campagne 2009	Wk-29717	Charbon, indét.	852 ± 25 (AMS)	1058-1073 (2,3 %) 1154-1258 (93,1 %)	Conte et Molle, 2014
	Campagne 2009	Wk-29718	Charbon, indét.	1088 ± 25 (AMS)	894-1014	Conte et Molle, 2014
	Campagne 2009	Wk-29721	Os humain	585 ± 30 (AMS)	1431-1532 (88 %)	Conte et Molle, 2014
	Campagne 2009	Wk-34066	Os humain	686 ± 25 (AMS)	1407-1489	Conte et Molle, 2014
	Campagne 2009	Wk-34067	Os humain	604 ± 25 (AMS)	1441-1545 (84 %)	Conte et Molle, 2014
	Campagne 2009	Wk-34068	Os humain	635 ± 25 (AMS)	1432-1545 (91 %)	Conte et Molle, 2014
	Campagne 2009	Wk-34069	Os humain	618 ± 25 (AMS)	1462-1635	Conte et Molle, 2014
Manihina	MAN-1	Beta-74243	Coquillage	1350 ± 60	950-1269	Conte, 2002
	MAN-1	I-17,852	Charbon, indét.	340 ± 90	1414-1683 (88 %) 1736-1805 (5,9 %) 1935-1953 (1,5 %)	Conte, 2002
	MAN-1	I-17,853	Charbon, indét.	570 ± 100	1226-1515 (94,2 %) 1599-1618 (1,2 %)	Conte, 2002
	MAN-1	I-17,854	Charbon, indét.	590 ± 100	1218-1490 (95,1 %) 1603-1610 (0,3 %)	Conte, 2002
	MAN-1	I-17,917	Os humain	480 ± 100	1459-1883 (1508-1698 à 77 % pour 1 σ)	Conte, 2002
	MAN-3	Beta-116143	Charbon, indét.	non disponible	1675-1775	Conte, 2002

Tabl. 1 – Synthèse des datations obtenues sur les sites côtiers de Ua Huka.
***Table 1** – Overview of the dates obtained for the coastal sites on Ua Huka.*

Vallée	N° site / information	N° laboratoire	Matériau	Date (BP)	Date calibrée (2 σ)	Références
Hatuana	TP 4	Beta-116140	Charbon, indét.	1030 ± 90	780-792 (1 %) 805-1208 (94,4 %)	Conte et Poupinet, 2002
	TP 5	Beta-116141	Charbon, indét.	800 ± 50	1054-1078 (2,4 %) 1153-1287 (93 %)	Conte et Poupinet, 2002
	Campagne 2009	Wk-27332	Charbon, indét.	361 ± 30 (AMS)	1450-1530 (48,5 %) 1542-1635 (46,9 %)	Molle et Conte, 2011
	Campagne 2009	Wk-27333	Charbon, indét.	234 ± 30 (AMS)	1528-1543 (2 %) 1634-1683 (47,5 %) 1737-1804 (36,1 %)	Molle et Conte, 2011
	Campagne 2009	Wk-27334	Charbon, *Thespesia populnea*	170 ± 30 (AMS)	1659-1699 (17,6 %) 1722-1818 (50,7 %) 1833-1880 (8,2 %) 1916-1954 (18,9 %)	Molle et Conte, 2011
	Campagne 2009	Wk-27335	Charbon, *Thespesia populnea*	366 ± 30 (AMS)	1448-1529 (52,5 %) 1551-1634 (42,9 %)	Molle et Conte, 2011
	Campagne 2013	Wk-38089	Charbon, indét. (brindille)	749 ± 23 (AMS)	1224-1235 (4,7 %) 1242-1286 (90,7 %)	Molle, 2014
	Campagne 2013	Wk-38090	Charbon, indét.	690 ± 23 (AMS)	1270-1305 (75,8 %) 1363-1385 (19,6 %)	Molle, 2014
	Campagne 2013	Wk-38091	Charbon, *Hibiscus tiliaceus*	255 ± 23 (AMS)	1526-1557 (9,9 %) 1631-1670 (70,6 %) 1781-1799 (14,9 %)	Molle, 2014
	Campagne 2013	Wk-38092	Charbon, *Cordia subcordata*	265 ± 22 (AMS)	1523-1559 (21,8 %) 1631-1668 (66,8 %) 1782-1798 (6 %)	Molle, 2014
	Campagne 2013	Wk-38093	Charbon, indét.	753 ± 23 (AMS)	1280-1318 (47,4 %) 1353-1390 (48 %)	Molle, 2014
Haavei	HAV-2	I-17,855	Charbon, indét.	440 ± 80	1319-1351 (4,4 %) 1390-1644 (91 %)	Edwards *et al.*, non publié
	HAV-2	I-17,856	Charbon, indét.	350 ± 90	1410-1682 (89,9 %) 1738-1753 (0,7 %) 1762-1803 (3,6 %)	Edwards *et al.*, non publié
Hinipohue	HIP-3	Wk-27336	Charbon, indét.	306 ± 30 (AMS)	1488-1650	Molle, 2011a
Hokatu	Tranchée 2	Wk-8059	Charbon, indét.	860 ± 60 (AMS)	1038-1265 (95,4 %)	Conte et Anderson, 2003
	Tranchée 1	Wk-8060	Charbon, indét.	890 ± 50	1027-1226 (94,8 %)	Conte et Anderson, 2003
	HKT-48	Beta-148759	Charbon, indét.	340 ± 90	1414-1683 (88 %) 1736-1805 (5,9 %)	Conte et Molle, 2012

Laboratoires : Beta- : Beta Analytics ; Wk- : Waikato Radiocarbon Laboratory ; I- : Teledyne. Les identifications botaniques ont été réalisées par R. Wallace et J. Huebert (université d'Auckland, NZ) et G. Murakami (IARII, Hawaii). Les datations sur échantillons de charbon ont été calibrées sur OxCal Vers.4.1.4 (Bronk Ramsey, 1995 et 2001) suivant la *Northern Hemisphere (IntCal09) Calibration Curb* (Reimer *et al.*, 2009). Les datations sur os humains ont été calibrées sur Calib Rev 6.0.1 (Stuiver et Reimer, 1993) suivant la courbe mixte *IntCal09/Marine09*, en tenant compte pour Ua Huka d'un delta r de 45 ± 48 (Petchey *et al.*, 2009). La participation du régime marin a été obtenu au préalable par les analyses isotopiques de $\delta^{13}C$ and $\delta^{15}N$.

Tabl. 1 (suite et fin) **–** Synthèse des datations obtenues sur les sites côtiers de Ua Huka.
***Table 1** (end) – Overview of the dates obtained for the coastal sites on Ua Huka.*

Y. Sinoto avait déjà relevé plusieurs pavages à ce même niveau. En ajoutant les pavages de 2009 à son inventaire, il est possible de circonscrire une zone d'habitation englobant au moins toute l'aire centrale de la dune dont la surface avoisinerait 300 m². Il s'agit d'une approximation minimale puisque les pavages s'étendaient sans aucun doute au-delà des limites de nos fouilles respectives. Une telle concentration de maisons bâties sur des soubassements de pierre suggère la volonté de la communauté de s'installer sur la dune de manière pérenne, voire définitive, selon des modalités spatiales qui laissent supposer la formation d'un petit hameau côtier.

L'épaisse couche de sable stérile du niveau D qui recouvre le dernier pavage marque une réelle rupture dans l'occupation du site et témoigne en premier lieu d'un abandon de la dune. Celui-ci survient au XIII^e siècle, peut-être en raison de changements climatiques liés au « petit âge glaciaire » qui, dans cette région, entraîna

notamment un réchauffement progressif accompagné d'une remontée du niveau marin et d'une intensification du phénomène El Niño (Cobb *et al.*, 2003 ; Allen, 2006 et 2010a). Il est possible que les zones côtières, très fragiles face à de telles transformations environnementales (et particulièrement à l'augmentation des risques cycloniques et de tsunamis), aient alors été désertées en faveur des secteurs de moyennes vallées où commencent par ailleurs à se développer de nouveaux villages autour desquels se réorganise et s'intensifie aussi la production horticole (Kellum-Ottino, 1971).

Après quelques décennies, au début du XIVe siècle, un groupe revient sur la dune et met en place un nouveau pavage identifié dans le niveau C dont il est difficile d'affirmer la fonction, domestique ou cultuelle, et qui correspond à la phase III.1 de notre séquence. Par la suite, la rupture avec les phases précédentes devient très nette puisque la découverte de plusieurs sépultures humaines indique une transformation du site en un espace à vocation exclusivement funéraire. Le cimetière qui occupe le niveau B a livré en 2009 les restes de dix-huit individus, adultes et enfants, dans des positions variées, le plus souvent déposés dans des coffrages limités par des blocs posés de chant. Sept d'entre eux ont été datés, démontrant que le fonctionnement du cimetière s'est étendu entre les XVe et XVIe siècles, soit la phase III.2. Bien que la zone littorale continue bien sûr à être fréquentée par les pêcheurs, la dune est ensuite définitivement abandonnée, provoquant son recouvrement par la couche A superficielle de sable éolien.

La séquence reconstituée sur le site de Hane est donc exceptionnelle par son étendue chronologique, assez rare en contexte archéologique polynésien. Elle témoigne également d'une évolution des modalités d'habitat et d'une réelle variabilité fonctionnelle de la dune à travers le temps, passant d'une occupation de nature domestique à son usage strictement funéraire dans la dernière phase. En outre, cette séquence présente certains points communs avec un autre complexe de Ua Huka, lui aussi bien étudié, localisé à l'embouchure de la vallée de Manihina, à l'est de Hane.

Le complexe dunaire de Manihina

La baie de Manihina, située entre les villages de Hane et de Vaipaee, présente une grande dune d'environ 100 m de diamètre et s'élevant à près de 12 m d'altitude. Un programme de recherches fut mis en place sur ce site à partir de 1991 à l'initiative de É. Conte et trois campagnes se succédèrent jusqu'en 1998 (Conte, 2002). Il s'agissait initialement d'explorer ce complexe dunaire où apparaissaient en surface des vestiges de pavages en pierre déjà repérés par Y. Sinoto et M. Kellum lors de leur séjour sur l'île en 1964 (Sinoto et Kellum, 1965). Ces derniers implantèrent trois sondages sur le front de la dune qui s'avérèrent présenter une stratigraphie relativement simple et de faible profondeur.

La fouille des pavages apparaissant au sommet de la dune réalisée en 1991 révéla rapidement la présence de sépultures humaines associées au pavage. Une étude approfondie de ce secteur fut entreprise en 1993 et 1998 (Maureille et Sellier, 1996 ; Murail, 1996 ; Sellier, 1998 ; Sellier *et al.*, 2007). Au total, les archéologues découvrirent trente-neuf squelettes humains, auxquels s'ajoutent onze cochons et deux chiens, pour lesquels ont été démontrés des pratiques et des gestes funéraires complexes. La plupart correspondent à des inhumations primaires, le plus souvent individuelles mais parfois doubles. Les positions des corps sont très variées : décubitus dorsal, décubitus latéral gauche et droit, procubitus (en extension, fléchi, hyperfléchi). De plus, les défunts étaient parfois placés dans des contenants en bois de type cercueil, enveloppés de linceuls en tapa, ou bien calés par des pierres délimitant des coffrages. On compte aussi quelques sépultures secondaires, avec ou sans sélection des ossements, des processus pré-déposition (momification par dessiccation, désarticulation) ainsi que des réouvertures de tombes pour réduction des corps en faisceaux, reprise de certains ossements (notamment la tête osseuse) ou addition d'autres. L'un des individus, présentant des traces de lèpre, a été daté à 480 ± 100 BP, soit 1377-1661 apr. J.-C. (Sellier *et al.*, 2007).

La fouille du site s'est poursuivie plus profondément et a permis de découvrir des niveaux d'occupation antérieurs à la mise en place du cimetière. Sous le niveau de surface, une couche de sable stérile B recouvre un troisième niveau C de 30 cm d'épaisseur, quant à lui d'origine anthropique : des éléments de pavage ont été mis au jour par endroits, ainsi que plusieurs structures de combustion. De nombreux fragments de corail débités étaient concentrés dans une petite surface interprétée comme une aire de fabrication de limes, ces dernières étant par ailleurs découvertes à divers stades de façonnage. Un charbon prélevé dans l'un des fours a livré une date de 570 ± 100 BP soit 1226-1515 apr. J.-C. (tabl. 1). En-dessous, la couche D de sable foncé de 20 cm d'épaisseur a livré les vestiges d'anciens habitats relativement étendus (un pavage correspondant a été fouillé dans un autre secteur à 12 m au nord-est de l'ouverture principale). L'une des particularités de cette structure vient de la structuration de l'espace domestique propre aux habitats marquisiens, appelés *paepae hiamoe* : d'un côté un sol formé de petits galets de plages constituant la zone couverte de la maison, ou lieu de couchage, et de l'autre un pavage régulier de dalles de plus gros modules servant de véranda extérieure. Les deux espaces sont séparés par une bordure de dalles posées de chant. Cette conception architecturale n'était jusqu'à présent documentée que pour les habitats en vallées mais jamais dans les zones côtières. Ce type de maison était par ailleurs considéré comme un développement relativement récent, datant de la période classique (Suggs, 1961 ; Ottino-Garanger, 1986 et 1990 ; Allen, 2010b). Le niveau d'occupation de Manihina a été daté à 590 ± 100 BP soit 1218-1490 apr. J.-C. Ainsi, les occupations des niveaux D et C ont été très rapprochées dans le temps, signifiant, comme à Hane, la mise en place d'un habitat plus durable (et en

l'occurrence très organisé d'un point de vue architectural) et dynamique aux environs des XIIIe-XIVe siècles.

La couche E se distingue assez peu de la précédente. La densité de galets mise en évidence au niveau immédiatement supérieur diminue ici de manière très nette, bien que les quantités de restes fauniques restent importantes. Ce niveau est interprété comme une occupation antérieure à D qui aurait été remaniée et perturbée par la construction du pavage. Enfin, on atteint en dessous le niveau F de sable clair contenant de nombreuses branches de corail de grandes dimensions, probablement déposées de manière volontaire. Ces branches ont été retrouvées dans les différents secteurs de la fouille mais on ignore leur fonction réelle. Il n'est pas impossible que ces éléments aient eu pour but de stabiliser le sol sableux avant l'installation de structures d'habitat pérennes.

D'autres sondages furent pratiqués en 1993 à l'arrière de la dune, à l'aide d'engins mécaniques. L'un d'entre eux présentait une couche profonde apparemment d'origine anthropique. La présence de plusieurs fragments de charbon laissait supposer aux auteurs (Conte et Poupinet, 2002, p. 35) que ce niveau était peut-être lié à une période de défrichage associée à l'occupation humaine de la vallée. Un coquillage *(Cypraea)* collecté dans ce niveau fut daté à 1350 ± 60 BP soit un intervalle compris entre 950 et 1269 apr. J.-C.

La stratigraphie étudiée à Manihina se révèle donc plus complexe que ne le laissaient entendre les premiers travaux réalisés dans ce secteur de l'île. Dans un contexte écologique et sédimentaire semblable à celui de Hane, plusieurs éléments culturels ont été mis en évidence, certains étant susceptibles de remonter aux premiers temps de l'installation humaine à cet endroit. Si pour la dune à proprement parler, on suppose une occupation initiale vers le XIIe siècle, le résultat obtenu en arrière du cordon littoral laisse entendre que des communautés ont pu occuper le secteur à une époque plus ancienne. L'analyse du vaste corpus de données reste à approfondir et d'autres datations doivent être réalisées afin de préciser la séquence chronologique du site, mais deux remarques nous semblent ici importantes à souligner qui montrent une éventuelle évolution partagée de l'occupation des sites de Manihina et Hane : d'une part, la mise en place d'un habitat permanent et durable visible à travers les grands pavages mis au jour, et d'autre part, l'utilisation du site comme cimetière montrant une fois encore un changement de fonction de la dune, passant d'un espace domestique à un espace funéraire.

Un secteur de pêche à Hinipohue

Le site de Hinipohue est localisé à l'embouchure sud-ouest de la petite vallée de Hiniaehi, située entre Hane et Manihina. Cette zone, d'une superficie d'environ quatre hectares, est formée d'une dune de sable blanc plantée de *aito (Casuarina equisetifolia)* qui se développe en amphithéâtre ouvert à l'est, bénéficiant ainsi d'une bonne aération sous l'action des alizés. À l'arrière s'étendent des petits vallons qui constituent le plateau de l'actuel aéroport de Ua Huka. Un cours d'eau, aujourd'hui asséché, serpente depuis le nord-ouest et trace son lit au sud de Hinipohue pour rejoindre la côte à l'endroit nommé Pahonu qui est encore aujourd'hui un lieu privilégié de récolte d'algues marines, mais également connu comme un point d'arrivée des tortues en période de ponte (Conte et Payri, 2002). La dune de sable offre une pente générale de 30 % à 40 % sur un axe est-ouest, mais celle-ci n'est pas continue et des surfaces planes apparaissent par endroits. Des prospections préliminaires permirent de recueillir quelques objets en surface, à proximité de certains endroits où l'on apercevait aussi des bordures de dalles de corail disposées de chant constituant sans doute les vestiges de simples encadrements de maisons autrefois édifiées en matériaux végétaux (Conte et Poupinet, 2002, p. 149). Des décapages nous ont conduits à identifier au moins sept structures assez ruinées auxquelles étaient associés des espaces de préparation ou de consommation de nourriture matérialisés par des amas osseux et coquilliers. Des sondages furent implantés dans trois zones. Les stratigraphies sont assez simples, réduites à trois niveaux au maximum sur une profondeur ne dépassant pas 40 cm. Nous n'avons relevé qu'un seul véritable niveau anthropique dans lequel, outre les fragments d'hameçons, d'herminettes et de grattoirs en porcelaine *(Cypraea)*, nous avons découvert un foyer dans le sondage HIP-2-SOND-2. Celui-ci a été daté à 306 ± 30 BP, soit en âge calibré, soit un intervalle de temps compris entre 1488 et 1650 apr. J.-C.

Le site de Hinipohue était probablement un point d'attraction pour les communautés qui y trouvaient un accès aisé aux ressources marines dont elles avaient besoin : pêche côtière, collecte de coquillages, capture des tortues ou bien encore ramassage des algues. Il est fort probable que cet endroit fut fréquenté, du moins temporairement, dès les premiers temps du peuplement de l'île. Les structures de surface que nous avons étudiées témoignent pour leur part d'une installation plus durable qui prend place vers le XVIe siècle. Elle se compose d'un groupe de maisons construites légèrement, sans pavage en pierre. Nous interprétons cet ensemble comme un petit hameau, ou une zone d'habitat secondaire réservée à des pêcheurs située à l'écart des deux villages les plus proches localisés au fond des vallées voisines de Hiniaehi et Hinitaihava. L'occupation de la dune de Hinipohue marquerait donc une extension maximale de l'habitat à l'intérieur du territoire géographique de la tribu.

Le secteur de Hatuana

Le dernier site d'importance est celui de Hatuana, où nos recherches se sont intensifiées au cours des dernières années. La baie de Hatuana est localisée à l'extrême pointe sud-ouest de Ua Huka, délimitée à l'ouest par un promontoire rocheux surélevé d'une trentaine de mètres au-dessus du niveau de la mer (fig. 3). L'histoire traditionnelle de l'île a conservé la mémoire de ce lieu qu'on désignait comme le point d'envol des âmes vers Hawaiki, appelé Tetiutiu (Handy, 1923). L'endroit est

aussi décrit comme une zone de guet d'où l'on prévenait autrefois toute invasion de guerriers ennemis en provenance de Nuku Hiva. Si cette fonction semble plausible pour des raisons géographiques, la nature symbolique et rituelle de l'endroit peut, quant à elle, trouver un écho en la présence de plusieurs pétroglyphes gravés sur des affleurements rocheux sur et aux environs du plateau. Selon les traditions, l'occupation ancienne du lieu aurait été circonscrite à la dune et au promontoire tandis que la vallée de Hatuana elle-même, très sèche et aux pentes abruptes peu favorables au développement de l'horticulture, n'a semble-t-il jamais accueilli d'habitat. Ce caractère fut confirmé par nos prospections qui ne révélèrent aucun vestige monumental de quelque type que ce soit (*paepae*, terrasses agricoles etc.).

Le complexe dunaire de Hatuana présente immédiatement en haut de plage un premier cordon littoral récent. À l'ouest, l'entrée du plateau est occupée par une dune moyenne. La formation la plus imposante se situe quant à elle dans la partie orientale. Les travaux préliminaires engagés par É. Conte sur la dune en 1997 étaient notamment motivés par la découverte possible d'une occupation à la fois aussi ancienne que sur les autres secteurs de Hane et Manihina, mais aussi susceptible de fournir une séquence de longue durée. Cinq sondages et coupes furent ouverts et livrèrent des dates réalisées sur des échantillons de charbon malheureusement non identifiés botaniquement, et dont certaines entraient en contradiction avec la stratigraphie relevée. Afin de clarifier cette dernière et de procéder à de nouvelles datations en contexte contrôlé, une nouvelle fouille fut organisée en 2009 sur la dune occidentale (Molle et Conte, 2011). Une succession de sept niveaux a été mise en évidence, avec une occupation débutant ici entre 1450 et 1530 apr. J.-C., orientée principalement vers des activités de pêche. Elle se poursuit avec la mise en place d'un pavage en pierre vers le début du XVIII^{e} siècle qui témoignerait selon nous d'une volonté de s'installer plus durablement et de faire du promontoire un site de guet, tel qu'indiqué dans les traditions orales. Les activités de pêche se poursuivent bien entendu mais un tel changement dans l'organisation de l'habitat attesterait d'une évolution de la fonction principale du lieu. Celui-ci restera occupé jusqu'à la fin du XVIII^{e} siècle, au moment où l'archipel est découvert par les Occidentaux.

En 2013, une autre mission eut lieu à Hatuana, cette fois-ci pour explorer de manière plus approfondie la grande dune orientale. Deux secteurs principaux ont été ouverts, nous offrant ainsi une meilleure vision chronologique de l'occupation (Molle, 2014). La première aire de fouille consistait en une surface de 4 m² au sommet de la plus haute dune, à proximité d'un amas de pierres interprété comme les vestiges d'un ancien pavage. Elle a révélé une stratigraphie assez faible composée d'un niveau principal reposant sur un sol grésifié marquant une dune fossile. Un fragment de charbon (identifié comme de l'écorce d'angiosperme) date cette occupation de 743 ± 23 BP. De manière intéressante, le niveau de dune fossile apparaît en surface plus bas dans la pente et a pu être suivi dans une série de sondages réalisés le long d'un transect nord-sud offrant un profil général des couches géologiques remarquables. Il apparaît que la partie haute du complexe dunaire est simplement recouverte d'un dépôt éolien de faible épaisseur, qui recouvre cette ancienne dune désormais passive et grésifiée.

Fig. 3 – Vue de la baie de Hatuana (cliché G.Molle).
Fig. 3 *– View of the bay of Hatuana (photo G. Molle).*

Un second secteur de fouille de 4 m² fut ouvert sur la dune moyenne, quant à elle active, en bordure de la rupture de pente. Un premier niveau, correspondant à celui dans lequel apparaissaient des vestiges dans la coupe en front de mer, a livré deux fours. À l'est, on trouve un amas de pierres vacuolaires utilisées traditionnellement dans les fours de terre, pris dans une fosse très charbonneuse. Un fragment identifié comme du bois d'*Hibiscus tiliaceus* a été daté de 255 ± 23 BP. À 1 m au sud-est, on découvre un second four, différent dans sa mise en place car composé de plus d'une centaine de petits galets chauffés. Cette structure de combustion est interprétée comme un « grill » utilisé sans doute pour cuire rapidement des aliments, à l'instar de certains fours observés aux Tuamotu (Conte, 1988). Malgré un possible effet de vieux bois, sa datation confirme la date précédente puisqu'un fragment de *Cordia subcordata* remonte à 265 ± 23 BP. Sous ce niveau principal qui traduit une occupation intensive et sans doute plus durable du secteur, on rencontre un épais niveau de sable stérile. Devant la difficulté de fouiller à une telle profondeur dans un espace aussi réduit, nous n'avons poursuivi la fouille au-delà de 2 m que dans le seul carré H59 où nous avons pu mettre en évidence un niveau d'occupation plus profond. On y trouve une nappe de charbon, associée à quelques éclats de chauffe qui marque l'existence d'une petite structure de combustion. Dans et autour de cet élément, on trouve des restes fauniques en quantité plus importante incluant principalement des poissons et des coquillages mais également des oiseaux. Ces ossements sont actuellement en cours d'identification et feront l'objet de datations ultérieures. Deux fragments de charbon, dont l'un provenant d'une petite branche, ont été datés respectivement à 749 ± 23 BP et 690 ± 23 BP. La présence d'ossements d'oiseaux dans un niveau relativement ancien en contexte marquisien est remarquable et pourrait attester ici une première occupation dans le secteur de la baie.

Ayant désormais à notre disposition un faisceau de dates couvrant tous les secteurs et les niveaux archéologiques mis en évidence à Hatuana, nous pouvons proposer une première reconstitution de l'histoire du complexe dunaire qui peut se découper en plusieurs phases (tabl. 1). Les premières occupations semblent remonter au tout début du XIIIe siècle, d'après les informations recueillies en 2013 dans le niveau profond. Le paysage devait alors être assez différent de l'actuel, avec une petite falaise séparant la banquette de la dune moyenne active de la dune haute passive. De fait, la surface disponible était réduite à la partie antérieure du système dunaire principal alors que seule une occupation légère a été mise en place au sommet. Ce manque de place a pu être un des facteurs expliquant l'abandon de la dune attestée par l'épaisse couche de sable stérile. Une nouvelle occupation est ensuite démontrée autour de 1500 apr. J.-C., d'abord dans le secteur occidental fouillé en 2009. Un habitat est aménagé contre les parois rocheuses à l'entrée du plateau occidental, destiné sans doute à une petite communauté de pêcheurs exploitant les ressources abondantes de la baie. Par la suite, la mise en place d'un habitat plus pérenne, visible à travers un *paepae* et un ensemble de fours, correspondrait à un changement dans la fonction du site, à savoir un poste d'observation des ennemis durant les conflits qui s'intensifient à partir du XVIIIe siècle (Kellum-Ottino, 1971). Cette occupation découverte sur la dune ouest est aussi étendue à la dune principale à l'est où des maisons sont à nouveau construites. D'après les traditions orales recueillies sur Ua Huka, les communautés alors installées à Hatuana ne formaient pas une entité tribale à part entière. D'ailleurs, comme nous l'avons dit, la vallée elle-même ne semble pas avoir été occupée. Il s'agit très probablement d'un groupe dépendant de l'une des deux grandes vallées situées immédiatement à l'est, Haavei ou Vaipaee, dont on sait qu'elles étaient en guerre contre d'autres tribus de Nuku Hiva (Kellum-Ottino, 1971 ; Pechberty, 1995).

Le secteur de Hatuana méritera à l'avenir d'autres recherches plus approfondies, notamment pour documenter les modalités d'occupation du niveau profond découvert en 2013. Cette présentation du contexte général de la baie montre cependant un exemple de variabilité fonctionnelle à l'échelle d'un complexe dunaire étendu.

Données complémentaires sur d'autres secteurs de l'île

Si notre approche comparative repose essentiellement sur les quatre sites dont il vient d'être question, il nous faut aussi ajouter à cette étude les résultats obtenus sur les deux autres secteurs côtiers de Haavei et Hokatu, qui n'ont jusqu'à présent fait l'objet que d'investigations préliminaires. Le site de Haavei, déjà reconnu par Y. Sinoto (Sinoto et Kellum, 1965), fut sondé dans sa partie orientale, hors dune, par des archéologues du département d'archéologie de Tahiti en 1984-1985. Certaines dates, quoique discutables, sembleraient indiquer une occupation de ce secteur de la baie entre les XIVe et XVIIe siècles, secteur où est alors établi un *me'ae*, terme définissant une structure cérémonielle ici utilisée par des pêcheurs pour leurs rituels (Edwards *et al*., n. d.). Toutefois, le contexte environnemental de la baie de Haavei, sans doute l'un des plus favorables de toute l'île en termes d'abondance des ressources marines, de dimensions et de protection, suggère une occupation plus intensive qui pourrait éventuellement remonter aux périodes les plus anciennes de la colonisation de Ua Huka, à l'instar de la dune de Hane.

En ce qui concerne la baie de Hokatu située immédiatement à l'est de Hane, il reste difficile d'affirmer, en l'absence de toute étude géomorphologique, qu'un véritable système dunaire s'y développait autrefois. De plus, l'impact anthropique moderne lié à l'installation du village a contribué à remodeler toute cette zone côtière, faisant disparaitre les éventuels vestiges anciens. En 1998, la découverte inopinée de niveaux enfouis à une profondeur de près de 3 m sous la surface actuelle a toutefois permis d'ancrer une occupation entre 1038 et 1265 apr. J.-C., contemporaine de la phase I de Hane (Conte et Anderson, 2003 ; Conte et Molle, 2012).

VARIABILITÉ CHRONOLOGIQUE ET FONCTIONNELLE DES OCCUPATIONS CÔTIÈRES

La comparaison des séquences culturelles mises en évidence sur les secteurs dunaires de Ua Huka démontre au final une variabilité qui s'exprime à deux niveaux, chronologique et fonctionnel (fig. 4). L'étude approfondie de ce type d'espace aura permis non seulement de définir l'étendue chronologique des occupations humaines en ces lieux mais aussi de mieux préciser leur nature, parfois changeante, à travers le temps.

Si les baies les plus grandes et les plus favorables telles que Hane, Manihina ou Hatuana ont connu une fréquentation souvent intense dès les premiers peuplements, et ce malgré des phases d'abandon, d'autres plus petites semblent plutôt avoir été occupées de manière marginale. Ainsi en est-il de Hinipohue, par exemple, où les seules traces d'habitat pérenne n'apparaissent qu'assez tardivement, à une époque où tous les territoires de l'île sont déjà exploités. Cela ne signifie pas pour autant que ces zones n'étaient pas fréquentées auparavant. Bien au contraire, leur fonction d'interface, offrant un accès aisé aux ressources marines indispensables aux communautés, justifie à elle seule leur fréquentation, peut-être quotidienne, tout au long de l'histoire de l'île. Néanmoins, le caractère permanent des installations répond avant tout à une variété de besoins qui diffèrent d'une communauté à l'autre.

Il est désormais établi que les complexes dunaires, du moins les plus accueillants d'un point de vue écologique, ont constitué des lieux d'habitat privilégiés aux premiers temps de la colonisation de l'île, répondant ainsi au modèle de distribution idéale évoqué en introduction de cet article. Le site de Hane a livré à ce jour les dates les plus anciennes de l'archipel en contexte contrôlé, recueillies dans le niveau J le plus profond. Des traces d'activité apparaissent ici vers la fin du xe siècle, laissant supposer que la découverte réelle de l'île a pu survenir aux environs de 850 apr. J.-C. Des groupes, aux effectifs probablement restreints, s'installent sur cette zone côtière dont ils commencent à exploiter les ressources, en particulier les produits de la mer directement accessibles dont témoignent les riches assemblages de restes fauniques (qui, par ailleurs, comprennent aussi beaucoup de restes d'oiseaux dont certaines espèces furent surexploitées dans ces premiers temps de l'installation). Cette phase de colonisation de l'île ne correspond pas à un évènement unique mais à une succession d'arrivées ou d'installations à divers endroits de la côte où des activités anthropiques sont identifiables dans un intervalle de près de deux siècles, compris entre la fin du xe et la fin du xiie siècle. Ainsi, les baies de Manihina et de Hokatu voient-elles à leur tour les premières occupations humaines. Il est fort possible que la baie de Haavei ait été elle aussi fréquentée dès cette époque.

Un autre marqueur culturel de grande importance a été mis en évidence sur les complexes dunaires de Hane et Manihina. Durant la phase de colonisation, les vestiges découverts dans les niveaux profonds de Hane laissaient supposer l'existence d'habitats très légers, sans soubassement, édifiés par des groupes peu désireux de développer un lieu de vie permanent à cet endroit. L'apparition, autour de 1200 apr. J.-C., de pavages en pierre destinés à accueillir les maisons construites en matériaux périssables signifie une transformation du mode de vie et matérialise la volonté des communautés de s'implanter sur ces secteurs littoraux de manière plus durable. Le

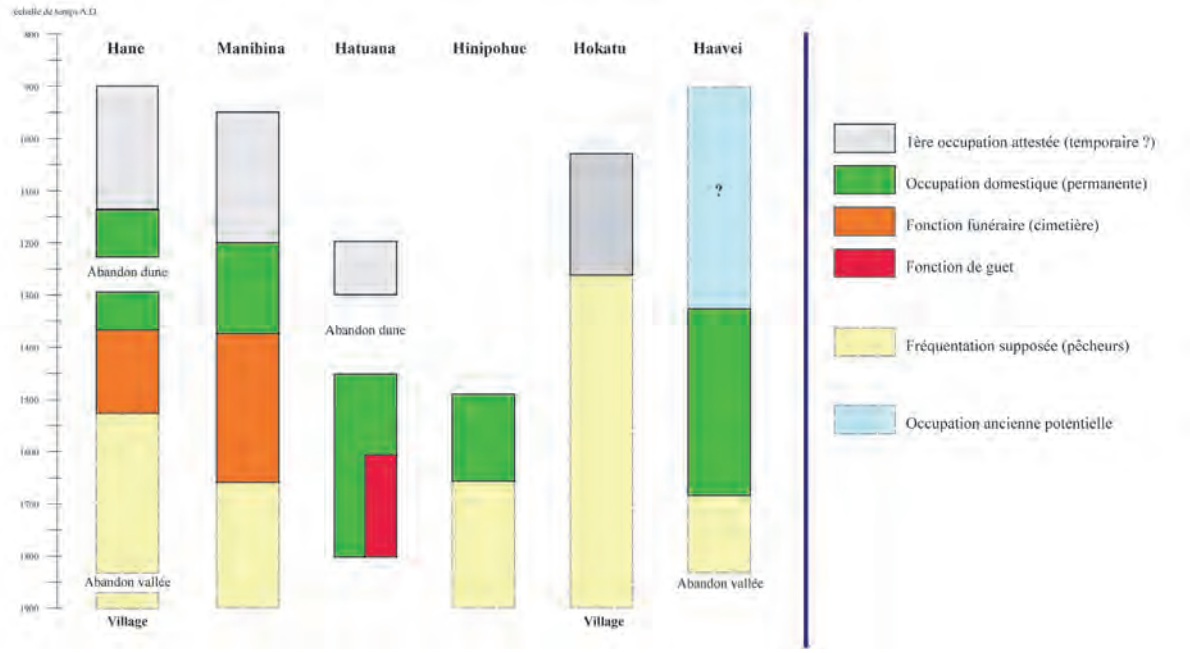


Fig. 4 – Comparaison des séquences d'occupation littorale de Ua Huka
Fig. 4 *– Comparison of the coastal occupation sequences on Ua Huka.*

développement de ce type architectural, dont la caractéristique locale d'une différenciation de l'espace interne est très tôt visible à Manihina, marque clairement l'entrée dans la phase dite d'« établissement » (Graves et Addison, 1995) dont les conditions sont tout à la fois démographiques et sociopolitiques. Cette époque correspond à une structuration de plus en plus marquée des chefferies. Même après que ces groupes aient établi leurs centres de vie à l'intérieur des vallées, où se développent systèmes horticoles et structures spécialisées pour les rituels et les festivités, les secteurs côtiers ne sont pas délaissés pour autant, comme le montrent les résultats obtenus à Hinipohue et Hatuana. Bien au contraire, leur fréquentation, le plus généralement par des groupes de pêcheurs en charge de l'approvisionnement de la communauté, traduit une extension maximale du territoire de ces chefferies dans l'espace de vie qu'est la vallée.

Au-delà des fonctions présupposées des espaces dunaires, les travaux conduits à Ua Huka auront révélé deux autres caractères possibles. Le premier est la transformation des dunes en sites funéraires à laquelle on assiste, tant à Hane qu'à Manihina, au début du XIVe siècle. Rappelons que des sépultures avaient aussi été découvertes par R. C. Suggs (Suggs, 1961) à Ha'atuatua, Nuku Hiva. Leur présence sur les zones littorales n'en reste pas moins surprenante aux Marquises où les lieux d'inhumation sont surtout connus à l'intérieur des vallées, parfois dans des endroits extrêmement reculés et difficiles d'accès (Vigneron, 1985). Cette question, bien que récemment abordée (Molle, 2011a, p. 278), reste très complexe et mérite des travaux complémentaires pour mieux cerner l'évolution du système funéraire, mais cette découverte de sépultures sur les dunes lors de la dernière période pré-européenne souligne un aspect aucunement documenté dans la littérature ethno-historique.

L'autre fonction est associée à la période de conflits intertribaux qui agitent l'archipel, en particulier à partir du XVIe siècle. Dans le cas de Hatuana, les données archéologiques ont pu être interprétées à la lumière des traditions indiquant que l'endroit servait de poste de guet pour prévenir les invasions ennemies depuis Nuku Hiva, dont on sait par ailleurs que les tribus Naiki s'allièrent fréquemment à celle de Vaipaee dans leur lutte contre les Maku-Oho de Hokatu. La transformation du promontoire adjacent à la baie en site d'observation n'est pas exclusive pour autant car les groupes installés sur les dunes y poursuivent leurs activités de pêche, comme le démontre le grand nombre d'hameçons, de poids de pêche et d'ancres qui y ont été découvertes. Si les fonctions de l'occupation peuvent donc être multiples, les raisons motivant l'installation d'un lieu de vie durable (ici encore matérialisée par la construction de pavages en pierre) à une époque relativement tardive et correspondant à une période d'intensification des guerres entre chefferies, répondent néanmoins à un besoin particulier de défense.

De par la nature et la durée de leurs occupations respectives, les complexes dunaires de Ua Huka nous fournissent à présent un vaste jeu de données à exploiter. Les résultats acquis sur ces sites constituent le socle sur lequel les archéologues peuvent s'appuyer pour reconstituer l'armature d'une séquence chrono-culturelle définie à l'échelle d'une île entière (fig. 5). Les marqueurs qui

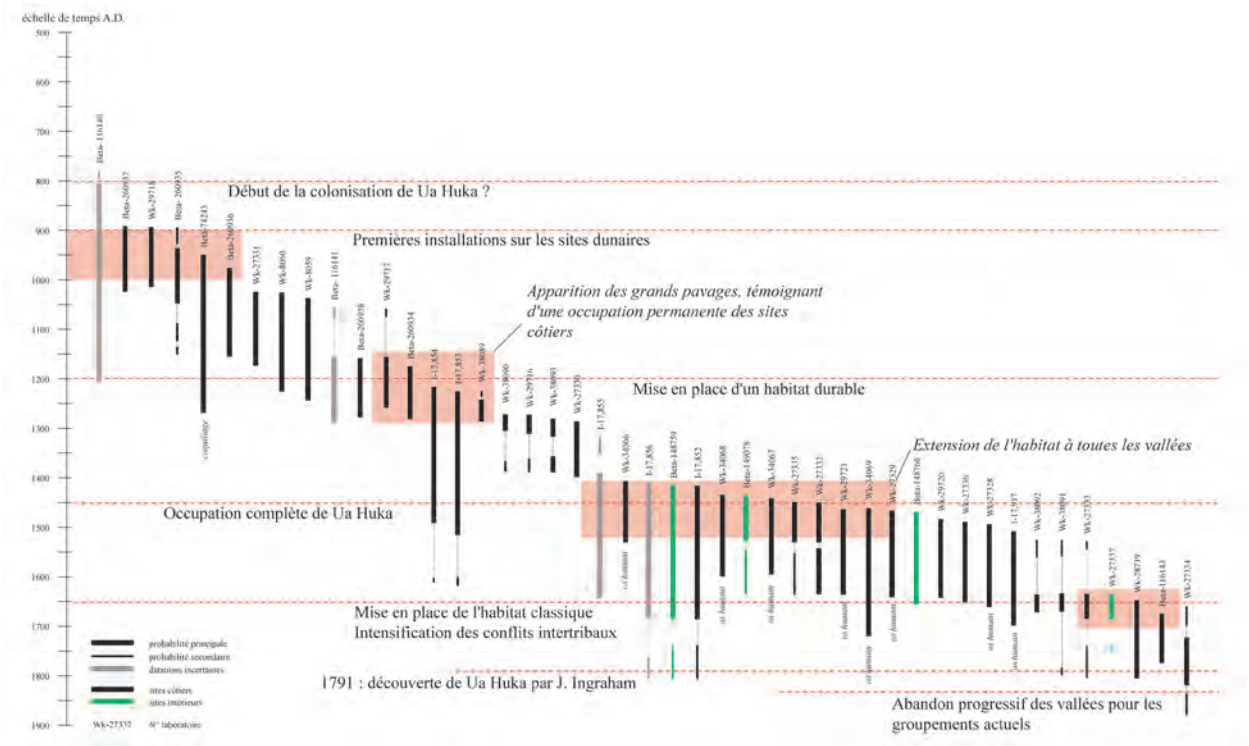


Fig. 5 – Reconstitution de la séquence chronoculturelle de Ua Huka à partir du corpus de datations archéologiques.
***Fig. 5** – Reconstruction of the temporal and cultural sequence of Ua Huka based on the archaeological dates.*

rythment les trajectoires historiques des communautés sont identifiables dans les stratigraphies couvrant parfois des longues durées et offrent des repères indispensables pour comprendre le développement des sociétés marquisiennes. Bien entendu, le travail de comparaison proposé dans cet article fut aussi rendu possible par l'ouverture de larges surfaces, réaffirmant, si besoin était, la nécessité de suivre une méthodologie adaptée aux questions soulevées.

Si de larges efforts ont été consacrés à l'étude des secteurs littoraux, il ne faut pas oublier pour autant qu'ils ne constituent qu'une très faible surface d'un territoire insulaire dont on sait qu'il était largement exploité et vécu par les populations. Il importe donc de ne pas délaisser l'étude – et par là s'entend l'ouverture de fouilles et non pas simplement des inventaires de surface – des zones d'habitation localisées à l'intérieur des vallées pour lesquelles les datations restent encore très insuffisantes, tant en nombre qu'en résolution. À terme, seule la confrontation des données complémentaires issues des deux types d'espaces constitutifs du paysage marquisien, permettra une reconstitution fine de l'histoire de l'archipel.

RÉFÉRENCES BIBLIOGRAPHIQUES

Allen M. S. (2004) – Revisiting and Revising Marquesan Culture History: New Archaeological Investigations at Anaho Bay, Nuky Hiva Island, *Journal of Polynesian Society*, 113, 2, , p. 143-196.

Allen M. S. (2006) – New Ideas about Late Holocene Climate Variability in the Central Pacific, *Current Anthropology*, 47, 3, p. 21-535.

Allen M. S. (2010a) – Oscillating Climate and Social-Political Flexibility: The Case of the Marquesan Chiefdom, Polynesia, *Antiquity*, 84, p. 86-102.

Allen M. S. (2010b) – Morphological Variability and Temporal Patterning in Marquesan Domestic Architecture: Anaho Valley in Regional Context, *Asian Perspectives*, 48, 2, p. 342-381.

Allen M. S. (2014) – Marquesan Colonisation Chronologies and Post-Colonisation Interaction: Implications for Hawaiian Origins and the 'Marquesan Homeland' Hypothesis, *Journal of Pacific Archaeology*, 5, 2, p. 1-17.

Allen M. S, Mcalister A. J. (2010) – The Hakaea Beach Site, Marquesan Colonisation, and Models of East Polynesian Settlement, *Archaeology in Oceania*, 45, 2, p. 54-65.

Anderson A. (1995) – Current Approaches in East Polynesian Colonisation Research, *Journal of the Polynesian Society*, 104, 1, p. 110-132.

Anderson A. (1996) – Adaptive Voyaging and Subsistence Strategies in the Early Settlement of East Polynesia, *in* T. Akazawa et E. J. E. Szathmáry (dir.), *Prehistoric Mongoloid Dispersals*, Oxford, Oxford University Press (Oxford Science Publications), p. 359-373.

Anderson A., Leach H. M., Smith I, Walter R. (1994) – Reconsideration of the Marquesan Sequence in East Polynesian Prehistory, with Particular Reference to Hane (MUH1), *Archaeology in Oceania*, 29, 1, p. 29-52.

Anderson A., Sinoto Y. (2002) – New Radiocarbon Ages of Colonization Sites in East Polynesia, *Asian Perspectives*, 41, 2, p. 242-257.

Bellwood P. (1979) – Settlement patterns, *in* J. Jennings (dir.), *The Prehistory of Polynesia*, Cambridge, Harvard University Press, p. 308-322.

Bronk Ramsey C. (1995) – Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program, *Radiocarbon*, 37, p. 425-430.

Bronk Ramsey C. (2001) – Development of the Radiocarbon Program OxCal, *Radiocarbon*, 43, p. 355-363.

Cobb K. M., Charles C. D., Cheng H., Edwards R. L. (2003) – El Niño/Southern Oscillation and Tropical Pacific Climate during the Last Millennium, *Nature*, 424, p. 271-276.

Conte É. (1988) – *La pêche pré-européenne et ses survivances. L'exploitation traditionnelle des ressources marines à Napuka (Tuamotu, Polynésie française)*, thèse de doctorat, université Paris I – Panthéon-Sorbonne, 925 p.

Conte É. (2002) – Current Research on the Island of Ua Huka, Marquesas Archipelago, French Polynesia, *Asian Perspectives*, 41, 2, p. 258-268.

Conte É., Anderson A. (2003) – Radiocarbon Ages for Two Sites on Ua Huka, Marquesas, *Asian Perspectives*, 42, 1, p. 155-160.

Conte É., Molle G. (2012) – *Vestiges d'une histoire marquisienne. Contribution à l'archéologie de Ua Huka*, Faaa, CIRAP (Cahiers du CIRAP, 2), 108 p.

Conte É., Molle G. (2014) – Reinvestigating a Key-Site for Polynesian Prehistory: New Results from the Hane Dune Site, Ua Huka (Marquesas), *Archaeology in Oceania*, 49, 3, p. 121-136.

Conte É., Payri C. (2002) – La consommation des algues en Polynésie française : premiers résultats d'une enquête, *Journal de la Société des océanistes*, 114-115, p. 165-172.

Conte É., Poupinet Y. (2002) – *Étude paléoécologique et archéologique de l'île de Ua Huka (archipel des Marquises, Polynésie française), campagne 1997*, Papeete, ministère de la Culture et de l'Enseignement supérieur (Dossier d'archéologie polynésienne, 1), 172 p.

Davidson-Arnott R. (2010) – *An Introduction to Coastal Processes and Geomorphology*, Cambridge, Cambridge University Press, 369 p.

Dening G. (1999) – *Marquises 1774-1880 : réflexion sur une terre muette*, Pirae, Association 'Eo Enata, 347 p.

Dickinson W. R. (2014) – Beach Ridges as Favored Locales for Human Settlement on Pacific Islands, *Geoarchaeology*, 29, p. 249-327.

Dickinson W. R., Burley D. V., Nunn P. D., Anderson A. J., Hope G., De Biran A., Burke C., Matararaba C. (1998) – Geomorphic and archaeological landscapes of the Sigatoka Dune Site, Viti Levu, Fiji: Interdisciplinary Investigations, *Asian Perspectives*, 37, 1, p. 1-31.

Eddowes M., Dennison J. K. (1996) – Sauvetage archéologique du site de Taitapu-Rivnac, *Bulletin de la Société des études océaniennes*, 272, p. 3-23.

Edwards E., Cristino C., Vargas P. (n. d.) – *Travaux archéologiques à Ua Huka*, département d'archéologie du CPSH, Tahiti.

Emory K. P., Sinoto Y. (1969) – *Age of Sites in the South Point Area, Ka'u, Hawai'i*, Honolulu, Bishop Museum Press (Pacific Anthropological Records, 8), 17 p.

Fretwell S. D., Lucas H. L. (1970) – On Territorial Behavior and Other Factors Influencing Habitat Distribution in Birds: I. Theoretical Development, *Acta Biotheoretica*, 19, 1, p. 16-36.

Fretwell S. D. (1972) – *Populations in a Seasonal Environment*, Princeton, Princeton University Press, 218 p.

Furey L. (2002) – *Houhora: A Fourteenth Century Maori Village in Northland*, Auckland, Auckland War Memorial Museum (Bulletin of the Auckland Museum, 19), 169 p.

Goff J. R., Lane E., Arnold J. (2009) – The Tsunami Geomorphology of Coastal Dunes, *Natural Hazards and Earth System Sciences*, 9, p. 847-854.

Graves M. W., Addison D. J. (1995) – The Polynesian Settlement of the Hawaiian Archipelago: Integrating Models and Methods in Archaeological Interpretation, *World Archaeology*, 26, 3, p. 380-399.

Handy E. S. C. (1923) – *The Native Culture in the Marquesas*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 9), 358 p.

Hermann A. (2013) – *Les industries lithiques pré-européennes de Polynésie centrale. Savoir-faire et dynamiques techno-économiques*, thèse de doctorat, université de la Polynésie française, Faaa, 420 p.

Hunt T. L., Lipo C. (2006) – Late Colonization of Easter Island, *Science*, 311, p. 1603-1606.

Kellum-Ottino M. (1971) – *Archéologie d'une vallée des îles Marquises. Évolution des structures de l'habitat à Hane, Ua Huka*, Paris, Société des océanistes (Publication de la Société des océanistes, 26), 192 p.

Kennett D., Anderson A., Winterhalder B. (2006) – The Ideal Free Distribution, Food Production and the Colonization of Oceania, *in* D. J. Kennett et B. Winterhalder (dir.), *Behavioral Ecology and the Transition to Agriculture*, Berkeley, University of California Press (Origins of Human Behavior and Culture, 1), p. 265-288.

Kirch P. V. (1986) – Rethinking East Polynesian Prehistory, *Journal of the Polynesian Society*, 95, 1, p. 9-40.

Kirch P. V., Mccoy M.D. (2007) – Reconfiguring the Hawaiian Cultural Sequence: Results of Re-dating the Halawa Dune Site (MO-A1-3), Moloka'i Island, *Journal of the Polynesian Society*, 116, 4, p. 385-406.

Kirch P. V., Conte É., Sharp W., Nickelsen C. (2010) – The Onemea Site (Taravai Island, Mangareva) and the Human Colonization of Southeastern Polynesia, *Archaeology in Oceania*, 45, p. 66-79.

Maureille B., Sellier P. (1996) – Dislocation en ordre paradoxal, momification et décomposition : observations et hypothèses, *Bulletin et mémoires de la Société d'anthropologie de Paris*, 8, 3-4, p. 313-327.

Molle G. (2011a) – *Ua Huka, une île dans l'histoire. Histoire pré- et post-européenne d'une société marquisienne*, thèse de doctorat, université de la Polynésie française, Faaa, 435 p.

Molle G. (2011b) – *Recherches archéologiques sur l'île de Ua Huka, archipel des Marquises, Polynésie française. programme 2008-2009*, rapport final, CIRAP, université de la Polynésie française, Faaa,165 p.

Molle G. (2014) – *Recherches archéologiques sur l'île de Ua Huka (archipel des Marquises), étude des sites de Hatuana et Hinipohue*, rapport final de la campagne 2013, CIRAP, université de la Polynésie française, Faaa, 41 p.

Molle G., Conte É. (2011) – New Perspectives on the Occupation of Hatuana Dune Site, Ua Huka, *Journal of Pacific Archaeology*, 2, 2, p. 103-108.

Murail P. (1996) – *Rapport préliminaire de l'étude anthropologique des vestiges osseux humains du site de Manihina*, département d'archéologie du CPSH, Tahiti, 8 p.

Ottino-Garanger P. (1986) – Une structure lithique marquisienne : le *paepae*, *Cahiers des sciences humaines*, 22, 2, p. 185-201.

Ottino-Garanger P. (1990) – L'habitat des anciens marquisiens : architecture des maisons, évolution et symbolisme des formes, *Journal de la Société des océanistes*, 90, p. 4-15.

Ottino-Garanger P.. (1993) – Peuplement et environnement insulaire : exemples archéologiques aux Marquises, *Bulletin de l'Association des historiens et géographes de Polynésie française*, 2, p. 5-22.

Ottino-Garanger P., Bergh M.-N. de (1990) – *Hakao'hoka : étude d'une vallée marquisienne*, Paris, ORSTOM (Travaux et documents microédités, 66), 103 p.

Ottino-Garanger P., Ottino-Garanger M.-N. (2010) – Approche de la perception insulaire aux îles Marquises, *in* F. Valentin et M. Hardy (dir.), *Hommes, milieux et traditions dans le Pacifique sud*, Paris, De Boccard (Travaux de la Maison Archéologie & Ethnologie René-Ginouvès, 9), p. 125-134.

Paulmier T. (2013) – *On a marché sur la dune. Archéologie des complexes dunaires en Polynésie française : formation, anthropisation, érosion et méthodes d'investigation*, mémoire de master 1, université Paris I – Panthéon-Sorbonne, 124 p.

Pechberty D. (1995) – Répartition des tribus dans les îles Marquises au XVIII^{e} siècle d'après W. P. Crook et E. Robarts, *Bulletin de la Société des études océaniennes*, 267, p. 68-72.

Petchey F., Allen M. S., Addison D., Anderson A. (2009) – Stability in the South Pacific Surface Marine ^{14}C Reservoir over the Last 750 years. Evidence from American Samoa, the Southern Cook Islands and the Marquesas, *Journal of Archaeological Science*, 36, 10, p. 2234-2243.

Reimer P. J., Baillie M. G. L., Bard E., Bayliss A., Beck J. W., Blackwell P. G., Bronk Ramsey C., Buck C. E., Burr G. S., Edwards R. L., Friedrich M., Grootes P. M., Guilderson T. P., Hajdas I., Heaton T. J., Hogg A. G., Hughen K. A., Kaiser K. F., Kromer B., Mccormac F. G., Manning S. W.,

Reimer R. W., Richards D. A., Southon J. R., Talamo S., Turney C. S. M., Van Der Plicht J., Weyhenmeyer C. E. (2009) – InCal09 and Marine09 Radiocarbon Age Calibration Curves, 0-50,000 Years cal BP, *Radiocarbon*, 51, 4, p. 1111-1150.

Rolett B. V. (1998) – *Hanamiai. Prehistoric Colonization and Cultural Change in the Marquesas Islands (East Polynesia)*, New Haven, Yale University (Publications in Anthropology, 81), 277 p.

Rolett B. V. (2002) – Voyaging and Interaction in East Polynesia, *Asian Perspectives*, 41, 2, p. 182-194.

Rolett B. V., Conte É. (1995) – Renewed Investigations of the Ha'atuatua Dune (Nuku Hiva, Marquesas Islands): A Key Site in Polynesian Prehistory, *Journal of the Polynesian Society*, 104, 2, p. 195-228.

Rolett B. V., Conte É., Pearthree E., Sinton J. M. (1997) – Marquesan Voyaging: Archaeometric Evidence for Inter-Island Contact, *in* M. I. Weisler (dir.), *Prehistoric Long-Distance Interaction in Oceania: An Interdisciplinary Approach*, Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 21), p. 134-148.

Sellier P. (1998) – *Manihina, Ua Huka. Archéologie funéraire. Campagne 1998. Présentation sommaire et premiers résultats*, Papeete, ministère de la Culture, 14 p.

Sellier P., Murail P., Conte É. (2007) – Compound Funerary Practices and 'Final Burial' in Ancient Marquesas as Seen from Manihina (Ua Huka, French Polynesia), *in* P. Wallin et H. Martinsson-Wallin (dir.), *The Gotland Papers: Selected Papers from the VII International Conference on Easter Island and the Pacific: Migration, Identity, and Cultural Heritage*, actes du colloque international (Visby, 20-25 août 2007), Visby, Gotland University Press (Gotland University Press, 11), http://uu.diva-portal.org/smash/get/diva2:361187/FULLTEXT02.pdf [en ligne].

Sinoto Y. H. (1966) – A Tentative Prehistoric Cultural Sequence in the Northern Marquesas Islands, French Polynesia, *Journal of Polynesian Society*, 75, 3, p. 286-303.

Sinoto Y. H. (1970a) – Le rôle des Marquises dans le peuplement de la Polynésie Orientale, *Bulletin de la Société des études océaniennes*, 14, 11-12, p. 401-411.

Sinoto Y. H. (1970b) – An Archaeologically Based Assessment of the Marquesas Islands as a Dispersal Center in East Polynesia, *in* R. C. Green et M. Kelly (dir.), *Studies in Oceanic Culture History*, Honolulu, Bishop Musem Press (Pacific Anthropological Records, 11), p. 105-132.

Sinoto Y. H., Kellum M. (1965) – *Preliminary Report on Excavations in the Marquesas Islands*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Polynesian Archaeological Program), 55 p.

Spriggs M., Anderson A. (1993) – Late Colonization of East Polynesia, *Antiquity*, 67, p. 200-217.

Stuiver M., Reimer P. J. (1993) – Extended ^{14}C Data Base and Revised CALIB 3.0 ^{14}C Age Calibration Program, *Radiocarbon*, 35, p. 215-230.

Suggs R. C. (1961) – *The Archaeology of Nuku-Hiva, Marquesas Islands, French Polynesia*, New York, American Museum of Natural History (Anthropological Papers, 49, 1), 206 p.

Sweeney M., Graves M. W., Hunt T. L. (1993) – A Reappraisal of Evidence for Subsistence Change at the Hane Dune Site, Marquesas Islands, French Polynesia, *Asian Perspectives*, 32, 2, p. 225-238.

Thomas N. (1990) – *Marquesan Societies: Inequality and Political Transformation in Eastern Polynesia*, Oxford, Clarendon Press, 276 p.

Tuggle D. H., Spriggs M. (2000) – The Age of the Bellows Dune Site O18, O'ahu, Hawai'I, and the Antiquity of Hawaiian Colonization, *Asian Perspectives*, 39, 1-2, p. 165-188.

Vigneron E. (1985) – *Recherches sur l'histoire des attitudes devant la mort en Polynésie française*, thèse de doctorat, École des hautes études en sciences sociales, Paris, 600 p.

Winterhalder B., Kennett D. J., Grote M. N., Bartruff J. (2010) – Ideal Free Settlement of California's Northern Channel Islands, *Journal of Anthropological Archaeology*, 29, 4, p. 469-490.

Guillaume Molle
The Australian National University
AD Hope Building
14, Ellery Crescent
Canberra, ACT 2601 (Australie)
guillaume.molle@anu.edu.au

Éric Conte
UMR7041 « ArScAn »
Centre international de recherche archéologique sur la Polynésie (CIRAP),
université de la Polynésie française,
BP 6570-98702 Faa'a,
Tahiti, Polynésie française
eric.conte@upf.pf

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 141-160
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Public *versus* Corporate Ritual in the Prehistoric Society Islands (French Polynesia)

A Multi-Scalar Analysis of Religious Practices

Jennifer G. Kahn

Abstract: Multi-scalar analysis of religious architecture and ritualized practices are discussed for the late prehistoric Society Islands chiefdoms. Utilizing a spatio-temporal perspective, I compare and contrast evidence for public, corporate ritual versus more private and communal household ritual. In comparing and contrasting evidence for temples, shrines, priests' houses, and specialized ritual features, I outline similarities and differences in such ritual elements at residential complexes and more isolated aggregate ritual centers in the 'Opunohu Valley, island of Mo'orea. The goal is to demonstrate how multi-scalar spatio-temporal analyses can be used to investigate the elaboration of religious practices in the Society Islands. In addition, links between social complexity and ideology in the development of the Ma'ohi chiefdoms are explored. Archaeological data confirms that later corporate ceremonial complexes incorporate spatial aspects of earlier communal sites, suggesting an appropriation of ritual power by Ma'ohi elites through time. Later aggregate centers retain the use of temple enclosures and shrines, the latter serving as more individualized areas for prayer or worship. These elements are the building blocks for earlier family temple sites used in communal ritual. The essential elements of marae and shrines (i.e. the rows of uprights) are clearly significant. These features represented the ancestors, providing a material link between the social power and well-being of the residential or community group in the present with the ancestors from the past. Corporate ceremonial sites also derived power from association with the ancestors, particularly in their inclusion of ancestral burial remains, however, they differ in critical ways from less elaborate, more inclusive communal ritual sites. Elaborate corporate sites lack evidence for residential use, and represent isolated ritualized zones on the landscape where socio-ritual elites carried out elaborate *rites de passage* and rituals linked to the annual cycle. For the large part, the general laity community was excluded from these most sacred of rites, other than playing a participatory role as audience members, and importantly, as members of the community providing offerings of food and other goods to the reigning chiefs, the ancestors, and the gods. As a result, corporate rites elevated both elites and ritual specialists to positions of socio-ceremonial power.
Aggregate ritual centers focused on corporate ritual are constructed late in the Society Islands sequence after AD 1600. This is a period when multiple lines of evidence point towards increasing chiefly power throughout the archipelago. Archaeological data from corporate ritual centers includes structures indicative of communal feasting, sport, and political meetings of social elites. In diverse ways, aggregate temple complexes served as ritual-economic centers, where tribute was funneled up to the most high status chiefs. As such, the corporate ritual sites were multi-purpose, having both socio-economic, ritual, and political use. Isolated and formalized concentrations of aggregate corporate ritual centers increasingly excluded commoners and women, members of society who lacked *mana*, from the 'state religion'. Corporate ritual sites thus served as one avenue for elites to strategically use ideology to institutionalize social hierarchies and political status, a pattern seen in many other ranked societies.

Keywords: religion, Pacific Islands, East Polynesia, priests, place-making, micro-scale analysis, multi-scalar analysis, corporate ritual, communal ritual.

Rituels publics et spécialisés aux îles de la Société (Polynésie française) : une analyse multiscalaire des pratiques religieuses

Résumé : Cet article propose une analyse multi-scalaire de l'architecture religieuse et des pratiques rituelles au sein des chefferies préhistoriques des îles de la Société à la fin de la période pré-européenne. Dans une perspective spatio-temporelle, nous différencierons les pratiques publiques / « corporatistes » de celles menées dans le cadre plus privé de la maisonnée. La comparaison des types de structures rituelles (temples, autels, maisons des prêtres et autres éléments fonctionnels) met en évidence des similitudes et différences visibles dans les complexes résidentiels et les centres rituels plus isolés de la vallée de 'Opunohu, sur l'île de Mo'orea. L'objectif de cette approche multi-scalaire est de documenter l'élaboration des pratiques rituelles dans l'archipel de la Société. Nous discutons

également des liens entre complexité sociale et idéologie dans le développement des chefferies Ma'ohi. Les données archéologiques indiquent que les complexes cérémoniels publics tardifs ont intégré divers éléments des sites plus anciens, suggérant une appropriation progressive du pouvoir rituel par les élites. Les groupements les plus récents conservent l'usage de temples entourés d'un enclos ainsi que d'autels, ces derniers servants essentiellement d'espaces privés dédiés aux prières et adorations. Ces structures existaient autrefois sur les sites familiaux utilisés dans les rituels communautaires. Les rangées de pierres dressées qui sont les éléments essentiels des marae et des autels, sont à, ce titre, particulièrement importantes. Elles matérialisent le lien entre pouvoir social et bien-être du groupe résidentiel avec ses ancêtres. Les sites « corporatistes » tiennent eux-aussi leur pouvoir de leur association aux ancêtres, notamment en recevant leurs dépouilles. Ils diffèrent cependant en plusieurs points des sites communautaires moins élaborés. Les ensembles corporatistes ne présentent aucune trace d'usage résidentiel et constituent plutôt des secteurs isolés où l'élite conduisait des rites de passage ainsi que des rituels liés au cycle annuel. La plupart du temps, le reste de la communauté était exclu de ces cérémonies très sacrées et voyait son rôle restreint à celui de simple assemblée. Ses membres devaient néanmoins pourvoir aux offrandes de nourriture et autres biens destinés aux chefs en place, aux ancêtres et aux dieux. De cette manière, les rites spécialisés permettaient aux élites et aux spécialistes des rituels de s'élever à des positions de pouvoir socio-cérémoniel.
Les centres réservés à ces pratiques rituelles se développent tardivement sur les îles de la Société, après 1600 AD. Plusieurs éléments indiquent qu'à cette époque, le pouvoir des chefs augmente de manière significative dans tout l'archipel. Les sites cérémoniels comprennent des structures réservées aux repas communautaires, aux pratiques sportives et aux rencontres à vocation politique. Les complexes de temples participaient aussi du système d'économie rituelle en cela que les tributs y étaient versés aux chefs de haut rang. Les sites servaient donc plusieurs fonctions, à la fois socioéconomique, rituelle et politique. Le développement de ces centres isolés exclut peu à peu les gens du commun et les femmes, c'est-à-dire les membres de la société ne disposant pas de *mana*, de la « religion d'état ». Les sites rituels spécialisés permirent ainsi aux élites d'utiliser à leur avantage l'idéologie pour institutionnaliser les hiérarchies et les statuts politiques, une pratique décrite par ailleurs dans de nombreuses autres sociétés de rangs.

Mots-clés: religion, Pacifique, Polynésie orientale, prêtres, fabrique du lieu, analyse à micro-échelle, analyse multi-scalaire, rituels spécialisés, rituels communautaires.

Many archaeologists consider ideology to be an avenue through which elites developed and maintained power in complex chiefdoms and state societies. Some researchers view ideology as a source of economic power, enabling political leaders to mobilize surplus for competition and status (Earle, 1991a; Stein, 1998; Clark et al., 2014). Others view ideology as a source of social power, providing a means for elites to broadcast political messages which promote their own interests and lead to increasing inequality (Gailey, 1987; De Marrais et al., 1996; Joyce and Winter, 1996). It is likely that ideology served both functions in the past, supporting complementary aspects of elite power in the social, economic, and political realms (Earle, 1991b; Baltus and Baires, 2012).

In Polynesia, most studies of ideology have a materialist bent, focusing on the scale and temporality of monumental architecture, most notably, temple sites. Temples, typically defined by an enclosure or pavement with an altar or *ahu* at one end, are the largest structures associated with prehistoric religious activities in East Polynesia. While East Polynesian temples undeniably provide strong material evidence for ancient ritual, the practice of focusing exclusively on the largest of religious structures results in a biased perspective. Ethnohistoric and archaeological data demonstrate that East Polynesian religious practices, each of which had an ideological component, took place in a number of locales. East Polynesian rituals were likewise associated with a wide range of material culture and site types. The latter include shrines with god figures, priests's houses, mortuary sites, temples, rock art, and sacred elements of the landscape.

In this paper, I provide a multi-scalar analysis of religious architecture and ritualized practices in the Society Islands. Utilizing a spatio-temporal perspective, I compare and contrast evidence for public, corporate ritual versus more private and communal household ritual. In comparing and contrasting evidence for temples, shrines, priests' houses, and specialized ritual features, I outline similarities and differences in such ritual elements at residential complexes and more isolated aggregate ritual centers in the 'Opunohu Valley, island of Mo'orea (Society Islands, French Polynesia). The goal is to demonstrate how multi-scalar spatio-temporal analyses can be used to investigate the elaboration of religious practices in the Society Islands. In addition, links between social complexity and ideology in the development of the Ma'ohi[(1)] chiefdoms are explored. In particular, I question whether elites may have appropriated certain ritual spaces, ideas, and practices to exploit ideology as a form of socio-economic and political control.

PREVIOUS ARCHAEOLOGICAL STUDIES OF RELIGION IN POLYNESIAN CHIEFDOMS

In ancient Polynesia at the time of European contact, status was derived from one's sacredness *(tapu)*. People were vessels for supernatural power *(mana)* and their mana had to be protected in order to guard their sacredness. This led to a series of social prohibitions or restrictions about how people of different statuses should act, and about the sacredness or non-sacredness *(noa)* of particular places, activities, and persons, generally referred to as the *tapu* system (Shore, 1989). Those entering the most highly ritualized areas were bound by rules of

ceremony and status, leading to place making (see discussion below), identity construction, and affirmations of bounded status. Generally in East Polynesia, things related to the gods and the ancestors were considered sacred. Because chiefs carried out 'the work of the gods' (Kirch, 1991), and often shared such responsibilities with priests and other ritual specialists, control over ritual was a source of chiefly power.

The story of East Polynesian religion is more complex, however, as places, as well as persons, were imbued with ritual significance. People's relationships with the landscape, and the myths and stories told about them, as well as the activities and ceremonies remembered on them, formed a means of place-making whereby the natural world was imbued with ritual significance. Thus, in East Polynesia and widely throughout Oceania, ritual life centered on sacred sites of a material nature—shrines, temples, mortuary caves, and rock art locales—and sacred sites of a naturalistic nature—features on the landscape such as peaks, promontories, and bodies of water. In some instances, sacred features of the landscape grew into named places, remembered in oral traditions and myths or encoded in site layout or alignment.

Archaeologists have overwhelmingly focused on material elements of East Polynesian religious sites, and in particular, the largest, most monumental structures. In Polynesian chiefdoms, temples or *marae* are the main forms of ceremonial architecture and the *marae-ahu* (temple-altar) complex is well distributed throughout East Polynesia (Kirch and Green, 2001, p. 251–254, p. 276). While the function of specific temple sites varied, temples were places where offerings and incantations were made to the gods and the ancestors. Archaeologists have long studied the size and morphology of *marae* as a proxy for chiefly religious control. Religious ideologies and ceremonial rituals carried out at East Polynesian temples established elite control over labor, production, and the annual calendar, created avenues for territorial marking, and facilitated warfare, territorial disputes, and elite hegemonic influences (Kolb, 1994 and 2006; Dixon et al., 1995; Kirch, 2004; Kirch and Sharp, 2005; Sharp et al., 2010; McCoy et al., 2011; Wallin and Martinsson-Wallin, 2011; Kahn and Kirch, 2014).

While the central importance of the marae-ahu complex cannot be disputed, ethnohistoric texts also describe a myriad of other East Polynesian site types that had ritual significance with differing functions (table 1; see

Site Type	Form	Context	Activities
Rock Art	Petroglyphs of mourning costumes	Associated with banyan trees, caves, aggregate *marae* sites, chief's house platform	Mark sacred sites associated with mourning rituals (A, E)
Banyan Tree	–	Planted on or near other ritual structures in aggregate *marae* complexes, *me'ae*	Mortuary- bones placed in tree limbs (A, E)
Shrine	Simple stone pavement or less frequently a simple walled enclosure; rows of uprights at one end, backrest stone at the other end, sometimes with a *ti'i* (god figure) in between	Often attached to *marae*, but sometimes stand alone in residential or ritual complexes; those for occupational specialists found in unique contexts near natural resources	Incantation or prayers; sometimes used by occupational specialists (A, E)
Ti'i	Anthropomorphic image sculpted in stone or wood	Associated with shrines attached to temples (often simple temples), or isolated shrines and other religious structures	Symbolize the ancestors; mediate between the world of the gods and the living; incantation or prayers (A, E)
Family *marae*	Simple to elaborate stone enclosure, with or without *ahu* (altar)	Associated with residential structures (rectangular houses, oval-ended houses), pavements, terraces	Feasting, offerings to the gods and ancestors (A, E)
Community *marae*	More elaborate stone enclosure with *ahu*, entry-way, ramp	Often associated with aggregate *marae* sites with numerous elaborate *marae*, priests' houses, council platforms, other specialized structures	Feasting, but more removed from temple and associated with priest house or council platform; ritual storage and memorialization of ancestor bones; procession; dance, performance; games (A, E)
Tupapa'u	Pole and thatch platform	Associated with major temples or chiefs' houses	Mortuary (embalming, presentation of dead to the family community); public mourning (E)

Table 1 – Variability in ritual site types found in East Polynesia, (A) refers to archaeological data, (E) refers to ethnohistoric data.
Tabl. 1 *– Variabilité des types de sites rituels retrouvés dans l'Est de la Polynésie. (A) se réfère aux données archéologiques, (E) se réfère aux données ethnohistoriques.*

Kahn and Kirch, 2014 for a recent Society Islands study, McCoy, 2008 and 2014 for recent Hawaiian studies). Society Island and Marquesas Island texts note how Banyan trees were afforded sacred significance (Orliac, 1984; Lepofsky, 2003; Kahn and Coil, 2006; Ottino-Garanger, 2006). Indeed, such trees are often found in association with *marae-ahu* and *me'ae* archaeological complexes (Ottino-Garanger, 2006; Rolett, 2010; Kahn and Kirch, 2011). R. Linton (Linton, 1925) has argued that the majority of Marquesan meae are associated with Banyan trees planted in prehistory, while J. Kahn and P. Kirch (Kahn and Kirch, 2014) have described a similar pattern at an aggregate *marae* complex on Mo'orea, Society Islands.(2)

Banyan trees on Marquesan *me'ae* were associated with mortuary offerings, with long bones placed in their roots (Linton, 1925). Banyan trees were also associated with mortuary complexes in the Society Islands, offering support for the *tapu* nature of Banyan trees and their association with sacred locales.

Small shrines, constructed as simple pavements or platforms with less elaborate architecture than temples, were also places of religious activity in East Polynesia. In the Society Islands, shrines comprised of pavements, uprights, backrest stones, and god figures are found directly attached to marae or in isolation from marae and distributed throughout residential complexes (Green, 1961, p. 171; Kahn and Kirch, 2013 and 2014). Sculpted stone anthropomorphic images, or *ti'i*, are commonly associated with shrines and less commonly with other religious structures (Campbell, 1991). While having multiple uses, *ti'i* were regarded as ancestral figures, and as mediators between the world of the gods and the world of the living. They were actively evoked at the local or family level by household members or ritual occupational specialists for general worship and protection (Montgomery, 1832a, p. 114, 1832b and 1832c). The specific placement of *ti'i* on shrines suggests active invocation, as they were positioned opposite backrest stones where the officiant would sit, but before the rows of uprights which symbolized the ancestors.

The archaeological association of *ti'i* with shrines suggests an individualistic style of ritual worship (see discussion below). This is supported by B. Campbell's (Campbell, 1991, p. 68) study of 'Opunohu Valley, Mo'orea shrines, which illustrated that shrines are most often associated with simple temples and may have been used for small family rites of an 'individual/occupational form'. In Hawai'i, small household shrines associated with stone uprights and coral offerings are often located in men's houses within residential clusters (Kirch, 1985; Weisler and Kirch, 1985; Weisler et al., 2006). P. Buck (Buck, 1957, p. 527–528) argued that shrines were used by small family groups or individuals in short rituals with offerings that did not require the participation of priests. Similar to Society Island shrines, Hawaiian household shrines were used to dedicate offerings to family deities in individualistic rituals.(3)

Fishing shrines are another ritual site common on the Hawaiian landscape. These religious sites are delineated by small courts and water worn upright stones and are often situated along coastal promontories (Kirch, 1985; Weisler et al., 2006). Fishing shrines are also found in the Marquesas Islands, where they were considered sacred sanctuaries of professional fishermen (Millerstrom, 2009), and the Tuamotu Islands, where they served as places for fisherman to provide offerings to marine deities (Emory, 1934 and 1947; Molle, 2015). Occupational shrines also were present in pre-contact Hawai'i (Buck, 1957; Malo, 1951) and differed from fisherman shrines in their specific locations. Finally, shrines similar to Society Island forms have been described for the upper reaches of the Mauna Kea adze quarry (McCoy et al., 2009) on Hawai'i Island. M. McCoy (McCoy, 1999 and 2014) has argued that these ridge top shrines were used in ceremonies initiating apprentice adze makers, in ceremonies related to adze manufacture, and in pilgrimages to this upland wilderness to worship local gods and goddesses. As this brief review suggests, East Polynesian shrines typically served religious purposes that were of a more individualistic or specialized nature than the larger communal events at monumental temple sites.

Other East Polynesia religious sites are associated with human burials and mourning locales. In the Society Islands, funerary rites carried out near elaborate temples were instrumental in transforming the deceased chief into a supernatural (Babadzan, 1993). Important high ranking individuals were embalmed and laid out on platforms *(tupapa'u)* for a period of time while the community engaged in mourning (Oliver, 1974, p. 494). These mourning rituals involved high priests donning elaborate mourning costumes with shiny breastplates (Henry, 1928, p. 293–94; Oliver, 1974, p. 503–4). Such costumes are described and depicted in both explorers' journals (Banks in Hooker, 1896) and rock art sites (fig. 1). As S. Millerstrom and H. Baumgartner Lesage (Millerstrom and Baumgartner Lesage, in press) note, rock art in the Society Islands and elsewhere in East Polynesia denote aspects of religious ideology. Mourning mask and headdress petroglyphs illustrating breast plates were found at Vaiote, Tautira (Tahiti; Emory, 1933, p. 171; Garanger, 1980; here: fig. 1), in association with a burial cave and a Banyan tree. Images of these types have been found at other sites, including Fare Hape, Papeno'o (Tahiti), and Tevaitoa (Rai'atea), at the former they were associated with several marae, shrines, a council platform, and a likely fare *tupapa'u*, at the latter they were associated with a corner stone of a chief's house platform (Millerstrom and Baumgartner Lesage, in press). These mask images depict traditional mourning costume headdresses used in burial ceremonies of important people (Emory, 1979, p. 200–221). Data suggest that rock art images of mourning costumes mark sacred areas where the *tupapa'u* or ghost house for an embalmed chief stood and thus, represent another type of religious context.

The diversity of ritual sites in the Society Islands calls for a multi-scalar approach, as ethnohistoric and archaeological data suggest that ritual structures and spaces of different size and form had different uses.

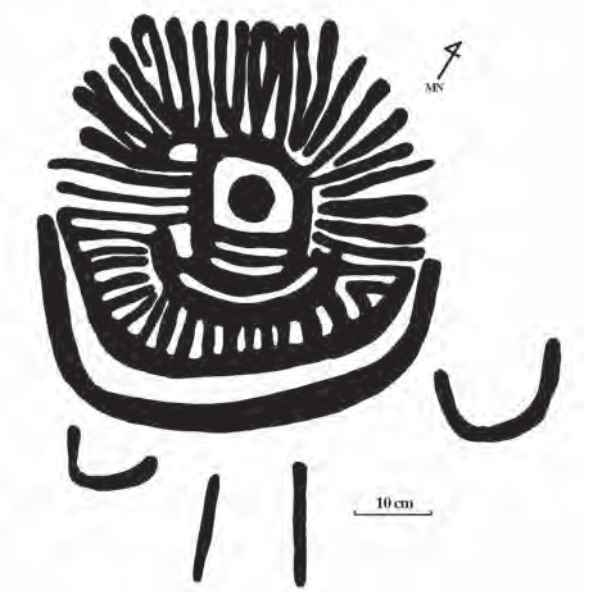


Fig. 1 – Rock art depiction of a mourning headdress and breastplate, Vaiote Valley, Tautira, Tahiti.
***Fig. 1** – Pétroglyphe représentant la coiffe et le plastron d'un deuilleur, vallée de Vaiote, Tautira, Tahiti.*

Ritual sites also had diverse users and audiences, including the chiefs and their elite retinue, formalized ritual specialists such as priests, laity practitioners, and the general community. The latter were at times members of audiences participating in larger ceremonial events led by chiefs and priests, and at other times, were active participants in household ritual and individual, meditative ritual (Oliver, 1974).

One means of investigating functional differences between Society Island religious structures is to focus on ritual architecture and its relationship to use and access (public versus private), patterns of visibility, and size and type of the audience and active participants. Utilizing such a methodology, L. Fogelin (Fogelin, 2003) has described three major forms of ritual worship. The first, individual ritual, is associated with one or more individuals directly interacting with an object of worship. Individualistic cultic practices lack ritual specialists and can be carried out by varied individuals in any society (see also Rakita, 2003, p. 72). As I will argue, local-scale ritual in East Polynesia associated with household shrines and shrines with god features aligns well with individual ritual. Communal ritual, as a form of group worship, relates to a group worshipping in relation to an object. As L. Fogelin (Fogelin, 2003) notes, communal ritual promoted egalitarian relationships within groups and did not require a ritual specialist. In the Society Islands, household ceremonies carried out at family marae by headman would conform to communal ritual. Both individual and communal ritual would be considered laity[(4)] rituals, as they were not associated with ritual specialists or other groups who were elevated in status or role above the rest of the participants.

Finally, corporate ritual involves worship between a group and an object or action. It is strongly hierarchical, as it is mediated by a ritual specialist, either an individual or group (clergy) who is elevated above the rest of the audience (laity).[(5)] L. Fogelin argues that corporate ritual was carried out in public areas allowing for community assembly, areas that were constructed so as to support the clergy/laity distinction. Merging L. Fogelin's architectural model of clergy/laity distinctions with ritual activities described in the Society Island ethnohistoric accounts will allow for a multi-scalar view of Ma'ohi religious practices to emerge.

MODELLING INDIVIDUAL, COMMUNAL, AND CORPORATE RITUAL: MERGING ETHNOHISTORIC AND ARCHAEOLOGICAL DATA TO INFER SITE FORM AND FUNCTION

Following a spatio-functional approach, ethnohistoric documents and archaeological data can be used to model whether religious activities at Society Island ritual sites were of an individualistic, communal, or corporate nature (table 1). With respect to temple sites *(marae)*, historic documents and terms in the earliest Tahitian dictionary indicate that the largest monumental temples in the Society Islands (community level and international—or paramount level—*marae*) were loci of community wide presentations to the chiefs (table 2 and table 3). Ritual ceremonies led by specialized priests at these structures included important rites of passage for the elites, such as political investiture ceremonies, coming of age ceremonies, and mourning ceremonies, in addition to the interment and memorializing of elite skeletal remains. *To'o*, sacred god images, and other religious sacra were housed exclusively at international or community level *marae*, and were unveiled and used during significant temple renewal ceremonies and rites of human sacrifice associated with war (Henry, 1928, p. 166; Beaglehole, 1955, p. 201; Orliac, 1982, p. 169; Eddowes, 1991). Community level temples were also associated with warfare rituals linked to engaging in battle, particularly when human sacrifices were offered up to the gods at war cult temples. Thus, community level temples were frequently associated with corporate rituals led by a clergy (formal ranks of priests, in association with chiefs).

In contrast, smaller temples served as house-based loci of ritual engagement, associated with laity rites of a more intimate nature (table 1). Family temples were contexts where headmen of the extended household performed rituals for the household to the ancestral deities (table 2). Rites at family *marae* not only sanctified household activities, but announced land ownership, delineated control over resources, and justified rank (Henry, 1928, p. 141).

Family temples also served as places for rites of passage for children of lower status households, while

higher status chiefly households performed such rites in their community level temples. These family-based rituals would be considered either individualistic or communal depending on the number of officiants and the size or presence of participatory audiences, while evocation prayers offered up to the ancestors at small shrines would likely be individualistic in their nature.

Because laity and clergy rituals in Ma‘ohi society have some overlap in terms of spatial location, it is instructive to look at the development of Ma‘ohi ritual in a multi-scalar fashion, both in terms of time and space. In terms of space, based on L. Fogelin’s (Fogelin, 2003) analyses, and ethnohistoric data from the Society Islands, the architectural form and spatial layout of specific ritual structures should be instructive for teasing out individualist ritual from communal or corporate ritual. One key difference is in the number of participants in the ritual, including the number of officiants and the size of the audience. Given that individualistic rituals typically involved one or a few individuals, we would expect such sites to be smaller in size than communal and corporate ritual locales which involved a larger number of officiants and a larger audience. Second, while participation in individualistic ritual may have cross-cut status and rank categories in the prehistoric Society Islands, it seems likely that corporate rituals were highly or exclusively associated with upper class elites and ritual specialists. This has relevance to site proxemics—the expectation would be that individualistic ritual sites may be found interspersed throughout ancient Society Island landscapes, while corporate ritual sites will be situated in more isolated or unique (i.e. high status) settings. Furthermore, given the difference in audience size, one would expect corporate ritual sites to not only be larger, but to have specific architectural elements allowing for a clear division of the clergy closely involved in the ceremonies from the laity, whose participation was solely in an audience capacity.

In terms of change through time, archaeologists studying ancient religion have posited that the role and number of ritual specialists and the complexity of religious practices parallels general trends in the society’s socio-political complexity (Blenkinsopp, 1995; Hayden, 2003; Sugiyama, 2003; Redmond and Spencer, 2008; Steadman, 2009). In many complex societies, elite leaders or ritual specialists appropriated early communal forms of religious worship as a means of consolidating socio-political power. With respect to the Society Island case study, the question becomes: are communal ritual sites earlier than corporate ritual sites on the Ma‘ohi landscape? And do later corporate ritual sites incorporate spatial aspects of earlier communal sites, suggesting an appropriation of ritual power by social elites through time? Finally, can spatio-temporal analyses of ritual sites illuminate aspects of socio-political complexity in Ma‘ohi chiefdoms through time?

‘OPUNOHU VALLEY CASE STUDY

‘Opunohu is the largest valley on Mo‘orea Island, which along with its neighbor Tahiti, comprise the

Rites de Passage (Tahitian term in italics)	Form	Context	Activities
Fa‘aari‘ra‘a	Office taking, investiture of the chief; large scale public ceremony and feast	International temple; Community level temple	Henry, 1928; Oliver, 1974
Taurua	Large scale public ceremony with feasting	*‘Oro* (war cult) temples; International or Community level temples	Corney, 1919; Oliver,1974
Pa‘iatua	New decoration of the *to‘o* or god image; performed as a prelude to other ceremonies (chief’s inauguration, laying a cornerstone of a *marae*)	International or Community level temples	Davies, 1851; Henry, 1928; Oliver, 1974
Matea, maui fa‘atere, haea mati	Large scale political and religious ceremonies prior to commencing a battle	International temples (and community temples?) dedicated to *‘Oro*	Ellis, 1829a and 1829b; Oliver, 1974
Honoring of the deceased	Mourning ceremonies, with elites laid out in an embalmed state for several weeks, while family and friends came to mourn; supervised by high priests or elder member of the family; associated with use of mourning masks	*Fare tupapa‘u*, platform for the dead, erected near international temples (and community temples?) dedicated to *‘Oro*; near chiefs’ houses (?)	Beaglehole, 1967, p. 190–91; Bligh and Tobin in Oliver, 1988, p. 188–89; Eddowes, 1991, p. 93–96; Ellis, 1829a and 1829b; Henry, 1928, p. 296; Oliver, 1974

Table 2 – Examples of corporate rituals and their material and spatial associations, as modeled from the Society Islands ethnohistoric record.

***Tabl. 2** – Exemples de rituels spécialisés et de leurs associations matérielles et spatiales, modélisés d’après les archives ethnohistoriques des îles de la Société.*

Rites de Passage (Tahitian term in italics)	Description	Reconstructed Locale	References
Paiatiare	Custom or ceremony, when restrictions of female children, were removed	?? international, community, and family level temples based on household rank?	Davies, 1851
Puaafatoi	Feast and ceremony, members of a family eat together for the first time, children having been considered sacred, and eaten apart	?? perhaps both international, community, and family level temples based on household rank?	Davies, 1851
Uhiā'iri	A ceremony performed, navel string of a first born was cut	international and community temples, family temples based on household rank?	Davies, 1851; Oliver, 1974; Henry, 1928
Amoa, Amo'a	Remove restrictions in regard to children of the chiefs	house near the temple, family residence, 'head-freeing rites' at the temple	Davies, 1851; Oliver, 1974
Tehera'a	Male circumcision rite	community or family temple	Henry, 1928
Fa'atoira'a	Coming of age rites/feast	community or family temple	Henry, 1928
Hunara'a a tupapa'u	Burial of the dead; internment of chiefs was supervised by priests, at first in a vault in the marae and later in a burial cave	community or international marae, *anaa* (burial caves)	Beaglehole 1962a, p. 378; Bligh, 1792, p. 153; Moerenhout 1837, p. 554–55; Oliver, 1974

Table 3 – Examples of individual and communal rituals and their material and spatial associations, as modeled from the Society Islands ethnohistoric record.
Tabl. 3 *– Exemples de rituels individuels et communautaires et de leurs associations matérielles et spatiales, modélisés d'après les archives ethnohistoriques des îles de la Société.*

Windward islands of the Society archipelago (fig. 2). At the time of European contact the valley was divided into two socio-political districts, Tupauruuru in the east and Amehiti in the west (Green, 1961; Lepofsky and Kahn, 2011). These two districts vary in the types and frequencies of archaeological structures situated on their landscapes (Green 1961; Green and Descantes, 1989; Kahn, 2013; Kahn and Kirch, 2013).

R. C. Green pioneered a settlement pattern approach in the 'Opunohu (Green, 1961; Green et al., 1967), mapping and describing close to four hundred residential sites, ritual structures (*marae*, shrines), and agricultural complexes (Green and Descantes, 1989). D. Lepofsky (Lepofsky, 1994; Lepofsky et al., 1996) amplified R. C. Green's survey by comprehensively mapping the spatial context of agricultural features, while Kahn (Kahn, 2003, 2005, and 2007; Kahn and Kirch, 2004 and 2013; Sharp et al., 2010) carried out extensive excavations at domestic structures and ritual structures of varying size and elaboration in both sectors, adding to our understanding of residential patterns and ceremonial practices.

Among the well-studied archaeological complexes in the Tupauruuru district is ScMo-170-171, a residential complex associated with a small temple (fig. 3). This complex is situated in upper Tupauruuru and its two major phases of site occupation date to between the mid-15th and the mid-17th centuries (Kahn, 2006). In contrast, ScMo-103 is a ceremonial complex with seven aggregated *marae*, eight shrines, and two large oval-ended houses (Green et al., 1967; here: fig. 4). This complex is associated with high status specialized structures, including a chief's council platform and an archery platform. ScMo-103 has multiple episodes of site construction and use dating to between the mid-15th and the early 17th century (Kahn, 2011). Finally, ScMo-163/129[(6)] is an aggregated *marae* complex in Tupauruuru found on one side of a major river (fig. 5). The complex includes three temples with elaborate architecture (-129, -161, 163), numerous shrines (165), and elite specialized structures including two large oval-ended houses (162, 164), two archery platforms (109), and a chief's council platform (164b) (Emory, 1933; Green et al., 1967). Dated samples suggest that the complex was constructed and used between the mid-15th and the 17th centuries (Kahn, 2011).

While residential sites in the Amehiti district can rival those found in Tupauruuru with respect to size and architectural elaboration, ceremonial sites in the Amehiti district tend to be less elaborate in terms of temple architecture, the number of aggregated structures, and the frequency of elite specialized-use structures. Among the well-studied archaeological complexes in the Amehiti

Fig. 2 – Mo'orea Island, showing 'Opunohu Valley and the Amehiti and Tupauruuru Districts.
***Fig. 2** – Île de Mo'orea : vallée de 'Opunohu et districts d'Amehiti et de Tupauruuru.*

district are zone A and zone B (Kahn and Kirch, 2013; here: fig. 6 and fig. 7). Zone A and B are comprised of residential sites and specialized houses interspersed among agricultural zones and ceremonial structures of a familial nature. Zone A was constructed and settled during the mid-14th and 15th centuries and used up until the 17th century, while zone B was constructed and settled in the mid-15th century and used up until the 17th century.

Family level *marae* and communal ritual

Family level marae *and communal ritual: spatial layout*

Current survey and excavation data for the Tupauruuru and Amehiti districts illustrate that small family level marae are typically found embedded within residential complexes. As can be seen in figure 3 and figure 7, small temple enclosures interpreted as family level marae are associated with residential sleeping houses, craft activity areas, and planting zones. Archaeological investigation of family level marae has produced evidence for temple offerings and feasting, either on the marae enclosure or on adjacent terrace structures (Kahn, 2005; Kahn and Kirch, 2013). The layout of family *marae*, with their simple enclosures and rows of uprights representing the ancestors, facilitated household assembly in a ritual context. Given their spatial context, it seems likely that family level temples were used in both individual and communal family based rituals led by the residential group's headman.

The form of family-based *marae* likewise suggests their use in intimate rituals of the residential group. Like other family level *marae*, ScMo-325, the small temple associated with Zone B, includes a stone enclosure and stone uprights or backrests stones, but lacks an elaborate altar *(ahu)* or a restricted entry way (fig. 7). The open rather than restricted form of the familial ritual structure would have lent itself to collective worship. As with ScMo-325, small shrines with rows of uprights are attached to family level temple site, indicative of individualistic worship. Isolated shrines not attached to temples are also found at other areas within residential complexes. For example, an isolated shrine with rows of uprights is found along the southern limit of the zone B complex, adjacent to a major river and interspersed among residential and agricultural structures (fig. 6). This pattern highlights that individualistic worship could take place either

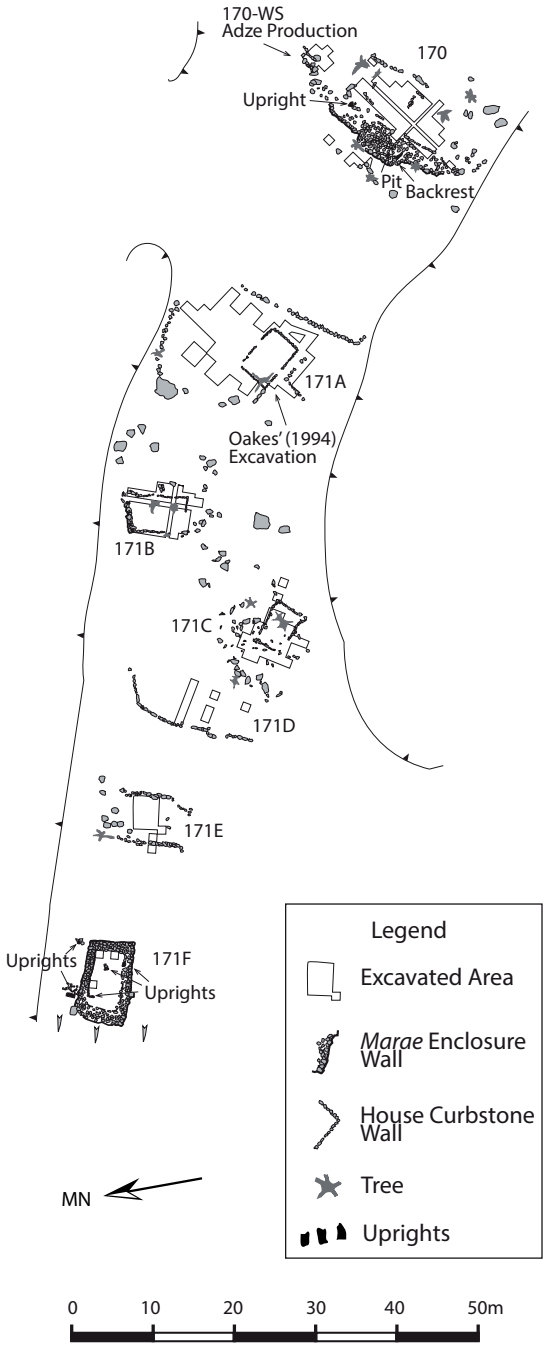


Fig. 3 – Plan view of the -170/171 residential complex.
Fig. 3 *– Vue en plan de l'ensemble de maisons -170/171.*

within direct association with a familial temple, or in isolation from temples and embedded within other zones of residential complexes. In this way, individualist worship at shrines can be seen as another form of intimate ritual associated with residential groups.

Family level marae *and communal ritual: temporal sequence*

AMS radiocarbon dating of short lived species has documented that small family temples are typically built early on in the inland expansion into the 'Opunohu Valley, ca. AD 1350 (Kahn and Kirch, 2013). In the Amehiti district, several complexes illustrate a shared pattern whereby family temples are the first to be built in conjunction with elite residences and agricultural complexes. One example is zone A in Amehiti, a neighborhood that has both large and small terrace complexes for irrigated taro cultivation and houses of varying size and morphology (fig. 6). This ridge also has one of the higher densities of temple sites in the sector, with three *marae* situated along its flanks (Kahn and Kirch, 2013). Within this complex, the earliest episodes of site use during AD 1350–1450 include the construction of a moderately elaborate sleeping house

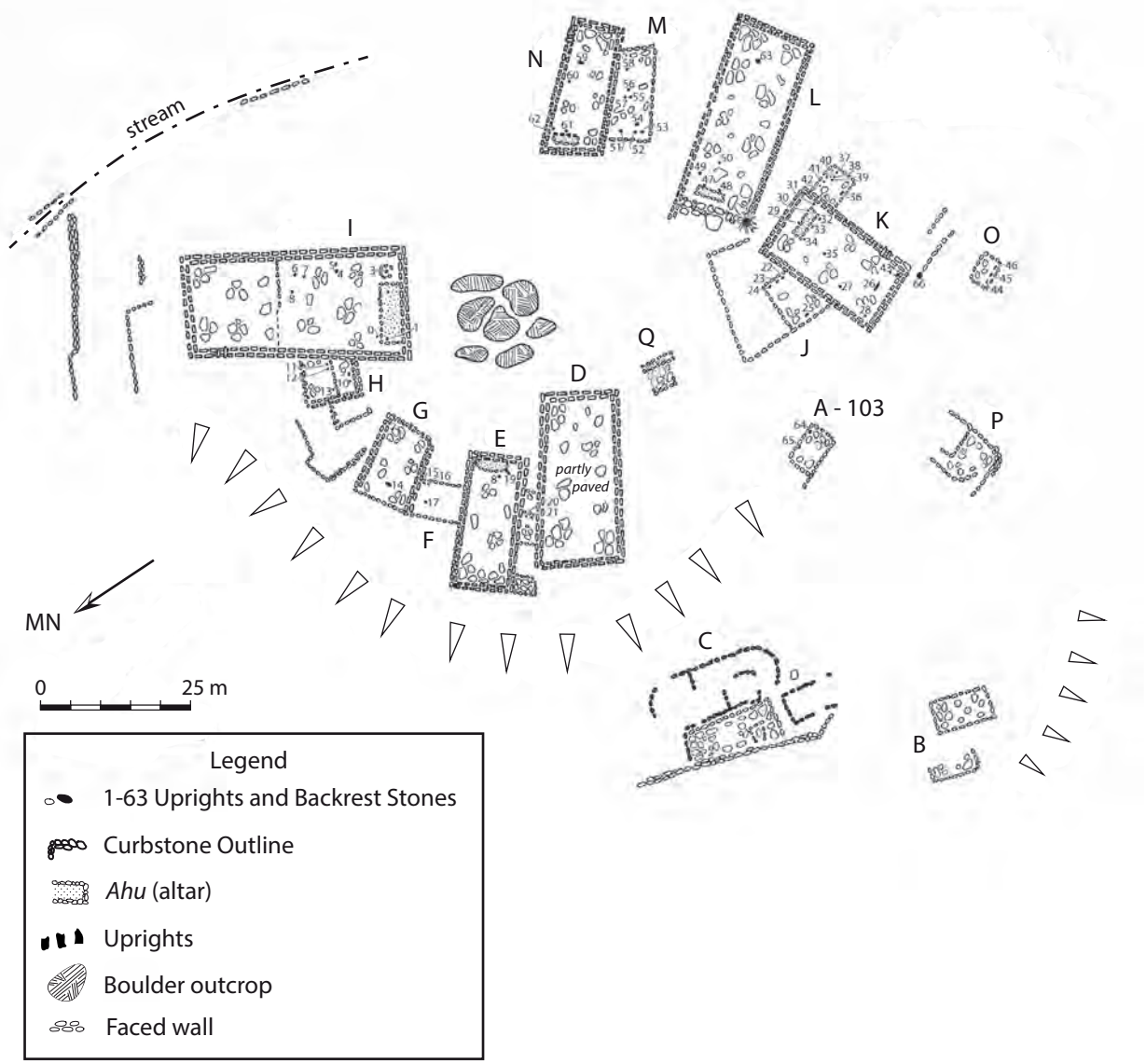


Fig. 4 – Plan view of the -103 aggregate *marae* complex.
Fig. 4 – *Vue en plan de l'ensemble de marae -103.*

(-289) and two family temples adjacent to major wetland taro complexes and important water sources (-287, -306). This has an appearance of territorial marking of the landscape by residential groups. The close spatial association of house sites and temples suggests social identity was reified as domestic groups participated in house-based annual rituals at family temples throughout the year. Individualistic ritual would also have been carried out in the small shrines attached to family temple sites or those found in other areas of each residential complex.

Family level marae *and communal ritual: discussion*

Current data indicates that during the early inland expansion period, between. AD 1350–1450, house groups actively competed for land and resources in the 'Opunohu Valley. Family-level temples and shrines and the ceremonies carried out at them were among the ritual locales actively used to mark territories and property. While such data support L. Fogelin's notion (Fogelin, 2003) that communal ritual promoted group solidarity and egalitarian relationships, as these religious activities did not require ritual specialists, it is clear that Society Island familial rituals also emphasized subtle hierarchical differences. Ethnohistoric documents suggest that most house-based rituals in the archipelago were led by the senior male or headman who officiated at the *marae* for the family in various ceremonies (Forster, 1778, p. 224–225; Oliver, 1974, p. 78; Orliac, 2000, p. 143). The senior headman of the senior household also served as leader at neighborhood level (Wilson, 1799, p. 186; Newbury, 1967, p. 477–478; Oliver, 1988, p. 43). Regional-wide hierarchies of families, based on notions of sanctity and rank

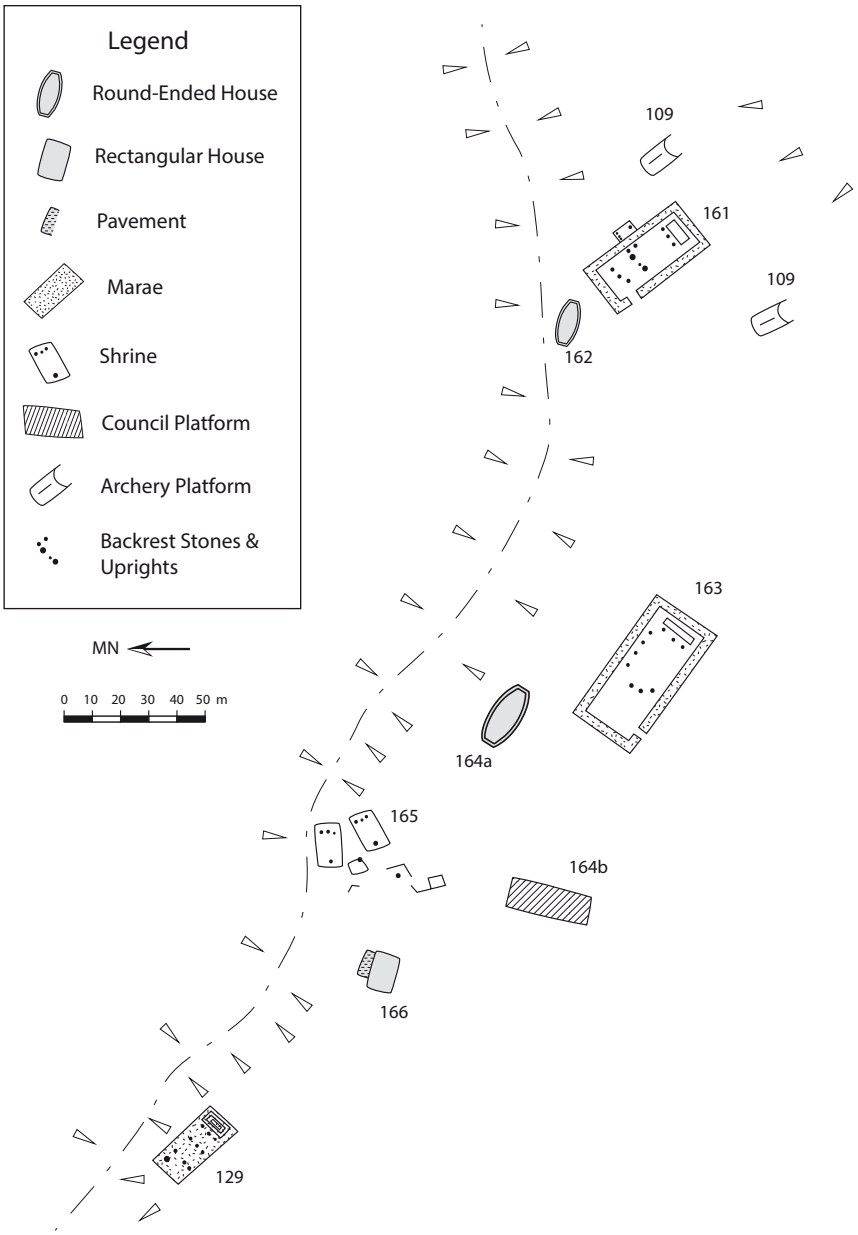


Fig. 5 – Plan view of the -163/129 aggregate *marae* complex.
Fig. 5 *– Vue en plan de l'ensemble de marae -163/129.*

of the household head (whether first born or from junior lines), existed in the Society Islands (Oliver, 1988, p. 45) and these hierarchies had great influence at the local level (Beaglehole, 1962, p. 339).

Thus, communal rituals at family level *marae* contributed both to social cohesion of the residential group and to subtle structures of hierarchy from the mid-14th century onwards. These patterns were accelerated in the two following centuries, from AD 1450–1650, when there was an infilling of the 'Opunohu Valley landscape. New, often lower status residential clusters were established in conjunction with ritual and subsistence zones (Kahn and Kirch, 2013), while other complexes first established in the 14th century continued to be occupied and expanded in size (Kahn, 2013).

The advent of community *marae* and corporate ritual

The advent of corporate ritual, or more exclusionary rites carried out by specialized priests in front of larger audiences, is materialized on the 'Opunohu Valley landscape in a different manner than that of communal ritual. Towards the latter half of the 15th century, construction of clustered temple sites with more elaborate architecture including raised altars *(ahu)* commences. I refer to these clusters of elaborate temple sites as aggregate complexes (Kahn, 2011). Through time, particularly after AD 1600, aggregate complexes expand to include numerous elaborate temples, and other types of 'elite' political structures such as archery platforms and chiefs' council platforms.

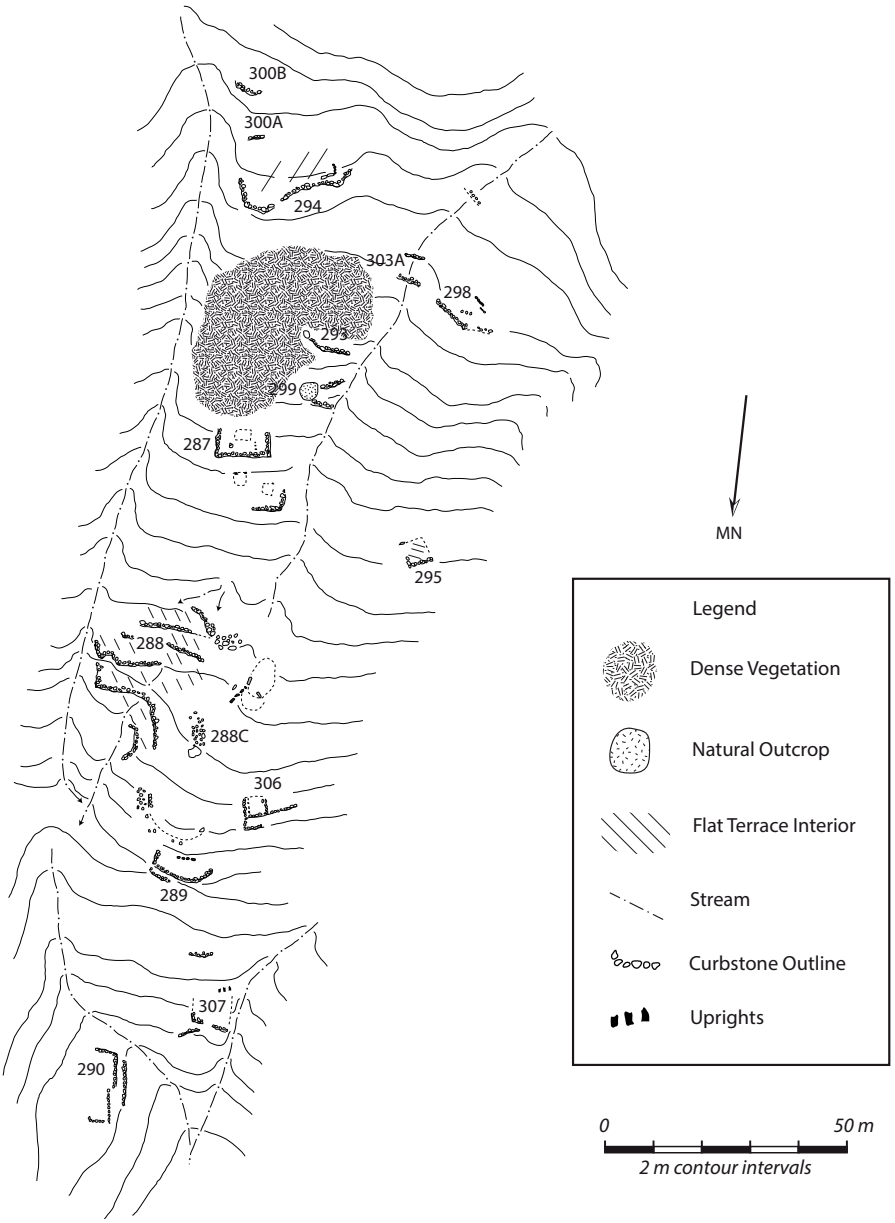


Fig. 6 – Plan view of the zone A residential complex.
Fig. 6 – *Vue en plan de la zone A de l'ensemble de maisons.*

Site proxemics, archaeological data, and ethnohistoric data illustrate that aggregate temple complexes are the material manifestations of Ma'ohi corporate ritual.

Corporate ritual: spatial layout

Aggregate marae complexes related to corporate ritual include a greater diversity of structures, including specialized structures with dual ritual and political functions. The ScMo-103 aggregate complex includes seven elaborate altar bearing temples, round-ended and rectangular house structures, and raised platforms (fig. 4). Specialized structures, including a chief's council platform and an archery platform, are found upslope (Kahn, 2011). A number of the temples have attached shrines, and three are appended to one another with shrines and rows of uprights. Based on excavation data (Orliac, 1982; Green, 1996), round-ended house site -103C was identified as a *fare 'ia manaha*, a house to store sacred items used in elaborate *marae* ceremonies. Numerous cooking features were located adjacent to the -103C round-ended house and pavement. Their size, frequency, and context are suggestive of a feasting locale (Green et al., 1967; Kahn, 2016).

While the form and spatial layout of ScMo-103 riffs on aspects of house-based ceremonial sites, such as the inclusion of temple enclosures, many with attached shrines, and the inclusion of feasting activities, there are notable differences. First, excavation data illustrates that house sites found at ScMo-103 were not ordinary sleeping houses, but rather, functioned as specialized houses serving a range of socio-political functions. The afore-

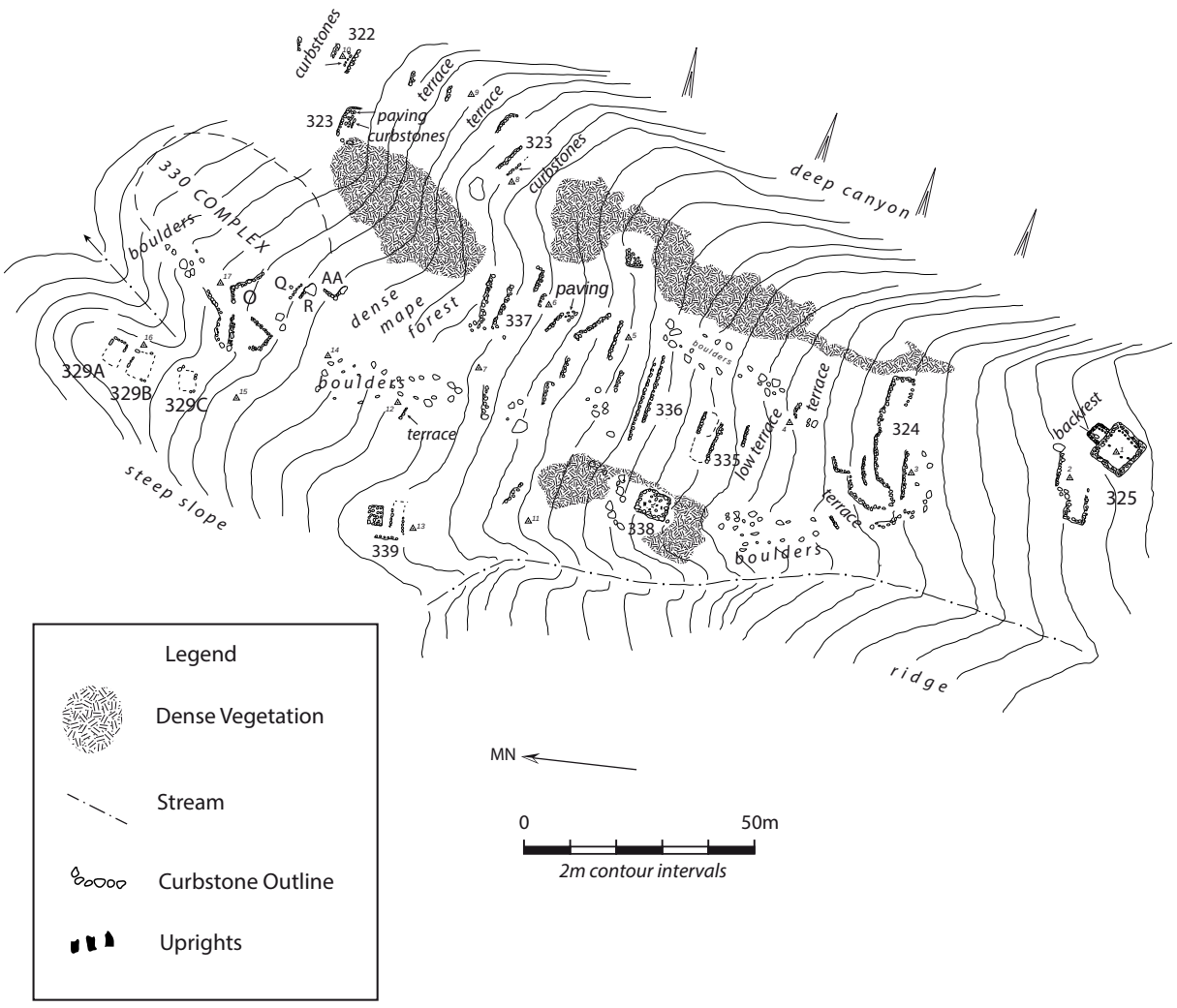


Fig. 7 – Plan view of the zone B residential complex.
***Fig. 7** – Vue en plan de la zone B de l'ensemble de maisons.*

mentioned round-ended house 103C served as a *fare* '*ia manaha* (Orliac 1982, p. 283; Green 1996, p. 221), a sacred house used for the storage of ritual paraphernalia, such as drums, god-idols, tapa cloth, and costumes utilized in rituals (Parkinson, 1773, p. 70; Henry, 1928, p. 135, p. 175–76). At aggregate complex -163/-129, large rounded ended-houses are paired with elaborate *marae* (fig. 4), suggesting similar use as *fare* '*ia manaha* with specialized function. Such sacred houses were typically found at communal or international level *marae*, where formal ritual sacra were utilized in public ceremonies.

Second, the ScMo-103 complex is situated near several elite political structures found upslope, including an archery platform, another large round-ended house, and a chiefs' council platform. Archery platforms were places where elites competed in sacred sport (Kahn and Kirch, 2014). Only elites, namely warriors, high chiefs, and their administrative land managers, could participate. The sport had a number of religious connotations (Wallin, 1997) and was associated with feasting and dancing. The fact that the 'king and chiefs' usually attended these festivities, as did chiefs from other socio-political districts (Ellis, 1829, p. 301; Henry, 1928, p. 279), illustrates that archery platforms and the structures surrounding them served as places for communal gatherings of a political and ritual nature.

Council platforms (one of which is found upslope of ScMo-103), are similarly identified as specialized structures for chiefly activities. At these stone platforms, elites, including chiefs, priests, and warriors, deliberated on political matters such as warfare (Kahn and Kirch, 2014). Thus, the spatial configurations of aggregate temple sites and the range of site types associated with them suggest they had corporate ceremonial functions. These complexes were used both as meeting places for a range of socio-political elites, as well as places of large, communal worship where economic tribute was filtered up to socio-ritual rulers. It is not surprising that aggregate marae complexes tend to be isolated in hard to access parts of the 'Opunohu Valley or in areas with sacred meaning (i.e. areas inscribed with *mana* due to natural landscape features such as sacred peaks, or due to internment of skeletal remains).

The inclusion of ancestral skeleton remains in the altar or walls of elaborate community level *marae* such as ScMo-163 (Green et al., 1967; see here fig. 5) or in the general precincts of aggregate complexes (Kahn and Kirch, 2014) mark these places as the most sacred of sacred. Given their association with the ancestors and exclusive ceremonial practices which served to support status hierarchies at the community scale, exclusivity and isolation of aggregate complexes also functioned to protect the sacred power of the elite.

Varied architectural elements of aggregate marae sites likewise argue for their use in more formalized and exclusive corporate ritual. At aggregate complex ScMo-163/-129, each of the three main marae has a volumous enclosure, allowing for sizeable numbers of participants (fig. 5). Each has a clearly defined enclosure or paved court, with an altar or *ahu* at one end and backrest stones, delineating an interior space for the clergy- ritual specialists such as priests, and the chiefs in their ritual capacities. Formal entryways in the temple walls are narrow, allowing the clergy to access the sacred court but restricting the laity audience to participatory activities in exterior areas. Other corporate ritual sites in the ‘Opunohu Valley such as ScMo-120 and -124 utilize altars, formal entry-ways, and enclosures in association with ramps that were likely used for formal pageantry, such as when the clergy brought ritual sacra, including god images, into the *marae* court (Kahn, 2005; Kahn and Kirch, 2014). Formal architectural elements such as altars, entry-ways, elevated courts, and processional ramps serve to create divisions among participants in corporate ritual, creating intimate exclusive spaces for the elevated clergy members, while decreasing active participation of the laity audience (see Kolb, 1992 and 1994, for a Hawaiian example).

Other features of aggregate *marae* sites, most notably large terraces fronting temples, speak to the economic functions of elaborate ceremonial sites in the ‘Opunohu Valley. Excavation at these terraces has overwhelmingly revealed that they were areas used for tribute (Kahn and Kirch, 2013). These areas lacked evidence for structures or sub-surface features. Other than micro-fossil remains (Kahn et al., 2014), they were remarkably clean. As I have argued, large terraces fronting the temples likely served as presentation areas for offerings used in *marae* rituals. Many of these rituals, including the annual first fruits festivals, involved lesser elites bringing large contributions of food to communal assembly grounds. The foodstuffs were then laid out in heaps and divided into shares, while a large part was appropriated for the gods and the highest ranking elites. This tribute—the direct result of commoner labor—was funneled up through the social hierarchy at certain times during the ritual calendar, confirming the integrated nature of Ma‘ohi social hierarchy and ideology. The presentation of ritualized tribute literally at or in front of community level *marae* underscores the integrated role of corporate ritual, production, and hierarchy in late pre-contact Ma‘ohi chiefdoms. Archaeological evidence reveals that these activities were organized by political elites as well as priests, as material evidence for priests’ houses and specialized ritual-use houses has been found at numerous aggregate sites (Kahn and Kirch, 2014). As such, corporate rituals associated with a ‘clergy’ of ruling chiefs and ritual specialists (priests) represent a distinctive strategy that led to increasing socio-political power of elites in the Society Islands through time.

Interestingly, both aggregate complex ScMo-103 and -163/-129 have numerous attached and isolated shrines with rows of uprights, back rest stones, and at times, *ti‘i* figures. While many shrines are attached directly to one or more *marae*, others are found as isolated structures. As previously noted, shrines are also situated in residential sites associated with family-level *marae* and communal worship, and likely served as locales for individualistic worship on the part of the headman or other individuals. The presence of shrines at large aggregate ceremonial complexes likewise substantiates the presence of individualized worship taking place at these elaborate corporate ritual sites. Based on ethnohistoric accounts, D. Oliver (Oliver, 1974, p. 103) has suggested that such shrines were used in the Society Islands by ritual specialists, such as priests, in individualistic worship. Given that in many world religions, leaders of corporate ritual, (i.e. the clergy and lineage heads), needed places for their own individualistic worship (Lane 2001; Kyriakidis, 2007), it is thus not surprising that such a pattern is retained on the Society Island landscape. Small shrines in corporate contexts in the Society Islands might also have been used by a select few chiefs and priests, further restricting access to the gods and the ancestors (see Hayden, 2003, p. 204–5, 315).

Corporate marae*: temporal sequence*

AMS radiocarbon dating of short lived species and U-Th series dating of corals has documented that aggregate marae centers typically have a staged construction sequence. The first phase of site construction dates to ca. AD 1400–1500 and is associated with major inland expansion (see Kahn, 2006, 2011, and 2013). The majority of temple sites and specialized elite structures in aggregate complexes post-date AD 1600 and are related to a period of intensified chiefly competition whereby new temples, elaborate specialized house sites, and structures with specific ritual-political uses were constructed, enlarged, and elaborated into ceremonial zones used more exclusively by ritual-social elites (Sharp et al., 2010; Kahn and Kirch, 2014). This pervasive pattern, whereby elites gained increasing socio-political, economic, and ritual power over the rest of the Ma‘ohi populace, became accelerated in the 17th century up until European contact in 1767. The fact that this shift is materialized most strongly in the construction of elite specialized structures and evidence for elite feasting at numerous aggregate ceremonial sites (Kahn and Kirch, 2014) indicates that the advent of corporate ritual and its elaboration through time resulted in broad-scale social transformations.

Corporate ritual: discussion

The chronology of Society Island aggregate complexes supports that the materialization of religious rituals and ideology was rapidly elaborated through corporate ceremonies as elites vied for political control in the late pre-contact era. Isolated and formalized concentrations of ceremonial sites such as -103 and -169/-129 served not only as corporate elite religious centers, but created avenues for the development of social difference by promoting dominant political ideologies and control over economic resources. Data from corporate ritual centers in the ‘Opunohu Valley demonstrate that this process of ritual landscape creation was accelerated during the period AD 1620–1760. It is thus during the last two centuries prior to European contact that Society Island elites strategically began to use ideology, notably elements of ritual and religion linked to inclusion and exclusion, to institutionalize social hierarchies and political status.

Corporate ritual and the evolution of elite power

Utilizing multi-scalar analysis of religious architecture and ritual activities in the Society Islands, I have proposed that individual and communal rituals based in Society Island residential complexes differ from corporate rituals carried out in larger ceremonial centers that come to dominate the landscape in the final two centuries prior to European contact. While both communal and corporate rituals served to transform late prehistoric Society Island communities into complex chiefdoms, I focus here on the unique role of corporate ritual. From a temporal perspective, it is clear that in the Society Islands, corporate ritual evolves out of an earlier period where individual and community based ritual predominated. In inland Society Island contexts, archaeological evidence suggests that communal ritual sites are constructed early on during the inland expansion, after AD 1350. The strongest evidence for formalized corporate ritual complexes comes over two centuries later, after AD 1600.

Archaeological data confirms that later corporate ceremonial complexes incorporate spatial aspects of earlier communal sites, suggesting an appropriation of ritual power by elites through time. Later aggregate centers retain the use of temple enclosures and shrines, the latter serving as more individualized areas for prayer or worship. These elements are the building blocks for earlier family temple sites used in communal ritual. The essential elements of *marae* and shrines—i.e. the rows of uprights—are clearly significant. These features represented the ancestors, providing a material link between the social power and well-being of the residential or community group in the present with the ancestors from the past. Corporate ceremonial sites also derived power from association with the ancestors, particularly in their inclusion of ancestral burial remains, however, they differ in critical ways from less elaborate, more inclusive communal ritual sites. The most elaborate corporate sites lack evidence for residential use, and represent isolated ritualized zones on the landscape where socio-ritual elites carried out elaborate *rites de passage* and rituals linked to the annual cycle. For the large part, the general laity community was excluded from these most sacred of rites, other than playing a participatory role as audience members, and importantly, as members of the community providing offerings of food and other goods to the reigning chiefs, the ancestors, and the gods. As a result, corporate rites elevated both elites and ritual specialists to positions of socio-ceremonial power.

In closing, we can ask how do spatio-temporal analyses of Ma‘ohi ritual sites illuminate aspects of socio-political complexity in Ma‘ohi chiefdoms through time? Aggregate ritual centers focused on corporate ritual are constructed late in the Society Island sequence, after AD 1600. This is a period when multiple lines of evidence point towards increasing chiefly power throughout the archipelago (Lepofsky and Kahn, 2011). Archaeological data from corporate ritual centers includes structures indicative of communal feasting, sport, and political meetings of social elites. In diverse ways, aggregate temple complexes served as ritual-economic centers, where tribute was funneled up to the most high status chiefs. As such, the corporate ritual sites were multi-purpose, having both socio-economic, ritual, and political use. Isolated and formalized concentrations of aggregate corporate ritual centers increasingly excluded commoners and women, members of society who lacked *mana*, from the ‘state religion’. Corporate ritual sites thus served as one avenue for elites to strategically use ideology to institutionalize social hierarchies and political status, a pattern seen in many other ranked societies.

The evolution of Society Islands ritual and religious practices mirrors that found in other complex chiefdoms, whereby patterns of both elaboration and increasing restriction or exclusivity are expressed through time (Emerson, 1997). In many societies, ancestor worship at local level temples and shrines, often of a communal or individual nature, are inclusive, while through time, cult worship emphasizing exclusiveness begins to dominate and serves as a politically manipulative tools for socio-political elites (Brown, 1997; Aldenderfer, 2010; Hastorf, 2007; Marcus, 2007; Renfrew, 2007). Identifying the particular function of ritual activities and their change through time thus provides an effective means of understanding how changes in ritual and religious systems can effect greater socio-political change in prehistoric societies.

Acknowledgements: Funding for this research was provided by the Roger Green Foundation and National Science Foundation grant BCS BCS-0749385. Warm thanks to the late Roger Green for first stimulating my interest in ‘Opunohu Valley shrines and *ti‘i*. Diana Izdebeski is thanked for expertly redrafting many of the site figures. Guillaume Molle is thanked for translating the abstract into French and providing comments on an earlier draft of this manuscript, as did an anonymous reviewer. Thanks also to Guillaume Molle and Frédérique Valentin for their editorial suggestions and for shepherding the manuscript through the publication process.

NOTES

(1) *Ma'ohi* is the term that Tahitians use to refer to themselves.
(2) In contrast, Larrue and Meyer (Larrue and Meyer, 2013) have contended that the association of Banyan and *marae* sites on Tahiti may be due to natural colonization.
(3) Household shrines are also found in other East Polynesian archipelagoes. For example, W. Mulloy (Mulloy, 1965, p. 34) recovered three clustered prismatic basalt uprights at a Rapan hilltop fortification which has been interpreted as a defensive village with a chief's house and other domestic structures (Kennett and McClure, 2012).
(4) Laity are members of the community who, while at times participate actively in ritual or ceremony, do not have formal professional roles or responsibilities, in contrast to priests or other types of formalized ritual practitioners.
(5) Rakita (Rakita, 2009, p. 73) uses the term 'ecclesiastical cult formation' to describe corporate ritual where "full-time professional clergy who learn their craft from other members of the religious institutions" perform ceremonies.
(6) I have used two of the main site numbers (-163, -129) to designate this complex, however, given Emory and Green's original site descriptions (Green and Descantes, 1987), and the close spatial association of the surface structures, it is clear that this aggregate complex consists of numerous structures that Green split into separate site numbers. These include ScMo-109, -129, -161, -162, -163, -165, and -166.

BIBLIOGRAPHICAL REFERENCES

Aldenderfer M. (2010) – Gimme That Old Time Religion: Rethinking the Role of Religion in the Emergence of Inequality, in D. T. Price and G. M. Feinman (eds.), *Pathways to Power: New Perspectives on the Emergence of Social Inequality*, New York, Springer (Fundamental Issues in Archaeology), p. 77–94.

Babadzan A. (1993) – *Les dépouilles des dieux. Essai sur la religion tahitienne à l'époque de la découverte*, Paris, Maison des sciences de l'homme, 344 p.

Baltus M. R., Baires S. E. (2012) – Elements of Ancient Power in the Cahokian World, *Journal of Social Archaeology*, 12, 2, p. 167–92.

Beaglehole J. C. (1955) – *The Journals of Captain James Cook on his Voyages of Discovery*, I. *The Voyage of the Endeavour 1772-1775*, Cambridge, Cambridge University Press (Haklyut Society Extra Series, 34a), 684 p.

Beaglehole J. C. (1962a) – *The Endeavour Journal of Joseph Banks 1768-1771*, I, Sydney, The Trustees of the Public Library of New South Wales and Angus and Robertson Limited, 476 p.

Beaglehole J. C. (1962b) – *The Endeavour Journal of Joseph Banks 1768-1771*, II, Sydney, The Trustees of the Public Library of New South Wales and Angus and Robertson Limited, 406 p.

Beaglehole J. C. (1967) – *The Journal of Captain James Cook on His Voyages of Discovery. The Voyage of the 'Resolution' and the 'Discovery', 1776–1780*, Cambridge, Cambridge University Press, 1647 p.

Blenkinsopp J. (1995) – *Sage, Priest, Prophet: Religious and Intellectual Leadership in Ancient Israel*, Louisville, Westminster John Knox (Library of Ancient Israel), 204 p.

Bligh W. (1792) – *A Voyage to the South Sea Undertaken by Command of His Majesty for the Purpose of Conveying the Bread-Fruit Tree to the West Indies in His Majesty's Ship the Bounty, Commanded by Lieutenant William Bligh*, London, George Nicol, 264 p.

Brown J. A. (1997) – The Archaeology of Ancient Religion in the Eastern Woodlands, *Annual Review of Anthropology*, 26, p. 465–85.

Buck P. H. (1957) – *Arts and Crafts of Hawaii*, Honolulu, Bishop Museum Press (Bernice P. Bishop Museum Special Publication, 45), 606 p.

Campbell B. (1991) – *Stone Ti'i of the Society Islands*, master's thesis, University of Auckland.

Clark G. R., Reepmeyer C., Melekiola N., Woodhead J., Dickinson W. R., Martinsson-Wallin H. (2014) – Stone Tools from the Ancient Tongan State Reveal Prehistoric Interaction Centers in the Central Pacific, *Proceedings of the National Academy of Sciences*, 111, 29, p. 10491–96.

Corney B. G. (1919) – *The Quest and Occupation of Tahity by Emissaries of Spain during the Years 1771-1776 Told in Despatches and Other Contemporary Documents*, III. *The Diary of Maximo Rodriguez*, London, The Hakluyt Society (Works issued by the Hakluyt Society, 43), 328 p.

Davies J. (1851) – *A Tahitian and English Dictionary with Introductory Remarks on the Polynesian Language and a Short Grammar of the Tahitian Dialect with an Appendix*, Papeete, London Missionary Society, 413 p.

De Marrais E., Castillo L J., Earle T. K. (1996) – Ideology, Materialization, and Power Strategies, *Current Anthropology*, 37, 1, p. 15–31.

Dixon B., Carpenter A., Eble F., Mitchell C., Major M. (1995) – Community Growth and Heiau Construction: Possible Evidence of Political Hegemony at the Site of Kaunolū, Lana'i, Hawai'i, *Asian Perspectives*, 34, 2, p. 229–56.

Earle T. K. (1991a) – Property Rights and the Evolution of Chiefdoms, in T. K. Earle (ed.), *Chiefdoms: Power, Economy, and Ideology*, Cambridge, Cambridge University Press (School of American Research Advanced Seminars), p. 71–99.

Earle T. K. (1991b) – The Evolution of Chiefdoms, in T. K. Earle (ed.), *Chiefdoms: Power, Economy, and Ideology*, Cambridge, Cambridge University Press (School of American Research Advanced Seminars), p. 1–15.

Eddowes M. (1991) – *Ethnohistorical Perspectives on the Marae of the Society Islands: The Sociology of Use*, master's thesis, University of Auckland.

Ellis W. (1829a) – *Polynesian Researches, during a Residence of Nearly Six Years in the South Sea Islands: Including Descriptions of the Natural History and Scenery of the Islands,*

with Remarks on the History, Mythology, Traditions, Government, Arts, Manners, and Customs of the Inhabitants, 1, London, Fischer, Son & Jackson, 536 p.

Ellis W. (1829b) – *Polynesian Researches, during a Residence of Nearly Six Years in the South Sea Islands: Including Descriptions of the Natural History and Scenery of the Islands, with Remarks on the History, Mythology, Traditions, Government, Arts, Manners, and Customs of the Inhabitants*, 2, London, Fischer, Son & Jackson, 576 p.

Emerson T. E. (1997) – *Cahokia and the Archaeology of Power*, Tuscaloosa, The University of Alabama Press, 318 p.

Emory K. P. (1933) – *Stone Remains in the Society Islands*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 116), 182 p.

Emory K. P. (1934) – *Tuamotuan Stone Structures*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 118), 78 p.

Emory K. P. (1947) – *Tuamotuan Religious Structures and Ceremony*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 191), 102 p.

Emory K. P. (1979) – The Societies, in J. D. Jennings (ed.), *The Prehistory of Polynesia*, Cambridge (Mass.), Harvard University Press, p. 200–21.

Fogelin L. (2003) – Ritual and Presentation in Early Buddhist Religious Architecture, *Asian Perspectives*, 42, 1, p. 129–54.

Forster J. R. (1778) – *Observations Made During a Voyage Round the World on Physical Geography, Natural History and Ethic Philisophy*, London, G. Robinson, 676 p.

Garanger J. (1980) – Prospections archéologiques de l'îlot Fenuaino et des vallées Airurua et Vaiote à Tahiti, *Journal de la Société des océanistes*, 66–67, p. 77–104.

Gailey C. W. (1987) – *Kinship to Kingship: Gender Hierarchy and State Formation in the Tongan Islands*, Austin, University of Texas Press (Texas Press Sourcebooks in Anthropology, 14), 344 p.

Green R. C. (1961) – Moorean Archaeology: A Preliminary Report, *Man*, 61, p. 169–72.

Green R. C., Descantes C. (1989) – S*ite Records of the* ʻOpunohu *Valley, Moʻorea*, Auckland, Green Foundation for Polynesian Research, 273 p.

Green R. C., Green K., Rappaport R. A., Rappaport A., Davidson J. (1967) – *Archeology on the Island of Moʻorea, French Polynesia*, New York, The American Museum of Natural History (Anthropological Papers of the American Museum of Natural History, 51, 2), 230 p.

Hastorf C. (2007) – Archaeological Andean Rituals: Performance, Liturgy, and Meaning, in E. Kyriakidis (ed.), *The Archaeology of Ritual*, Los Angeles, The Cotsen Institute of Archaeology Press (Cotsen Advanced Seminars, 3), p. 77–108.

Hayden B. (2003) – *Shamans, Sorceres and Saints: A Prehistory of Religion*, Washington, Smithsonian Books, 468 p.

Henry T. (1928) – *Ancient Tahiti*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 48), 651 p.

Hooker J. D. (1896) – *Journal of the Right Hon, Sir Joseph Banks during Captain Cook's First Voyage in H.M.S. Endeavour in 1768–71 to Terra del Fuego, Otahite, New-Zealand, Australia, The Dutch East Indies, etc.*, London, Macmillan, 466 p.

Joyce A. A., Winter M. (1996) – Ideology, Power, and Urban Society in Pre-Hispanic Oaxaca, *Current Anthropology*, 37, 1, p. 33–47.

Kahn J. G. (2003) – Maohi Social Organization at the Micro-Scale: Household Archaeology in the ʻOpunohu Valley, Moʻorea, Society Islands (French Polynesia), in C. Sand (dir.), *Pacific Archaeology: Assessments and Prospects. Proceedings of the International Conference for the 50th Anniversary of the First Lapita Excavation (Koné-Nouméa, 2002)*, Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 353–67.

Kahn J. G. (2005) – *Household and Community Organization in the Late Prehistoric Society Islands (French Polynesia)*, doctoral thesis, University of California, Berkeley, 573 p.

Kahn J. G. (2006) – Society Islands (Central Eastern Polynesia) Chronology: 11 Radiocarbon Dates for the Late Prehistoric Expansion and Proto-Historic Periods in the ʻOpunohu Valley, Moʻorea, *Radiocarbon*, 48, 3, p. 409–19.

Kahn J. G. (2007) – Power and Precedence in Ancient House Societies: A Case Study from the Society Island Chiefdoms (French Polynesia), in R. Beck (ed.), *The Durable House: House Society Models in Archaeology*, Carbondale, Center for Archaeological Investigations (Occasional Paper, 35), p. 198–223.

Kahn J. G. (2011) – Multi-Phase Construction Sequences and Aggregate Site Complexes of the Prehistoric Windward Society Islands (French Polynesia), *Journal of Island and Coastal Archaeology*, 6, p. 24–50.

Kahn J. G. (2013) – Temple Renovations, Aggregate Marae, and Ritual Centers: The ScMo-15 Complex, Lower Amehiti District, ʻOpunohu Valley, Moʻorea (Society Islands), *Rapa Nui Journal*, 27, 2, p. 33–49.

Kahn J. G. (2016) – The Functionality of Feasting at Late Prehistoric Residential and Ceremonial Sites in the Society Islands, *Journal of the Polynesian Society*, 125, 3, p. 203–38

Kahn J. G., Coil J. (2006) – What House Posts Tell Us about Status Difference in Prehistoric Tahitian Society: An Interpretation of Charcoal Analysis, Sacred Woods and Inter-Site Variability, *The Journal of the Polynesian Society*, 115, 4, p. 319–52.

Kahn J. G., Horrocks M., Nieuwoudt M. (2014) – Agriculture, Domestic Production, and Site Function: Micro-Fossil Analyses and Late Prehistoric Landscapes of the Society Islands, *Economic Botany*, 68, 3, p. 246–63.

Kahn J. G., Kirch P. V. (2004) – Ethnographie préhistorique d'une « société à maisons » dans la vallée de ʻOpunohu (Moʻorea, îles de la Société), *Journal de la Société des océanistes*, 119, p. 229–56.

Kahn J. G., Kirch P. V. (2011) – Monumentality and the Materialization of Ideology in Central Eastern Polynesia, *Archaeology in Oceania*, 46, p. 93–104.

Kahn J. G., Kirch P. V. (2013) – Residential Landscapes and House Societies of the Late Prehistoric Society Islands (French Polynesia), *Journal of Pacific Archaeology*, 4, 1, p. 50–72.

Kahn J. G., Kirch P. V. (2014) – *Monumentality and Ritual Materialization in the Society Islands: The Archaeology of a Major Ceremonial Complex in the ʻOpunohu Valley, Moʻorea*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin in Anthropology, 13), 267 p.

Kennett D. J., Mcclure S. B. (2012) – The Archaeology of Rapan Fortifications, in A. Anderson and D. J. Kennett (eds.), *Taking the High Ground: The Archaeology of Rapa, a Fortified Island in Remote East Polynesia*, Canberra, ANU E-Press (Terra Australis, 37), p. 203–34.

Kirch P. V. (1985) – *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*, Honolulu, University of Hawaii Press, 360 p.

Kirch P. V. (1991) – Chiefship and Competitive Involution: The Marquesas Islands of Eastern Polynesia, in T. K. Earle (ed.), *Chiefdoms: Power, Economy, and Ideology*, Cambridge, Cambridge University Press (School of American Research Advanced Seminars), p. 119–45.

Kirch P. V. (2004) – Temple Sites in Kahikinui, Maui, Hawaiian Islands: Their Orientations Decoded, *Antiquity*, 87, p. 102–14.

Kirch P. V., Green R. C. (2001) – *Hawaiki, Ancestral Polynesia: Essays in Historical Anthropology*, Cambridge, Cambridge University Press, 394 p.

Kirch P. V. Sharp W. D. (2005) – Coral ^{230}Th Dating of the Imposition of a Ritual Control Hierarchy in Precontact Hawaii, *Science*, 307, p. 102–4.

Kolb M. (1992) – Diachronic Design Changes in Heiau Temple Architecture on the Island of Maui, Hawaiʻi, *Asian Perspectives*, 31, 1, p. 9–37.

Kolb M. (1994) – Monumentality and the Rise of Religious Authority in Precontact Hawaiʻi, *Current Anthropology*, 34, 5, p. 521–47.

Kolb M. (2006) – The Origins of Monumental Architecture in Ancient Hawaiʻi, *Current Anthropology*, 47, 4, p. 657–65.

Kyriakidis E. (2007) – *The Archaeology of Ritual*, Los Angeles, The Cotsen Institute of Archaeology Press (Cotsen Advanced Seminars, 3), 319 p.

Lane P. (2001) – The Archaeology of Christianity in Global Perspective, in T. Insoll (ed.), *Archaeology and World Religion*, London, Routledge, p. 148–81.

Larrue S., Meyer J. Y. (2013) – Distribution of Native Banyan Fig-Trees on Archaeological Remains in the Island of Tahiti (Pacific Ocean): ʻNovel Habitatʼ or Past Human Cultivation?, in S. Larrue (ed.), *Biodiversity and Societies in the Pacific Islands*, Canberra and Aix-Marseille, ANU E-Press and Presses universitaires de Provence (Confluent des sciences), p. 183–96.

Lepofsky D. (1994) – *Prehistoric Agricultural Intensification in Society Islands, French Polynesia*, doctoral thesis, University of California, Berkeley.

Lepofsky D. (2003) – The Ethnobotany of Cultivated Plants of the Maohi of the Society Islands, *Economic Botany*, 57, 1, p. 73–92.

Lepofsky D., Kirch P. V., Lertzman K. P. (1996) – Stratigraphic and Paleobotanical Evidence for Prehistoric-Induced Environmental Disturbance on Moʻorea, French Polynesia, *Pacific Science*, 50, p. 253–73.

Lepofsky D., Kahn J. G. (2011) – Cultivating an Ecological and Social Balance: Elite Demands and Commoner Knowledge in Ancient Maʻohi Agriculture, Society Islands, *American Anthropologist*, 113, 2, p. 319–35.

Linton R. (1925) – *Archaeology of the Marquesas Islands*, Honolulu, Bishop Museum Press, (Bernice Pauahi Bishop Museum Bulletin, 23; Bayard Dominick Expedition 1920–1921, 10), 187 p.

Malo D. (1951) – *Hawaiian Antiquities*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publication, 2), 278 p.

Marcus J. (2007) – Rethinking Ritual, in E. Kyriakidis (ed.), *The Archaeology of Ritual*, Los Angeles, The Cotsen Institute of Archaeology Press (Cotsen Advanced Seminars, 3), p. 43–76.

McCoy M. D. (2008) – Life Outside the Temple: Reconstructing Traditional Hawaiian Ritual and Religion Through Ritualized Practices, in L. Fogelin (ed.), *Religion, Archaeology, and the Material World*, Carbondale, Center for Archaeological Investigations (Occasional Paper, 36), p. 261–78.

McCoy M. D. (2014) – The Significance of Religious Ritual in Ancient Hawaiʻi, *Journal of Pacific Archaeology*, 5, 2, p. 72–80.

Mccoy M. D., Ladefoged T. N., Graves M. W., Stephen J. W. (2011) – Strategies for Constructing Religious Authority in Ancient Hawaiʻi, *Antiquity*, 85, 329, p. 927–41.

McCoy P. C. (1999) – Neither Here Nor There: A Rites of Passage Site on the Eastern Fringes of the Mauna Kea Adze Quarry, Hawaiʻi, *Hawaiian Archaeology*, 7, p. 11–34.

McCoy P. C., Weisler M. I, Zhao J. X., Feng Y. X. (2009) – ^{230}Th Dates for Dedicatory Corals from a Remote Alpine Desert Adze Quarry on Mauna Kea, Hawaiʻi, *Antiquity*, 83, 320, p. 445–57.

Mccoy P. C., Nees R. (2014) – A Re-examination of Kenneth P. Emory's Theory of Necker Type *Marae* in the Summit Region of Mauna Kea, Hawaiʻi: Many *Marae* or Shrines Later, in W. K. McElroy and E. Komori (eds.), *Papers in Honour of Dr. Yosihiko Sinoto*, Honolulu, Society for Hawaiian Archaeology (Society for Hawaiian Arrchaeology Special Publication, 4), p. 27–50.

Millerstrom S. (2009) – Fishermen Shrines in the Northern Marquesas Islands, French Polynesia, *SAA Archaeological Record*, 9, 5, p. 22–25.

Millerstrom S., Baumgartner Lesage H. (in press) – Petroglyphs of the Society Islands and How They are Situated within the Polynesian Rock Art Repertoire.

Moerenhout J.-A. (1837) – *Voyages aux îles du Grand Océan contenant des documents nouveaux sur la géographie physique et politique, la langue, la littérature, la religion, les mœurs, les usages et les coutumes de leurs habitants et des considérations générales sur leur commerce, leur histoire et leur gouvernement, depuis les temps les plus reculés jusqu'à nos jours, tome premier*, Paris, Arthus Bertrand, 554 p.

Molle G. (2015) – *Ancêtres-dieux et temples de corail : approche ethnoarchéologique du complexe* marae *dans l'archipel des Tuamotu, Polynésie française*, Faa'a, Centre

international de recherche archaeologique sur la Polynésie (Les Cahiers du CIRAP, 3), 85 p.

Mulloy W. (1965) – The Fortified Village of Morongo Uta, in T. Heyerdahl and E. N. Ferdon (eds.), *Miscellaneous Papers, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 2, London, George Allen and Unwin (Monographs of the School of American Research and the Kon-Tiki Museum, Oslo, Norway, 24, 2), p. 23–68.

Newbury C. (1967) – Te Hau Pahu Rahi: Pomare II and the Concept of Inter-Island Government in Eastern Polynesia, *The Journal of the Polynesian Society*, 76, 4, p. 477–514.

Oliver D. L. (1974) – *Ancient Tahitian Society*, Honolulu, University of Hawaii Press, 1419 p.

Oliver D. L. (1988) – *Return to Tahiti: Bligh's Second Breadfruit Voyage*, Honolulu, University of Hawai'i Press, 281 p.

Orliac C. (1982) – *Matériaux pour l'étude des habitations protohistoriques* à *Tahiti (Polynésie française)*, docotoral thesis, Université Paris I – Panthéon-Sorbonne, 317 p.

Orliac C. (1984) – Détermination botanique de quatre ti'i (collections ethnographiques du musée de Tahiti et des îles), *Bulletin de la Société des études océaniennes*, 229, 14, 6, p. 1739–42.

Orliac C. (2000) – *Fare et Habitat à Tahiti*, Paris, Parenthèses (Architectures traditionnelles), 142 p.

Ottino-Garanger P. (2006) – *Archéologie chez les Taïpi. Hatiheu, un projet partagé aux îles Marquises*, Pirae, Au vent des îles, 176 p.

Rakita G. F. M. (2009) – *Ancestors and Elites: Emergent Complexity and Ritual Practices in the Casas Grandes Polity*, Lanham, Alta Mira Press (Archaeology of Religion, 6), 220 p.

Redmond E. M., Spencer C. S. (2008) – Rituals of Sanctification and the Development of Standardized Temples in Oaxaca, Mexico, *Cambridge Archaeological Journal*, 18, 2, p. 239–66.

Renfrew C. (2007) – The Archaeology of Ritual, of Cult, and of Religion, in E. Kyriakidis (ed.), *The Archaeology of Ritual*, Los Angeles, The Cotsen Institute of Archaeology Press (Cotsen Advanced Seminars, 3), p. 109–22.

Rolett B. V. (2010) – Marquesan Monumental Architecture: Blurred Boundaries in the Distinction between Religious and Residential Sites, *Archaeology in Oceania*, 45, 2, p. 94–102.

Sharp W. D., Kahn J. G., Polito C. M., Kirch P. V. (2010) – Rapid Evolution of Ritual Architecture in Central Polynesia Indicated by Precise ^{230}Th/U Coral Dating, *Proceedings of the National Academy of Sciences*, 107, 30, p. 13234–39.

Steadman S. R. (2009) – *The Archaeology of Religion: Cultures and Their Beliefs in Worldwide Context*, Walnut Creek, Left Coast Press, 348 p.

Stein G. J. (1998) – Heterogeneity, Power, and Political Economy: Some Current Research Issues in the Archaeology of Old World Complex Societies, *Journal of Archaeological Research*, 6, 1, p. 1–44.

Shore B. (1989) – Mana and Tapu, in A. Howard and R. Borofsky (eds.), *Developments in Polynesian Ethnology*, Honolulu, University of Hawaii Press, p. 137–73.

Sugiyama S. (2003) – Governance and Polity at Classic Teotihuacan, in J. A. Hendon and R. A. Joyce (eds.), *Mesoamerican Archaeology: Theory and Practice*, Oxford, Wiley-Blackwell (Blackwell Studies in Global Archaeology, 1), p. 97–123.

Montgomery J. (1832a) – *Journal of the Voyages and Travels by the Rev. Daniel Tyerman and George Bennett, Esq. Deputed from the London Missionary Society, to visit their Various Stations in the South Sea Islands, China, India, &c. between the Years 1821 and 1829*, 1, Boston, Crocker and Brewster (Library of Religious Knowledge, 1), 273 p.

Montgomery J. (1832b) – *Journal of the Voyages and Travels by the Rev. Daniel Tyerman and George Bennett, Esq. Deputed from the London Missionary Society, to visit their Various Stations in the South Sea Islands, China, India, &c. between the Years 1821 and 1829*, 2, Boston, Crocker and Brewster (Library of Religious Knowledge, 2), 287 p.

Montgomery J. (1832c) – *Journal of the Voyages and Travels by the Rev. Daniel Tyerman and George Bennett, Esq. Deputed from the London Missionary Society, to visit their Various Stations in the South Sea Islands, China, India, &c. between the Years 1821 and 1829*, 3, Boston, Crocker and Brewster (Library of Religious Knowledge, 3), 293 p.

Wallin P. (1997) – Archery Platforms (Vahi Te'a) in the Society Islands, Polynesia: A Contextual Interpretation, *Current Swedish Archaeology*, 5, p. 193–201.

Wallin P., Martinsson-Wallin H. (2011) – Monumental Structures and the Spirit of Chiefly Actions, *Time and Mind: The Journal of Archaeology, Consciousness and Culture*, 4, 1, p. 43–58.

Weisler M. I., Collerson K. D., Feng Y. X., Zhao J. X, Yu K. F. (2006) – Thorium-230 Coral Chronology of a Late Prehistoric Hawaiian Chiefdom, *Journal of Archaeological Science*, 33, 2, p. 273–82.

Weisler M. I., Kirch P. V. (1985) – The Structure of Settlement Space at Kawela, Molokai, Hawai'ian Islands, *New Zealand Journal of Archaeology*, 7, p. 129–58.

Wilson J. (1799) – *A Missionary Voyage to the Southern Pacific Ocean, Performed in the Years 1796, 1797, 1798, in the Ship Duff, Commanded by Captain James Wilson, Complied from Journals of the Officers and the Missionaries, and Illustrated with Maps, Charts and Views Drawn by Mr. William Wilson and Engraved by the Most Eminent Artists with a Preliminary Discourse on the Geography and History of the South Sea Islands and an Appendix Including Details never before Published of the Natural and Civil State of Otaheite by a Committee Appointed for the Purpose by the Directors of the Missonary Society*, London, S. Gosnell, 432 p.

Jennifer G. Kahn
Anthropology Department,
College of William & Mary,
Washington Hall, Room 103,
241 Jamestown Rd.,
Williamsburg, VA 23185 (USA)
jgkahn01@wm.edu

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 163-176
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Pottery spatial patterns at the Lapita site of Teouma, Central Vanuatu

Some preliminary refitting results

Mads Ravn, Stuart Bedford, Matthew Spriggs, Stuart Hawkins, Iarowai Philip and Frédérique Valentin

Abstract: In this paper, we will present preliminary results of spatial distribution of Lapita pottery at the Teouma burial site on Efate Island in Vanuatu. Based on reassembling of pots over the last ten years at the Vanuatu Culture Centre and GIS recording we argue that this excavation offers a possibility to discuss the spatial distribution of pottery and aspects of ritual burial patterns of the Lapita Culture 3000 years ago. Lapita pottery at the site reveals aspects of contemporaneity between grave groups, behavioral, technical and ritual choices in the use of pots and aspects of complex spatial activity patterns in the burial rites.

Keywords: spatial burial patterns; intra-site analysis, rituals; Lapita; fragmentation; refitting of pottery.

Répartition spatiale des poteries du site Lapita de Teouma, Vanuatu central : résultats préliminaires des remontages

Résumé : Dans cet article, nous présentons les résultats préliminaires d'une étude de la distribution spatiale des restes de poterie découverts sur le site de Teouma (Efate, Vanuatu). En nous basant sur les remontages et un SIG, nous soutenons l'idée selon laquelle cette fouille offre la possibilité de discuter la distribution spatiale des fragments de poteries en relation avec certains aspects des rituels et funéraires associés culture Lapita (*ca* 3000 BP). L'étude met en évidence des relations spatiales et de contemporanéité entre groupes de tombes, des choix comportementaux, techniques et rituels dans l'utilisation des pots ainsi qu'une spatialisation de certains gestes funéraires.

Mots-clés : répartition spatiale des sépultures, analyse intra-site, rituels, Lapita, fragmentation, remontages de céramique.

The evidence for deliberate object (and body) fragmentation can no longer be overlooked or dismissed as an irrelevant and time-consuming curiosity
(Chapman and Gaydarska, 2007, p. 204).

Decorated Lapita pottery has intrigued and fascinated researchers for more than half a century. The elaborate designs and their potential significance even inspired comment more than hundred years ago (Meyer, 1909) and have remained central to discussions ever since. More recent theoretical debate relating to the deposition and use of Lapita pottery has raised a number of central problems in relation to Lapita research and more specifically the fragmented nature of the pottery recovered from most sites (Sand et al., 2013, p. 2–12). To explain the overwhelming pattern of generally small sherds that have been recovered from the more than two hundred fifty recorded Lapita sites, Christophe Sand proposed that Lapita pottery could have been deliberately smashed and deposited in settlement sites as part of a ritual associated with the taming, inscribing and taking possession of landscapes. This would have been a ritual performed over a number of generations as new groups colonised different islands and new arrivals joined earlier colonists. A key argument challenging this hypothesis of deliberate breakage of Lapita pots, however, is the general problem of equifinality: that several behavioural actions may lead to the same material end pattern (Wylie, 1985; Ravn, 2011a). Pots may well have sometimes been ritually broken during specific ceremonies but whole vessels may also have ended up fragmented into tens of pieces owing to a range of other processes (Chapman and Gaydarska, 2007).

As outlined in the discussion by Christophe Sand and others (Sand et al., 2013, p. 2–12) these factors might include first and foremost that a variety of post-depositional processes could have led to the pattern of small, scattered pottery sherds at sites, which is an aspect that remains poorly understood in this region. In associated discussion both Peter Sheppard and Matthew Spriggs (in Sand et al., 2013, p. 7) pointed out that it is essential to better understand the patterns of pottery breakage and associated activities before we jump to conclusions. A further point, related to the first, is how one actually defines or identifies ritual in the archaeological record; is it possible to distinguish rituals from other human activity associated with deposition? Indeed the whole concept and definition of ritual is problematic; there is a tendency for archaeologists to reserve the term for something out of the ordinary but rituals of various forms are being performed on a daily basis (Marshall in Sand et al., 2013, p. 6). One of the ways in which these various processes can be better understood is a greater focus on ethnographic parallels and the relevance of direct historical continuity in the Pacific (Chiu in Sand et al., 2013, p. 9). However, while the latter avenue is important and can be very productive, it is also problematic as the discussion by Matthew Spriggs (Spriggs, 2008) and Jim Roscoe (Roscoe, 2009) reveals, since population density, owing to epidemics following contact with Europeans, is, even today, quite different from that of the pre-contact Pacific. It nonetheless remains a useful approach if applied cautiously where the focus is on the long-term perspective and involves assessing both similarities and differences, on both sides of the equation of past and present (Spriggs, 2008; Ravn, 2011a, p. 720).

However, if robust data are available, further focus on the archaeological side of the equation is still one of the most fruitful lines of inquiry in the Pacific. Such an opportunity has presented itself at the Lapita site of Teouma on Efate. At this settlement and cemetery site a detailed analysis of individual pots and their spatial distribution in relation to burials has provided an improved understanding of the actual behaviour and funerary rituals that were being practised there some 3,000 years ago (Bedford and Spriggs, 2007). This approach is the first step towards exploring archaeologically the hypothesis proposed by Christophe Sand: that at least some decorated Lapita pots were smashed in ceremonies associated with human colonisation and settlement of new landscapes. While well aware that we are never going to get into the heads of the Lapita people, a better understanding of their ritual behaviours may at least see us some of the way there (see Marshall and Spriggs in Sand et al., 2013, p. 6–8)!

DEFINITIONS AND HYPOTHESES

Here we present examples of vessels that as possible whole pots have formed part of an intentional burial ritual. Also we show examples where sherds from pots have formed part of secondary rituals. Finally, we discuss the possibility that some sherds may also have been the result of accidental breakage by trying to distinguish the spatial patterns that may represent a range of behaviours associated with burial and other activities at the site.

Generally, we suggest that the Teouma site offers original insights into a 3,000 year old ritual behaviour associated with Lapita pottery. It is now possible to substantiate this hypothesis because extensive data processing, although not complete, is approaching a level where complex analyses can reveal intra-spatial depositional patterns in relation to burials, space and time. Two principal factors make this possible.

The first is the time-consuming reassembling of pots that has been conducted over the last ten years at the Vanuatu Culture Centre. Like the refitting of stone flakes, the exercise of reassembling Lapita pottery may reveal contemporaneity, behavioural and technical choices as well as spatial activity patterns in more detail. By this approach we also avoid the fallacy of identifying "redundant design elements from the same vessel" as coming from multiple separate pots (Chiu, 2003, p. 162).

Spatial activity patterns are revealed especially when data-recording of finds in a GIS system is applied; this approach may help more precisely to illustrate the intra-spatial distribution of identified whole pots in relation to burials and other features. In particular, it has been revealed that unambiguous clusters of sherds in some cases must indicate that whole pots were deposited in association with one or more burials.

As suggested above we argue that reassembled pots provide the potential for assessing the role of the pottery in the funerary ritual. It would be reasonable to expect that if pots were deposited as whole pots and broken as part of the rituals at the graveside, they would have been placed within a relatively limited spatial area as a cluster. If pots were simply discarded in the midden, in association with everyday activities, they would be distributed in a less densely clustered way, more widely scattered over the site. However, a complicating factor is that judging from the treatment of the individuals *per se* (Scott et al., 2010; Valentin et al., 2010a), it is clear the burials and with them any grave goods were reprocessed several times and re-deposited in multiple graves, thus explaining the level of fragmentation of some of the sherds.

The data generated from the Teouma site make it possible to gain insights into the behavioural patterns behind some of the activities performed, thus placing the theoretical discussion of "the meaning of pots", as put forward by Christophe Sand and coworkers (Sand et al., 2013), into a stronger empirical framework than has so far been possible. As to the relation between religion and ritual, the following definition may be useful:

> Religion is no longer defined as theology, but is viewed much more as changing social practice, associated with religious transcendental discourse. Myth and ritual are understood as two different but interrelated social catego-

> ries. As a consequence, ritual is not necessarily regarded as a representation of myth, but can be apprehended as a formalized act that in itself creates meaning. Instead of merely maintaining a cosmological order, ritual is also seen as a transformative act. Besides, ritual is not regarded as necessarily religious, since it can refer to other — legal, political, and social — discourses (Andrén, 2014, p. 13).

From the quotation above, we understand that ritual is not something only in the minds of people but is also composed of practices that leave a material pattern. As a consequence, ritual use of material culture may here be defined as densely "clustered deposition of special finds or fixed combinations of special finds in a special context" (Ravn, 2011b, p. 138). Where we can identify such unambiguous patterns it is likely that ritual activity is being mapped.

INTRA-SITE DISTRIBUTION OF POTTERY AT TEOUMA

The Teouma site on Efate Island in Vanuatu was excavated by the Vanuatu Cultural Centre and the Australian National University in collaboration with numerous other institutions between 2004 and 2010. The site is located on a low, flat plain about 8 m above present sea level. Today the area is utilized as pastureland for cattle. When the first people arrived, they would have encountered a wide shallow bay. Located on the eastern side was a large flat, uplifted karstic reef terrace, a coral-rubble beach and a permanent water source in the form of a stream that drains from a swamp in the nearby eastern interior (Bedford et al., 2010). A map created from the isolines reveals an impression of the coastline 3,000 years ago (fig. 1).

The excavation team opened up 484 m^2 in the north area and 16 m^2 in the south area (Bedford et al., 2004, 2006, 2009, and 2010; Spriggs and Bedford, 2013). We concentrate here on the main northern area. It is a previously unoccupied site beginning with a number of first settlers burying their dead over the area of a previously-uplifted reef and beach. The Lapita settlers buried their dead in an orange tephra layer (layer III) that overlay the old reef and the adjacent upper beach. Activity at the site began around 3000 BP (Petchey et al., 2014). A total of sixty-eight burial features displaying a variety of arrangement of individuals was recorded (Valentin et al., 2009, 2010a, 2011, and 2014; Scott et al., 2010). Together with the burials, large amounts of pottery and other artefacts of the Lapita culture were recovered (Constantine et al., 2015).

Immediately to the east and respecting the cemetery boundaries was a contemporary Lapita midden (Spriggs and Bedford, 2013). Immediately sealing the graves in places was a late Lapita midden, which in turn was subsequently sealed by a Post-Lapita midden some 50-80 cm thick (layer II). The site was then abandoned no later than about 2500 BP on the evidence of pottery styles and radiocarbon dating. The extensive data processing from this site has consisted of more than 12,000 find numbers, not

Fig. 1 – Overview of the Teouma area. The hatched area north of the dark line is the estimated shoreline 3,000 years ago (CAD M. Ravn).

***Fig. 1** – Aperçu de l'aire de Teouma. La zone hachurée au nord de la ligne foncée correspond à la ligne de rivage d'il y a 3 000 ans (DAO M. Ravn).*

including human skeletal remains from the burials (Bentley et al., 2007; Valentin et al., 2010b; Kinaston et al., 2014; Hawkins, 2015).

In the burials, most skulls and many other upper skeletal elements had been removed. In addition, the bodies and bones were manipulated in various ways, as described in detail by Frédérique Valentin and coworkers (Valentin et al., 2009 and 2010a). Clearly then, we must assume that a number of rituals were performed in relation to the burials during and after the deceased were deposited. We shall here focus on the role of the pottery that has been reassembled in relation to the burials. From the Lapita phase at least three hundred pots have been wholly or partly refitted.

Here we take a closer look at a number of examples of Lapita pots from Teouma that have been refitted using criteria corresponding to codes 1, 2 and 3 of Charles Bollong (Bollong, 1994, p. 18). These encompass direct conjoins through to morphological characteristics that allow determination that sherds are derived from a common vessel, and with occasional use of code 4 that "judgment of gross morphology permits association as 'probable' (i.e. analyst judgment of better than 50%)". We do know that some pots were placed in graves as whole vessels (Bedford et al., 2007 and 2010), as possible grave markers and in several cases as repositories for secondary burials (Bedford and Spriggs, 2007; Valentin et al., 2010a and 2015). However, other patterns suggest some vessels may have been deliberately broken and distributed amongst particular graves. It is important to note that while we have been able to reconstruct the form and full design motifs of dozens of vessels from this site, there are very few vessels that have the full complement of sherds. Thus, where complete vessels can be reconstructed, some missing sections or sherds of some pots can be attributed to the quarrying activities that led to the site's discovery in 2004. Nonetheless, in areas of the site that were not disturbed by these activities, large pieces of incomplete individual vessels were also recovered from layer III deposits, raising the question of "what happened to the other fragments" (cf. Chapman and Gaydarska, 2007)?

Sherds from the same pot were by definition contemporaneous when the pot was whole; so the closer they are situated in space archaeologically, the more likely it is that they were deposited as one complete pot at a given time. Thus, the challenge of the following is to assess whether the reassembled pottery sherds were in situ and, if not, were they closely clustered in space in prehistory and to which graves, if any, they can be related. If there is a clear clustered association among potsherds and one or more graves, it may be suggested that graves where the sherds from the same pot appear are connected in some way. If pots can be identified as being associated with particular graves in our analysis we assign them here with a burial group which in turn may help explain social relationships between the various burials. If the sherds are scattered over the site and not associated with particular graves, it is however more likely that the pots had been originally deposited as refuse in the contemporary Lapita midden.

Pot TC 45 (Teouma carinated)

Pot TC 45 reveals just such a pattern where pottery pieces are scattered over an area. Twenty-seven pieces could be refitted to pot TC 45. It was found in the Lapita midden in the eastern part of the excavation, and while it could have been associated with some sort of ceremonial activity (fig. 2) it looks from its distribution that it is scattered more widely than other pots described below that were found in the cemetery area. This pot typifies the pattern one would expect of a pot being broken during some sort of activity, perhaps simply during non-ritual use, and becoming incorporated into the midden area.

Pot TD 16 (Teouma dish)

Twenty-eight pieces of pottery could be refitted to pot TD 16. This pot is a flat-bottomed dish decorated over its entire body (fig. 3). It is distributed in the western area and found in a relatively restricted area where burials B8, B50, B 51, B52, B53, B58 and B59 are situated. In nearby B52 two sherds occur within the grave fill. B53 is cut by B8, and B52 was buried after those two. Additionally both B52 and B59 were buried with anklets. It is not possible to assess conclusively whether those graves, among which the pottery has been deposited, were related. The argument, relating to the definitions given above for this, is that the pottery is closely confined in space. Owing to the confined spatial distribution, it seems less likely that these sherds are simply the result of refuse activity, but more likely that of a ritual activity related to specific graves where pots have been placed deliberately, as part of a burial ritual. It cannot be ruled out that the pot was damaged during later burial activity within in the same group of burials. Allowing for the possibility that this pattern may be a palimpsest accumulated over time, we shall call this burial concentration I (hereafter BCI).

Bird pot TC 5 (Teouma carinated)

One hundred and eighty pieces of pottery retrieved between 2004 and 2010 could be refitted to the distinctive bird pot TC 5 (Bedford and Spriggs, 2007). The large pot is unique within the Lapita distribution, suggesting a specialised ritual use for this item. The modelled birds on the rim, looking into the pot, additionally support the ritual function of this vessel (fig. 4). It was found in the lowest cultural layer and is spread over several square metres, but still restricted to a small number of individual graves. The basal part of the pot was still in situ but the upper part of the pot had been broken off in antiquity as a result of disturbance from the digging of later burials in the same area of the site (Bedford and Spriggs, 2007, p. 12).

The pot constitutes the container for secondary burial B22 and is situated between burials B6, B12, B14, B18, B25 and B17. Burials B1, B2, B4, and B5, B15, B19 and B23 are placed less centrally in relation to the pot. The well-delimited distribution of sherds from this pot and the closeness of graves in this area could suggest that

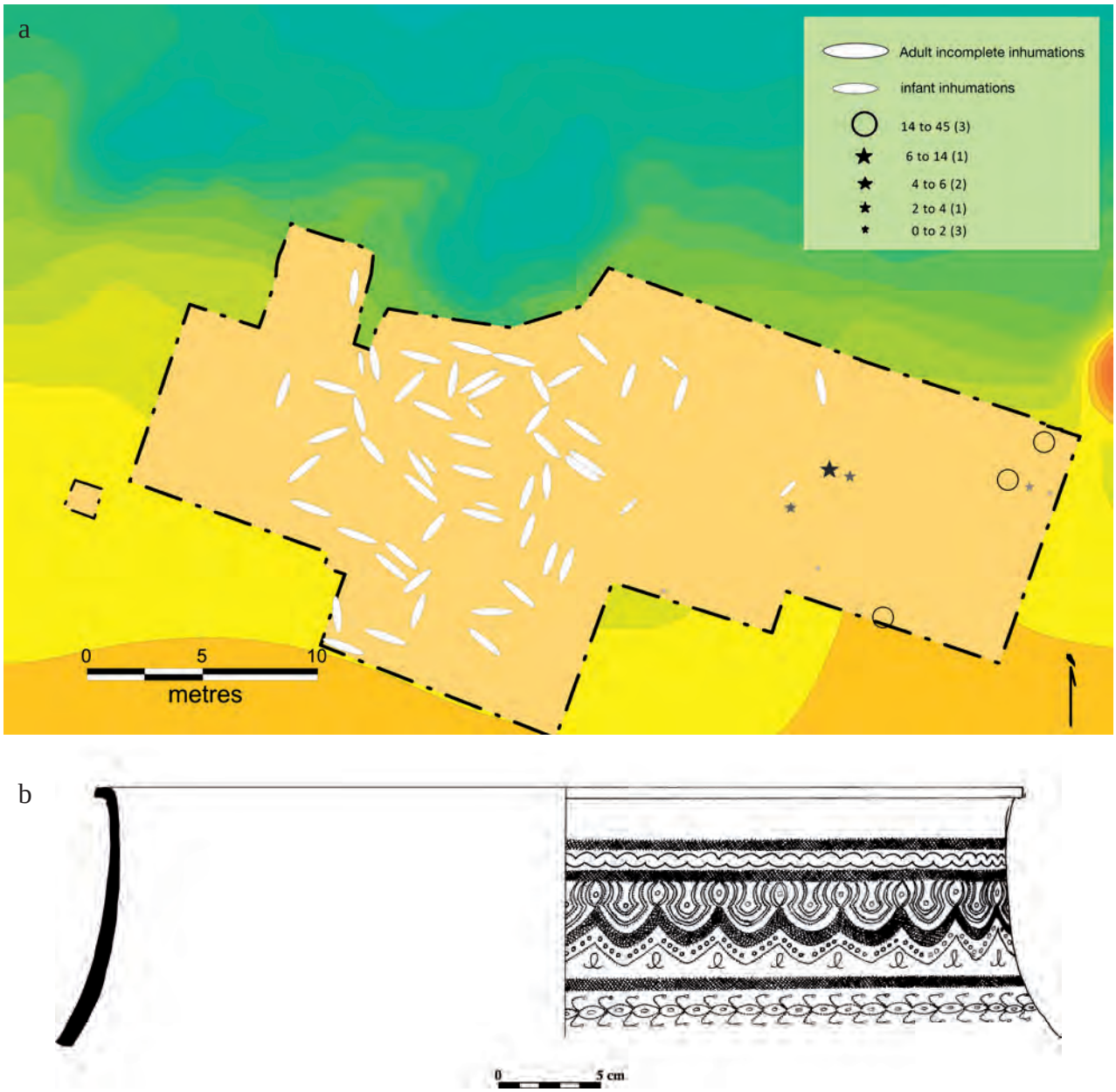


Fig. 2 – a: spatial distribution pattern of pot TC45, size of the circles and stars indicates weight of pottery sherds (CAD M. Ravn); b: form and design of pot TC45 (drawing S. Seoule, Vanuatu Cultural Centre).
***Fig. 2** – a : répartition spatiale du récipient TC45, les différentes tailles des cercles et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : forme et dessin du récipient TC45 (dessin S. Seoule, Centre culturel du Vanuatu).*

the burials here form part of a focal burial group among which related persons are buried. We shall call this burial concentration II (BCII). Furthermore, additional research needs to be done before we can rule out that the vessel was merely disturbed by later grave activity and thus incorporated into other graves adventitiously.

Pot TCC 3 (Teouma carinated convex)

Seventy-seven sherds, totalling 1,720 g, could be definitively assigned to the TCC 3 vessel. This is one of the vessels that has been established as being exotic to Vanuatu, having been brought to the site from New Caledonia (Dickinson et al., 2013). An initial glance at the spread of sherds reveals that they were found across the western part of the cemetery zone in two primary concentrations (fig. 5). Further clarification can be gleaned when considering together sherd spread, number, weight, surface condition and stratigraphic location. The greatest concentration of sherds was that found near burials B30, B41 and B44. In a single square meter alone, adjacent to these burials, eight sherds comprising some 34% (585 g) of the total sherds by weight were recovered. One sherd was found in the fill and one on the top of a skull of secondary burial B30 associated with burial B44. This collection of burials demonstrates multi-phase activity, and one was one of only

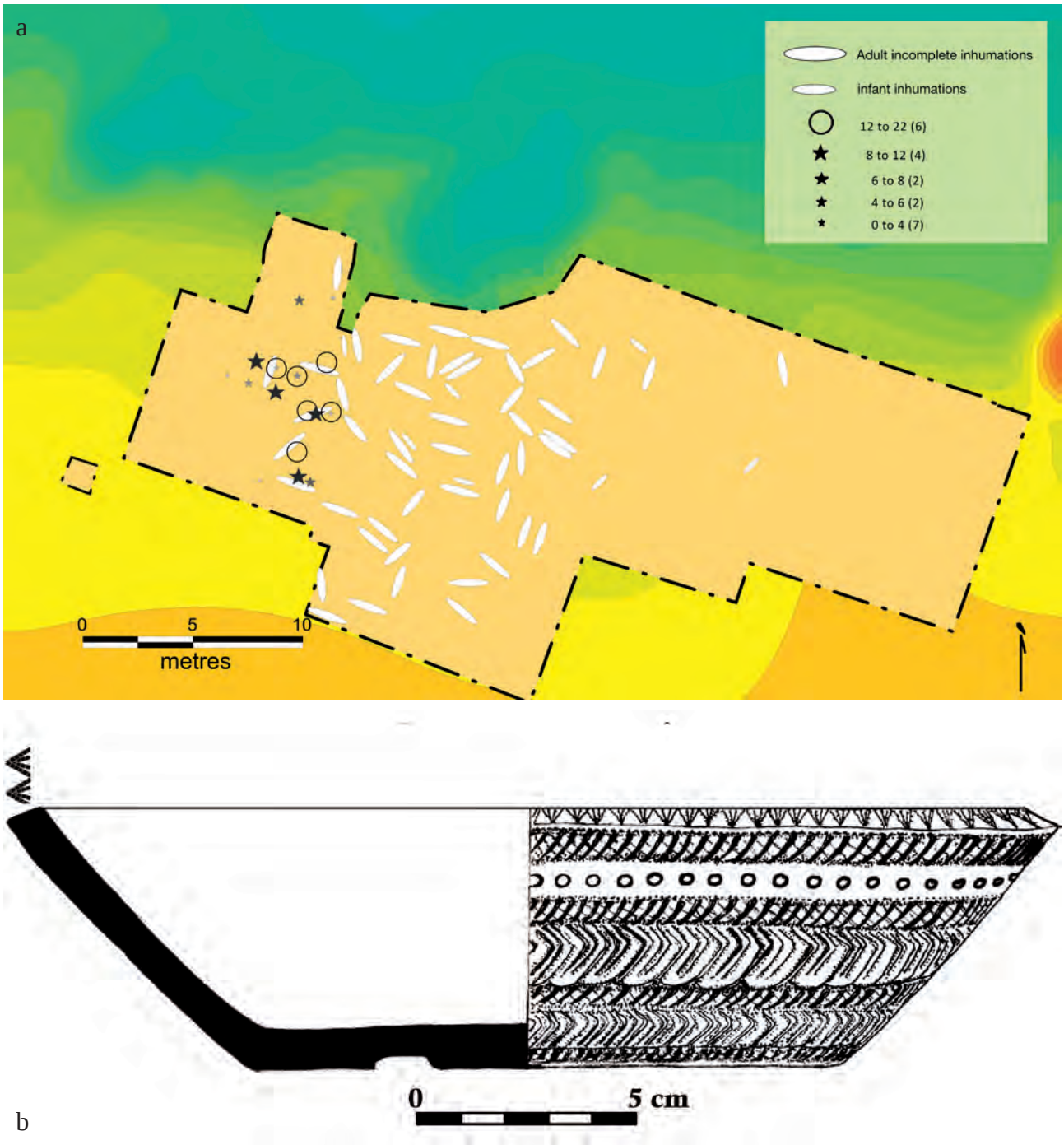


Fig. 3 – a: spatial distribution pattern of pot TD16, size of the circles and stars indicates weight of pottery sherds (CAD M. Ravn); b: flat dish TD16 (drawing S. Seoule, Vanuatu Cultural Centre).
***Fig. 3** – a : répartition spatiale du récipient TD16, les différentes tailles des cercles et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : dessin du récipient plat TD16 (dessin S. Seoule, Centre culturel du Vanuatu).*

three graves where complete skulls had been redeposited. In the eight adjacent squares there were again eight sherds recovered but only weighing 85 g or 5% of the total. It is noticeable that in the three adjacent southernmost squares there were no sherds at all recovered.

The other area of the cemetery where there appears to be a concentration of TCC 3 sherds is between burials B52, B53 and B59. Fifteen sherds weighing 408 g (25% of total by weight) were retrieved from five square metres centred amongst these burials. The recovered sherds outside these concentrations are all generally small (less than 20 g) and isolated. This is why they are not singled out as a concentration in figure 5. Later burial activity at the site would appear to account for much of their distribution. A number of sherds also confirm post-cemetery disturbance. Eleven were found in the Late Lapita midden sealing part of the cemetery and a single sherd was found in an area of recent disturbance associated with earthmoving.

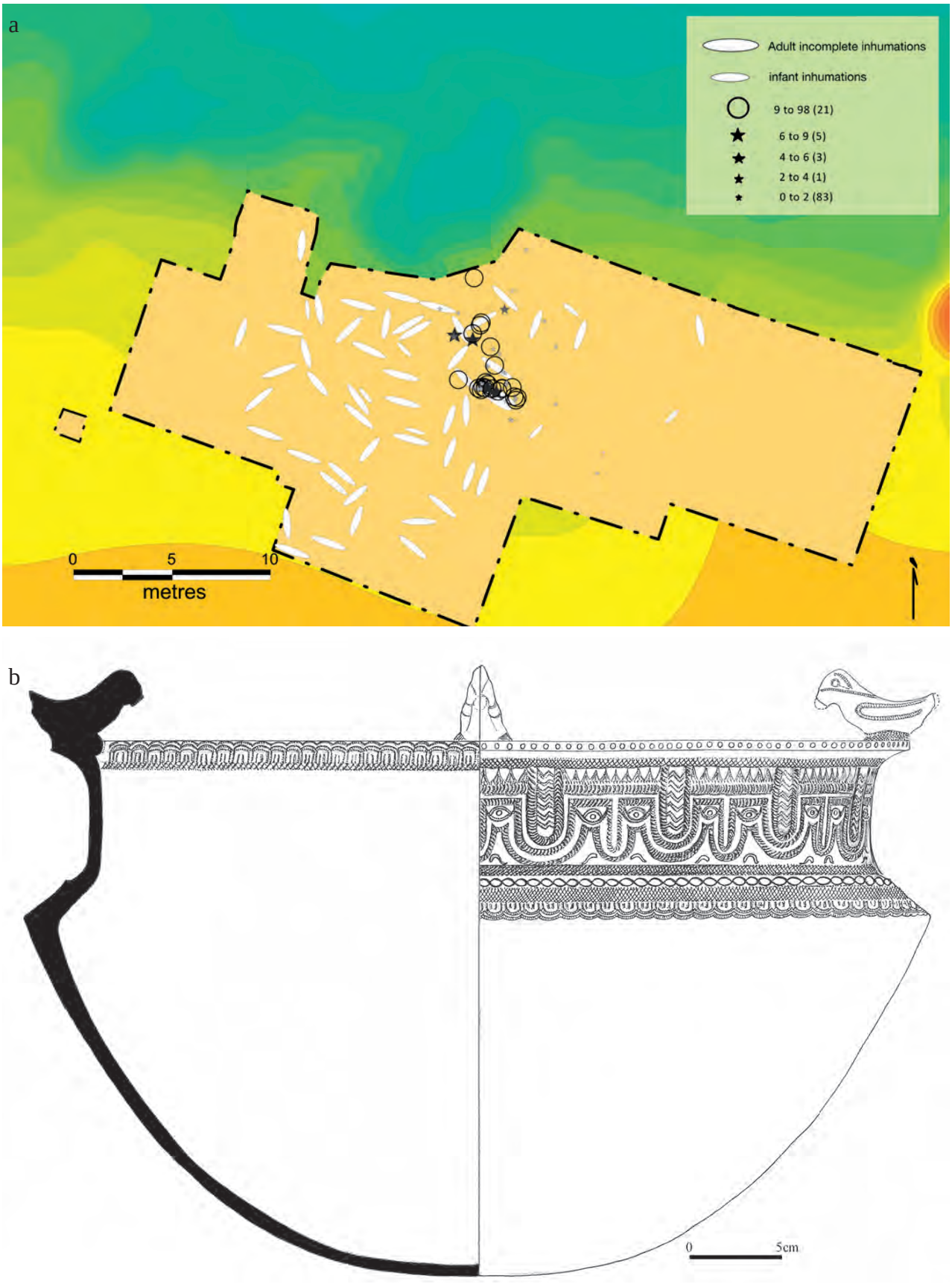


Fig. 4 – a: spatial distribution pattern of pot TC5, size of the circles and stars indicates weight of pottery sherds (CAD M. Ravn); b: form and design of TC5 (drawing F. Yoringmal, Vanuatu Cultural Centre).

***Fig. 4** – a : répartition spatiale du récipient TC5, les différentes tailles des cercles et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : forme et dessin du récipient TC5 (dessin F. Yoringmal, Centre culturel du Vanuatu).*

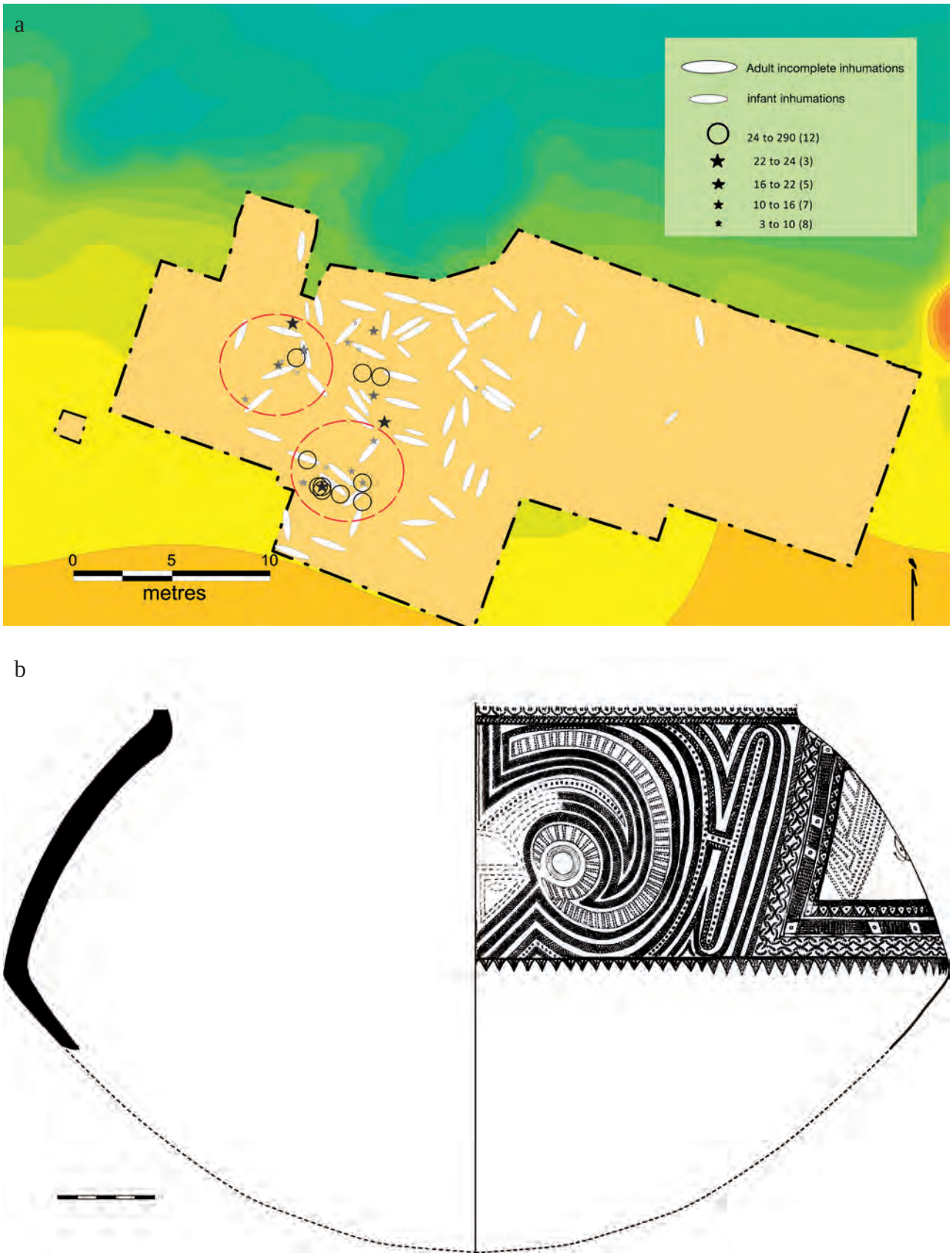


Fig. 5 – a: spatial distribution of pot TCC3, size of the circles and stars indicates weight of pottery sherds (CAD: M. Ravn); b: drawing of pot TCC 3 (drawing F. Yoringmal and S. Seoule, Vanuatu Cultural Centre).
***Fig. 5** – a : répartition spatiale du récipient TCC3, les différentes tailles des cercles et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : dessin du récipient TCC3 (dessin S. Seoule, Centre culturel du Vanuatu).*

The sherds recovered from TCC 3 suggest that it was associated with burial rituals that took place in two separated areas of the cemetery. This is an indication that this exotic vessel would have to have been smashed at some stage of the mortuary process and then distributed among two separated burial activity areas.

Pot TD 4 (Teouma dish)

This is another flat-bottomed dish. Fifty three sherds (1,005 g) were recovered. TD 4 is a very robust vessel with thick walls and base and is associated with B5. Nine sherds (160 g; 16% of total) were recovered from a single square meter where B5 was centred. Sherds were found both amongst the burial fill and beneath the B5 skeleton. In the other squares totalling 8 m^2 that surround this square a further twenty-nine sherds (586 g; 58.6% of total) were recorded. In summary then, 70% of the total number of recovered sherds, representing 74% (746 g) of the total weight of all sherds recovered came from squares centred around B5. The robust nature of this vessel and the recovery of numerous sherds within very few squares throughout the grave fill of B5 suggest it was broken at some stage during the burial ritual of this individual. Other more dispersed and isolated sherds from this vessel indicate both subsequent disturbance and displacement during cemetery use as well as recent quarrying activity. For instance, a single sherd was found in the fill of B32, which might indicate that this burial is later than B5 (fig. 6).

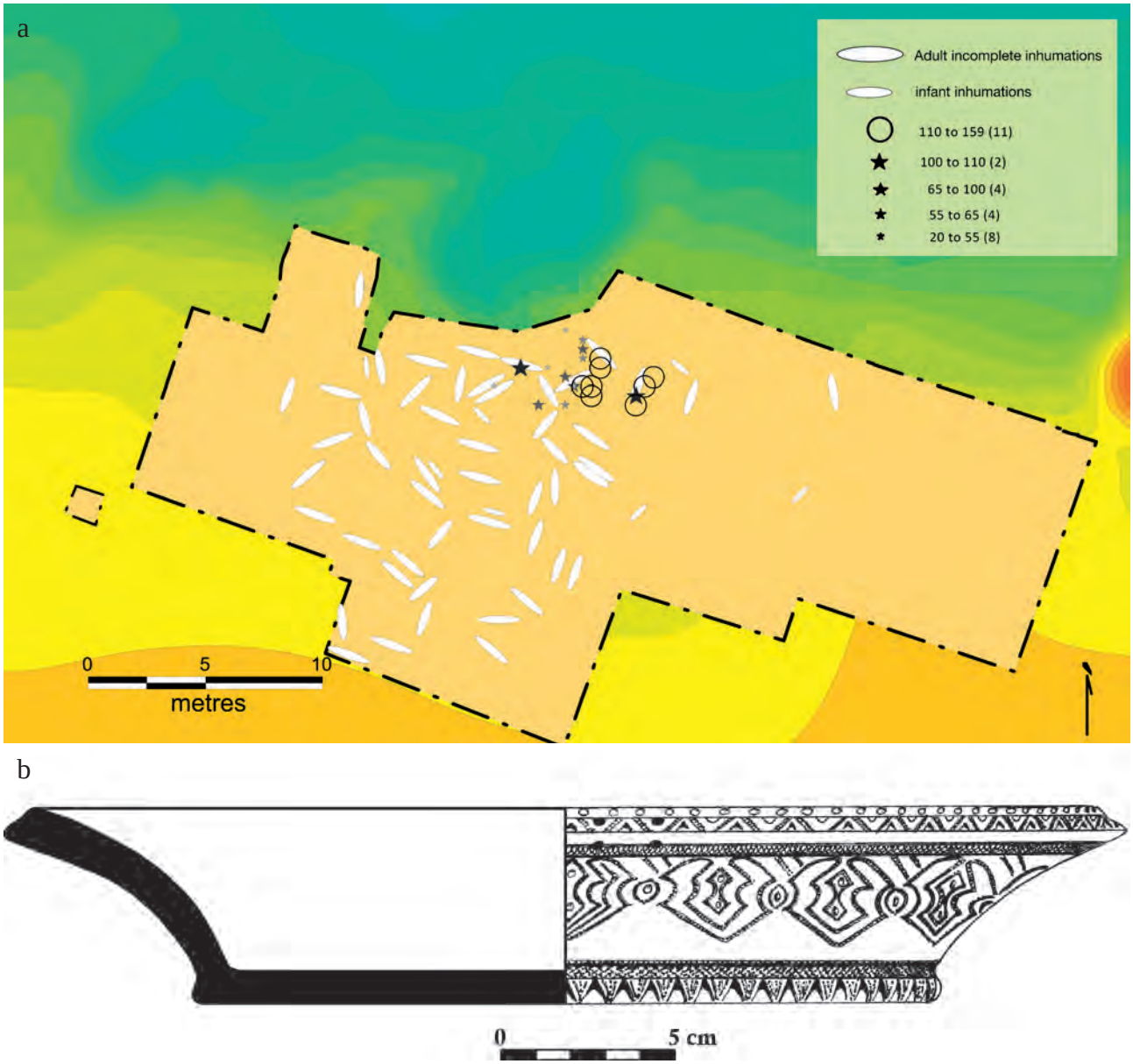


Fig. 6 – *a: spatial distribution of pot TD4, size of the circles and stars indicates weight of pottery sherds (CAD M. Ravn); b: drawing of potTD 4 (drawing F. Yoringmal,* Vanuatu Cultural Centre*).*
Fig. 6 – *a : répartition spatiale du récipientTD4, les différentes tailles des cercles et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : dessin du récipient TD4 (dessin F. Yoringmal, Centre culturel du Vanuatu).*

Pot TC 12 (Teouma carinated)

TC 12 is a large, flaring carinated vessel (fig. 7). Some 248 sherds (2,356.5 g) were identified as being associated with this vessel. However, it came from an area that was much disturbed by recent earthmoving activities. Removing those sherds that were interpreted as having been redeposited owing to these recent disturbances we are left with 198 sherds with a total weight of 1,811.5 g that came from 75 squares. However, almost 50% of the recovered sherds by weight and number come from two distinct areas (18 m^2). The base of the vessel was recorded in situ (fig. 7) indicating that it was initially likely to have been buried whole up to its carination. Its

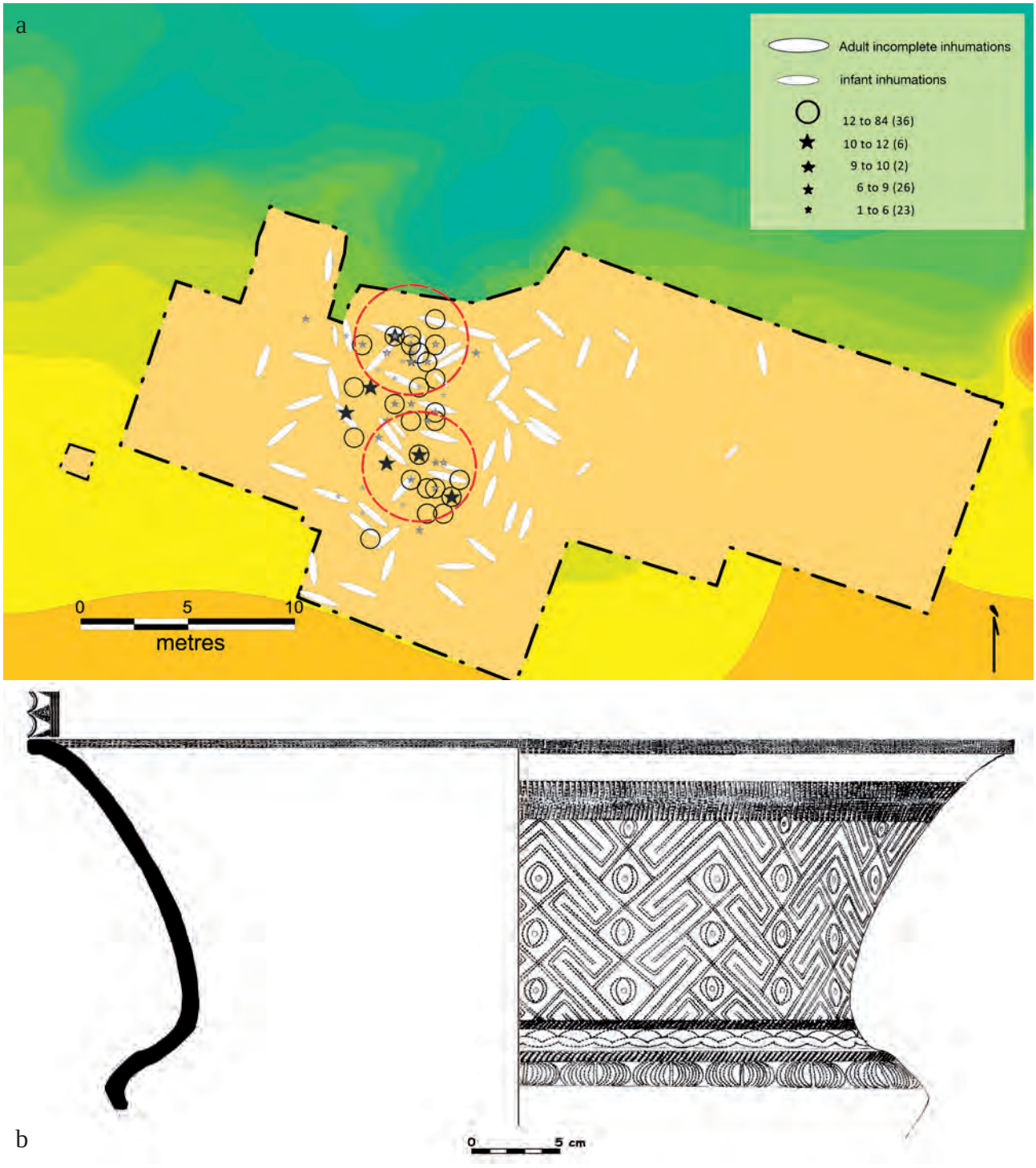


Fig. 7 – *a: spatial distribution of pot TC12, size of the circles and stars indicates weight of pottery sherds (CAD M. Ravn); b: drawing of pot TC 12 (drawing F. Yoringmal,* Vanuatu Cultural Centre*).*
Fig. 7 – *a : répartition spatiale du récipient TD12, les différentes tailles des cercels et des étoiles indiquent le poids des tessons (DAO M. Ravn) ; b : dessin du récipient TD12 (dessin F. Yoringmal, Centre culturel du Vanuatu).*

initial use may have been as a burial jar (Valentin et al., 2015). Some thirty-five sherds (17.5% of total; 27.4% total weight) come from the nine square meters that surround the in-situ base. A large percentage of those were found in association with B38 (underneath the burial). The other concentration centres around B49. Some forty-one generally smaller, sherds (20% of total; 22% of total weight) were recovered from the nine square meters surrounding this burial. Most of the other recorded sherds are spread in proximity to these two concentrations, with the vast majority weighing less than 10 g each. It is not surprising that there is a concentration of large sherds near the location of the in-situ base. This is the pattern that would be expected if a large vessel, mostly exposed above the ground surface, had been damaged and its fragments scattered nearby over time. The second concentration six metres north of the in situ base, however, suggests that parts of this vessel were deliberately used as part of the burial ritual of at least one other burial (B49).

DISCUSSION

It was established during the initial excavation of Teouma in 2004 and more dramatically in 2005 that whole Lapita vessels had been placed amongst some of the burials and were associated with burial ritual at the site (Bedford et al., 2006). Further confirmation of pottery associated with ritual at the Teouma cemetery is the presence of vessels brought from New Caledonia (Dickinson et al., 2013). The identification of clustered patterns, here defined as confined collections of sherds within a small area, further indicates that other whole pots were initially deposited in the cemetery area and that they are not simply representative of a generalised pattern of refuse disposal. However, apart from the whole vessels found *in situ*, almost every other identified individual vessel is incomplete despite excavations covering more than 400 m^2. This suggests a number of scenarios and brings us back again to the problem of equifinality. While part of the site was damaged by earthmoving in 2003 this does not account for the fact that many incomplete vessels, comprising clusters of associated sherds, have been identified outside the area of recent damage. The burial rituals at Teouma were lengthy and multi-staged and the deposition of decorated pottery was only one of the many stages associated with funerary rites. Some whole vessels placed with burials were clearly damaged as other later burial rituals were being performed (e.g. TC 5 and TC 12). They may also have been used (and broken) in separate ceremonies that occurred outside specific graves or even outside the immediate cemetery area. Some sherds may then have been placed with the burials. This is one aspect to consider when deciding whether to relegate decorated sherds from the midden zone to simple domestic discard. Pots may well have been broken deliberately during the burial ritual and some sherds may also have been removed, acting as 'relics' and strengthening connections with the dead (Chapman and Gaydarska, 2007, p. 99–100; Woodward, 2002, p. 1041). The (almost) whole upturned flat-dish that appears to have been used as an expedient protective cover is a further indication of the potential range of uses of these highly decorated vessels (Bedford et al., 2007).

It is worth noting that a pattern of ritual use of pottery in burials is commonly found in Neolithic and Bronze Age societies in Europe and Asia, as John Chapman and Bisserka Gaydarska (Chapman and Gaydarska, 2007) discuss. In Europe, pots were smashed ritually within and in front of megalithic monuments and systematically reburied several times in enclosure ditches (Ravn, 2011b). We know of partial skeletons and pottery pieces being placed with several different individuals in Scandinavia (Larsson, 2009), Britain (Thomas, 1999), Turkey (Hodder, 2006), in Neolithic societies in China (Morris, 2010) and in island Southeast Asia (Lloyd-Smith, 2009; Lloyd-Smith and Cole, 2010; Valentin et al., 2015). Morris observes that Neolithic societies around the world seem to have chosen quite similar ways of dealing with burials and skeletons, pottery and other valued artefacts in the grave ritual, as also pointed out by Sand (Sand et al., 2013, p. 5). The skeletons at Teouma, while all having been fragmented to some extent by removal of skulls and various other bones, are more intact than the typical Middle Neolithic skeletons of Europe. Burial appears more focused on actual individuals, as also seen from the later Neolithic, Bronze Age and Iron Age of Europe (e.g. Haak et al., 2008; Ravn, 2003, p. 106). Thus, we cannot exclude that burial of family groups was practiced in Teouma, as it certainly was in Late Neolithic Europe. What we can say is that in a comparative perspective it seems likely that the pots we find at Teouma should be seen as not only placed in individual graves both *in situ* and broken as a result of later burial activity in the area, but also that pots were smashed as part of a ritual of commemoration, with some of the sherds (and human bones) taken away off-site.

CONCLUSIONS

It hardly needs to be said that it is difficult to read the minds of past peoples, just as it is often difficult to understand the thoughts and motivations of contemporary populations. However, ritual is often the behavioural manifestation of less tangible ideas and thoughts, and studying the patterning of this behaviour makes it possible to access certain layers of meaning. The site of Teouma provides us with an almost unique opportunity in terms of understanding aspects of Lapita ritual behaviour, with its well-preserved cemetery and adjacent associated midden deposits. However, even at a site as well-preserved and extensively excavated as Teouma we cannot be definitive about all activities that were associated with pottery use. What we can certainly say is that decorated Lapita vessels were used during different phases of Lapita mortuary ritual. Whole vessels were placed with burials

and some were used for jar burials (Bedford et al., 2010; Valentin et al., 2015). Many other individual vessels were also placed amongst the burials and there is evidence that these could have been damaged post-placement or equally that they may have been purposely smashed as part of final rites. The largest numbers of vessels are variously represented by dozens of sherds but in some cases only a handful or a single 'orphan sherd' is present. Post-depositional activity may account for some of the breakage and absent sherds, but many vessels may have been only partly whole even when used as part of the burial rituals. Alternatively, parts of the smashed vessels could have been subsequently removed and taken elsewhere as part of ritual activities—as certainly happened with human skulls and bones at Teouma. In addition, some pottery fragments including single 'orphan sherds' may have been brought in as fragments from other contexts (cf. Chapman and Gaydarska, 2007).

The dead of the Lapita culture were buried in what may have been related groups, and rituals were undertaken where highly-decorated pots and shell valuables played a role (Bedford et al., 2006). Refitted pots have the potential to provide a clue as to which graves are related chronologically, although we are well aware of the many pitfalls associated with trying to use them in this way (Chapman and Gaydarska, 2007, p. 83–85). It seems that the most important and possibly one of the oldest burial concentrations must have been burial concentration II, within which area bird pot TC 5 was located. Further assessment of the apparent associations of finds using more precise means of dating and more detailed stratigraphic and refitting analyses (Blanco-Gonzalez and Chapman, 2014) should provide increased definition of the various activities at the site.

We cannot definitively establish whether pots were smashed purposefully as suggested by Sand (Sand et al., 2013), in this case as part of the burial ritual, but it does seem highly likely this was what was happening in some cases, such as with TCC 3, either on or off the burial area. It is possible to suggest that some pots were originally whole when used in the burial ritual, as these pots are found within well-defined areas around graves, such as with TD 4 and TC 12. It may be that they were deposited in order to mark one or more graves of a group. Some were used more directly as burial containers, as with TC 5. The patterning of TD 16 is an example where it is more difficult to reconstruct an artefact biography, as it must to some extent represent a palimpsest of activities including more recent taphonomic disturbance. Widely scattered patterns of potsherds such as that seen with pot TC 45 indicate refuse deposition as one would expect from a midden, although what the original function of the pots may have been remains open to speculation.

Christophe Sand (Sand et al., 2013) has suggested that one of the reasons that there is a high level of fragmentation in Lapita sherds found at sites may relate to the smashing of decorated vessels in ceremonies of colonisation. This may well be the case, although taphonomic processes are more likely to have been the primary agent in diminishing sherd size where sites are not deeply buried. With all things Lapita we can expect regional and chronological variation across its distribution. The challenge remains teasing out activities associated with major ritual from the myriad of daily rituals (Marshall in Sand et al., 2013) that were occurring at these sites, and distinguishing which ones might or might not have been associated with burial and other major ceremonies.

Acknowledgements: The Teouma Archaeological Project is a joint initiative of the Vanuatu National Museum and The Australian National University (ANU), directed by Stuart Bedford and Matthew Spriggs of the ANU, and Ralph Regenvanu (2004-2006) and Marcelin Abong successively directors of the Vanuatu Cultural Centre (VCC). Major funding has been provided by the Australian Research Council (ARC), the National Geographic Society and the Pacific Biological Foundation. Mads Ravn particularly thanks the staff at the VCC for generous support during various visits. His participation in the project has been funded by support from the ARC, Museum of Archaeology, Stavanger University (Norway), and the Museum of Culture History, University of Oslo (Norway). Matthew Spriggs thanks Bob Chapman and Bisserka Gaydarska of Durham University, UK, for discussions over the years on fragmentation studies.

BIBLIOGRAPHICAL REFERENCES

Andrén A. (2014) – *Tracing Old Norse Cosmology: The World Tree, Middle Earth, and the Sun in Archaeological Perspectives*, Lund, Nordic Academic Press (Vägar Till Midgård 16), 247 p.

Bedford S., Hoffman A., Kaltal M., Regenvanu R., Shing R. (2004) – Dentate-Stamped Lapita Reappears on Efate, Central Vanuatu: A Four Decade-Long Drought is Broken, *Archaeology in New Zealand*, 47, 1, p. 9–49.

Bedford S., Spriggs M., Buckley H. R., Valentin F., Regenvanu R. (2009) – The Teouma Lapita Site, South Efate, Vanuatu: A Summary of Three Field Seasons (2004–2006), in P. J. Sheppard, T. Thomas and G. R. Summerhayes (eds.), *Lapita: Ancestors and Descendants*, proceedings of the 7th International Lapita Conference (Honiara, 4–7 July 2007) Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 28), p. 215–34.

Bedford S., Spriggs M., Regenvanu R. (2006) – The Teouma Lapita Site and the Early Human Settlement of the Pacific Islands, *Antiquity*, 80, 310, p. 812–28.

Bedford S., Spriggs M. (2007) – Birds on the Rim: A Unique Lapita Carinated Vessel in its Wider Context, *Archaeology in Oceania*, 42, 1, p. 12–21.

Bedford S., Spriggs M., Regenvanu R. , Macgregor C., Kuautonga T., Sietz M. (2007) – The Excavation, Conservation and Reconstruction of Lapita Burial Pots from the

Teouma site, Efate, Central Vanuatu, in S. Bedford, C. Sand and S. P. Connaughton (eds.), *Oceanic Explorations: Lapita and Western Pacific Settlement*, Canberra, ANU E-Press (Terra Australis, 26), p. 223–40.

Bedford S., Spriggs M., Buckley H. R., Valentin F., Regenvanu R., Abong M. (2010) – A Cemetery of First Settlement: Teouma, South Efate, Vanuatu = Un cimetière de premier peuplement : le site de Teouma, Sud Efate, Vanuatu, in C. Sand and S. Bedford (eds.), *Lapita : ancêtres océaniens = Oceanic Ancestors*, Paris, musée du Quai-Branly et Somogy, p. 140–61.

Bentley A. R., Buckley H. R., Spriggs M., Bedford S., Ottley C. J., Nowell G. M., Macpherson M. C. G., Pearson D. G. (2007) – Lapita Migrants in the Pacific's Oldest Cemetery: Isotopic Analysis at Teouma, Vanuatu, *American Antiquity*, 72, 4, p. 645–56.

Blanco-Gonzalez A., Chapman J. (2014) – A New Method for Identifying Sherd Refits: A Case Study from the Neolithic of Northumbria, UK, *Journal of Field Archaeology*, 39, 3, p. 248–55.

Bollong C. A. (1994) – Analysis of Site Stratigraphy and Formation Processes Using Patterns of Pottery Sherd Dispersion, *Journal of Field Archaeology*, 21, 1, p. 15–28.

Chapman J., Gaydarska B. (2007) – *Parts and Wholes: Fragmentation in Prehistoric Context*, Oxford, Oxbow Books, 264 p.

Constantine A., Reepmeyer C., Bedford S., Spriggs M., Ravn M. (2015) – Obsidian Distribution from a Lapita Cemetery Sheds Light on Its Value to Past Societies, *Archaeology in Oceania*, 50, 2, p. 111–16.

Chiu S. (2003) – Social and Economic Meanings of Lapita Pottery: A New Caledonia Case, in C. Sand (dir.), *Pacific Archaeology: Assessments and Prospects*, proceedings of the International Conference for the 50th Anniversary of the First Lapita Excavation (Koné-Nouméa, 2002), Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 159–82.

Dickinson W., Bedford S., Spriggs M. (2013) – Petrography of Temper Sands in 112 Reconstructed Lapita Pottery Vessels from Teouma (Efate): Archaeological Implications and Relations to other Vanuatu Tempers, *Journal of Pacific Archaeology*, 4, 2, p. 1–20.

Haak W., Brandt G., De Jong H. N., Meyer C., Ganslmeier R., Heyd V., Hawkesworth C., Pike A. W. G., Meller M., Alt K. W. (2008) – Ancient DNA, Strontium Isotopes, and Osteological Analyses Shed Light on Social and Kinship Organization of the Later Stone Age, *Proceedings of the National Academy of Sciences*, 105, 47, p. 18226–31.

Hawkins S. C. (2015) – *Human Behavioural Ecology, Anthropogenic Impact and Subsistence Change at the Teouma Lapita Site, Central Vanuatu, 3000-2500 BP*, doctoral thesis, Australian National University, Canberra, 263 p.

Hodder I. (2006) – *The Leopard's Tale: Revealing the Mysteries of Çatalhöyük*, London, Thames and Hudson, 288 p.

Kinaston R., Buckley H. R., Valentin F., Bedford S., Spriggs M., Hawkins S., Herrscher E. (2014) – Lapita Diet in Remote Oceania: New Stable Isotope Evidence from the 3000-Year-Old Teouma Site, Efate Island, Vanuatu, *PLoS One*, 9, 3, e90376, doi: 10.1371/journal.pone.0090376 [online].

Larsson Å. M. (2009) – *Breaking and Making Bodies and Pots: Material and Ritual Practices in Sweden in the Third Millennium BC*, Uppsala, Uppsala University (AUN, 40), 493 p.

Lloyd-Smith L. R. (2009) – *Chronologies of the Dead: Later Prehistoric Burial Practices at the Niah Caves, Sarawak*, doctoral thesis, University of Cambridge, 345 p.

Lloyd-Smith L. R., Cole F. (2010) – The Jar-Burial Tradition in the West Mouth of Niah Cave, Sarawak: Burial Histories, Social Identities, and Changing Perceptions of Pottery and Death, in B. Bellina, E. A. Bacus, T. O. Pryce and J. Wisseman Christie (eds.), *50 Years of Archaeology in Southeast Asia: Essays in Honour of Ian Glover*, Bangkok, River Books, p. 114–27.

Meyer O. (1909) – Funde prähistorischer Töpferei und Steinmesser auf Vuatom, Bismarck-Archipel, *Anthropos*, 4, p. 251–52 and p. 1093–95.

Morris I. (2010) – *Why the West Rules – for Now: The patterns of History, and What They Reveal about the Future*, New York, Farrar, Straus and Giroux, 768 p.

Petchey F., Spriggs M., Bedford S., Valentin F., Buckley H. R., (2014) – Radiocarbon Dating of Burials from the Teouma Lapita Cemetery, Efate, Vanuatu, *Journal of Archaeological Science*, 50, p. 227–42.

Ravn M. (2003) – *Death Ritual and Germanic Social Structure (c. AD 200-600)*, Oxford, Archaeopress (BAR, International Series 1164), 151 p.

Ravn M. (2011a) – Ethnographic Analogy from the Pacific: Just as Analogical as Any Other Analogy, *World Archaeology*, 43, 4, p. 716–25.

Ravn M. (2011b) – The Early Neolithic Volling Site of Kildevang: Its Chronology and Intra-spatial Organisation, in S. Hartz, F. Lüth and T. Terberger (ed.), *Early Pottery in the Baltic: Dating, Origin and Social Context*, Darmstadt, Philipp von Zabern (Berichte der Römisch-Germanischen Kommission, 89), p. 135–63.

Roscoe P. (2009) – On the 'Pacification' of the European Neolithic: Ethnographic Analogy and the Neglect of History, *World Archaeology*, 41, 4, p. 578–88.

Sand C., Marshall Y., Sheppard P., Spriggs M., Chiu S. (2013) – Ritually Breaking Lapita Pots: or, Can we get into the Minds of Oceanic First Settlers? A Discussion, *Archaeology in Oceania*, 48, p. 2–12.

Scott R., Buckley H. R., Spriggs M., Valentin F., Bedford S., (2010) – Identification of the First Reported Lapita Cremation in the Pacific Islands using Archaeological, Forensic and Contemporary Burning Evidence, *Journal of Archaeological Science*, 37, 5, p. 901–9.

Spriggs M. (2008) – Ethnographic Parallels and the Denial of History, *World Archaeology*, 40, 4, p. 538–52.

Spriggs M., Bedford S. (2013) – Is there an Incised Lapita Phase after Dentate-Stamped Pottery ends? Data from Teouma, Efate Island, Vanuatu, in G. R. Summerhayes and

H. R. Buckley (eds.), *Pacific Archaeology: Documenting the Past 50,000 Years: Papers from the 2011 Lapita Pacific Archaeology Conference*, proceedings of the international conference (Apia-Samoa, 27 June–1 July 2011), Dunedin, University of Otago Press (University of Otago Studies in Archaeology, 25), p. 148–56.

Thomas J. (1999) – *Understanding the Neolithic*, Abingdon, Routledge, 280 p.

Valentin F., Spriggs M., Bedford S., Buckley H. R. (2009) – Une analyse diachronique des pratiques funéraires préhistoriques du centre du Vanuatu, *Journal de la Société des océanistes*, 128, 1, p. 39–52.

Valentin F., Bedford S., Buckley H. R., Spriggs M. (2010a) – Lapita Burial Practices: Evidence for Complex Body and Bone Treatment at the Teouma Cemetery, Vanuatu, Southwest Pacific, *Journal of Island and Coastal Archaeology*, 5, 2, p. 212–35.

Valentin F., Buckley H. R., Herrscher E., Kinaston R., Bedford S., Spriggs M., Hawkins S., Neal K. (2010b) – Lapita Subsistence Strategies and Food Consumption Patterns in the Community of Teouma (Efate, Vanuatu), *Journal of Archaeological Science*, 37, 8, p. 1820–29.

Valentin F., Spriggs M., Bedford S., Buckley H. R. (2011) – Vanuatu Mortuary Practices over Three Millennia: Lapita to the Early Contact Period, *Journal of Pacific Archaeology*, 2, 2, p. 49–65.

Valentin F., Herrscher E., Bedford S., Spriggs M., Buckley H. R. (2014) – Evidence for Social and Cultural Change in Central Vanuatu between 3000 and 2000 BP: Comparing Funerary and Dietary Patterns of the First and Later Generations at Teouma, Efate, *Journal of Island and Coastal Archaeology*, 9, 3, p. 381–99.

Valentin F., Choi J.-I., Lin H., Bedford S., Spriggs M. (2015) – Three Thousand Year Old Jar Burials at the Teouma Cemetery (Vanuatu): A Southeast Asian-Lapita Connection?, in C. Sand, S. Chiu and N. Hogg (eds.), *The Lapita Cultural Complex in Time and Space: Expansion Routes, Chronologies and Typologies*, Nouméa, Institut d'archéologie de la Nouvelle-Calédonie et du Pacifique (Archaeologia Pasifika, 4), p. 81–101.

Woodward A. (2002) – Beads and Beakers: Heirlooms and Relics in the British Early Bronze Age, *Antiquity*, 76, 294, p. 1040–47.

Wylie A. (1985) – The Reaction against Analogy, in M. B. Schiffer (ed.), *Advances in Archaeological Method and Theory*, 8, London, Academic Press, p. 63–111.

Mads Ravn
The Vejle Museums,
Flegborg 16-18,
DK-7100 Vejle (Denmark)
and
Kon-Tiki Museum,
Bygdøynesveien 36,
N-0286 Oslo (Norway)
marav@vejle.dk

Stuart Bedford
School of Culture, History and Language, CAP,
The Australian National University,
Canberra, ACT 2601 (Australia)

Matthew Spriggs
School of Archaeology and Anthropology, CASS,
The Australian National University,
Canberra, ACT 2601 (Australia)

Stuart Hawkins
School of Culture, History and Language, CAP,
The Australian National University,
Canberra, ACT 2601 (Australia)

Iarowai Philip
Vanuatu Cultural Centre
Port-Vila (Vanuatu)

Frédérique Valentin
CNRS, UMR 7041,
Maison de l'archéologie et de l'ethnologie,
21, allée de l'Université,
F-92023 Nanterre (France)

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 177-190
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Oceania and the Regional Relations Paradigm

Contrasting Regional Networks and beyond

Denis Monnerie

Abstract: This paper describes and analyzes the regional networks of the north-western Solomons (between c. 1850 and c. 1908) and the Hoot ma Whaap in the far north of Grande Terre (Kanaky/New Caledonia) from fieldwork observations during 1992 to 2012. In order to carry out comparative studies of the goods, ideas and people that circulated, of the ways in which they were circulated and of the local concepts and ideologies which underscored these dynamics, a wide concept of networks had to be assessed. The different modes of regional relations are compared, and the contrast between a patchwork-like network and a (much more) homogenous network are observed. Some of the theoretical issues raised by these descriptions, analyses and comparisons are discussed. One of which is a proposal for a renewed description for the whole of Oceania: the regional relations paradigm, the other is to acknowledge the usefulness and the limitations of our static anthropological tools.

Keywords: comparison, network, regional relations, circulations, dynamic models, Oceania, Solomon Islands, Kanaky/New Caledonia.

De l'Océanie considérée sous l'angle du paradigme des relations régionales : les contrastes entre réseaux régionaux et autres considérations.

Résumé : Ce texte décrit d'une part le réseau de relations régionales des îles Salomon du Nord-Ouest (étudié en anthropologie historique, entre 1850 environ et 1908) et d'autre part celui de l'extrême nord de la Grande Terre de Kanaky/Nouvelle-Calédonie, nommé Hoot ma Whaap (étudié sur le terrain entre 1992 et 2012). À partir d'études comparatives des biens, idées et personnes qui y circulent, des modalités de ces circulations et des concepts et idéologies locaux qui les sous-tendent, il apparaît que derrière la notion très large de réseau existent des modalités de relations régionales diverses. Les différentes modalités de relations comparées permettent de contraster un réseau en patchwork et un réseau (beaucoup plus) homogène. Certains points théoriques soulevés par ces descriptions, analyses et comparaisons sont abordés. Parmi eux figurent la proposition d'une modalité renouvelée de description de l'Océanie dans son ensemble : le paradigme des relations régionales ; et aussi, à propos des outils anthropologiques statiques, la reconnaissance de leur utilité, mais aussi de leurs limitations.

Mots-clés : comparaison, réseau, relations régionales, circulations, modèles dynamiques, Océanie, îles Salomon, Kanaky/Nouvelle-Calédonie.

The ethnographies of Mono-Alu and the north-western Solomons, and of Arama and the Hoot ma Whaap region in the far north of Kanaky/New Caledonia, show how deeply people are involved in regional relations dealing both with so called material and immaterial items. The reproduction of both these societies extends beyond the local area and resides, to a large extent, in regional relations. Both situated in Melanesia, these societies display strong preoccupations with ranking humans and non humans from cradle to grave, and beyond. Therefore, these ethnographies, beyond contradicting Marshall Sahlins's (Sahlins, 1963) famously heuristic and now obsolete characterization of the Big Man as the ideal Melanesian political type, have led me to view the tripartite geographical division of Oceania into Melanesia, Micronesia and Polynesia with a growing disbelief (Monnerie, 1998 and 2011). Paul D'Arcy's 2006 book *The People of the Sea* (D'Arcy, 2006) is a good example amongst many others that challenges the tripartite paradigm of Oceania and that attempts a better understanding of the Pacific as a whole. In this book, Paul D'Arcy favours several new paradigms, among these the

Near Oceania/Remote Oceania archaeological and linguistic distinction—which I shall call the bipartite paradigm. As an anthropologist my doubts about this bipartite paradigm stem from the fact that the societies and regions I study are not strikingly different, although the Solomon Islands belong to Near Oceania and Kanaky/New Caledonia to Remote Oceania. Another possible paradigm for a better understanding of Oceania, which I have long favoured and which is also suggested by Paul D'Arcy, is the regional relations paradigm.(1)

The overarching argument of this paper is that I believe that the regional relation paradigm is much more relevant in understanding Oceania as a whole than the tripartite model or the bipartite model. As far as one can tell from the archaeology, geography, history, linguistics and social and cultural anthropology after the Lapita period, this huge continent does not favour homogeneity—certainly not in the social and cultural domain. However, neither does it encourage extreme fragmentation into isolated local societies as our Western notion of 'insularity' would suggest. Indeed, this is where the regional relation paradigm intervenes, by aiming to better understand Oceania as a whole made up of parts (regions) wherein local societies systematically maintain numerous relationships (e.g. material, immaterial, peaceful, violent) with their regional neighbours. These latter are often very different and sometimes very distant in location. By comparison with the other paradigms, the regional relation paradigm is more precise and provides a clearer view of what we currently know and understand as regards the often tight, local and regional links in Oceania.

This regional relation paradigm requires the creation or use of models, such as networks. In the far north of contemporary Kanaky/New Caledonia, and in the north-western Solomons, using early (end of the 19h, beginning of the 20th century) anthropological sources, network models apply. However, these need to be qualified. From an anthropological perspective, emic anthropology is the principal research aim, though this also needs to be combined with etic concepts (Dumont, 1978 and 1983, p. 187–221) such as network models. Applied to regional systems, network models give us an overview of continuity and help to streamline the (sometimes baffling) ethnographic complexity of local/translocal social and cultural relations. Network models are also very flexible, a feature which enables us to account for the great variety of discontinuities, dynamics and spatial forms which are at work in Oceanian regional relations.

If we just consider Melanesia, ever since Richard Thurnwald, Bronisław Malinowski and Marcel Mauss, exchanges have been at the forefront of anthropological reflexions. More recently Joel Robbins (Robbins, 1994) has suggested that exchange is a pervading value in many Melanesian societies. I consider (see also Chave-Dartoen, this volume) that this crucial importance of exchange can be extended to most of Oceania. Local exchange and translocal exchange, which are conspicuous in local and regional relations in Oceania, are the building blocks of these networks or, more precisely, their dynamic components. To describe these types of exchange in more detail, I will use the concept of transfers and circulation (Monnerie, 2012); a circulation being made up of a series of transfers.

THE NORTH-WESTERN SOLOMON ISLANDS

The Mono-Alu people live on a small island south of Bougainville called Alu (or Shortland; fig. 1). For Mono-Alu and the north-western Solomons, my ethnographic research refers to a period from c. 1880 to c. 1909. This was precisely documented by Gerald Camden Wheeler who left us with an outstanding ethnographic documentation, though mainly unpublished. Gerald Wheeler is primarily remembered as a linguist for his excellent description of the Mono-Alu Austronesian (AN) language, and his remarkably advanced presentation of oral traditions (Wheeler, 1926). Many other sources from the same period also provide us with valuable information (for a description of the sources and more detailed analysis of the ethnography, see Monnerie, 1996).

The Mono-Alu people have matrilineal kinship groups involving *fanua* relations between people belonging to the same matrilineal group. Variants of these matrilineal groups extend to several societies in this region (i.e. Mono, Fauro, Buin, Siwai [Siuai], Tiarama), evidence that the *fanua* relations spread beyond the Mono-Alu society. Another characteristic feature of the Mono-Alu society is the distinction between nobles (*lalaafa* for the men, *mamaifa* for the women, with everyone ranked within these gendered categories), commoners *(soi)* and dependents *(toniga)*. With the exception of the village chiefs *(lalaafa)* who are always noble men, these distinctions are not readily apparent in everyday life. However, they are spectacularly performed, elaborated and exhibited in ceremonies, especially funerals, and in relations with the ancestors *(nitu)*. Running parallel and strongly linked to these rankings, is a system of five different shell valuables *(*i.e. *kia, kasisi, perasale, mimisi, mauai)* with different values expressed by qualifications of the term *olatu*.(2) In local Mono-Alu relations, this ranking of people, ancestors and shell valuables is articulated in transfers and circulations, both current and ceremonial. However, they are also mirrored by regional relationships with the societies of other islands in the Bougainville straits (Mono and Fauro), southern Bougainville (Buin, Siwai, Banone and Kieta), and Choiseul (Tiarama and Bambatana), and further afar New Georgia (Roviana; here: fig. 1 and fig. 7). We shall see that they do so differently. The best documented regional relations are between the Mono-Alu and Buin societies in southern Bougainville. Relations with the Siwai society seem to have been similar to those with Buin, only less frequent. The Buin and the Siwai people speak non-Austronesian (NAN) languages. Further on, I shall discuss how my model of relations with Buin (also valid with

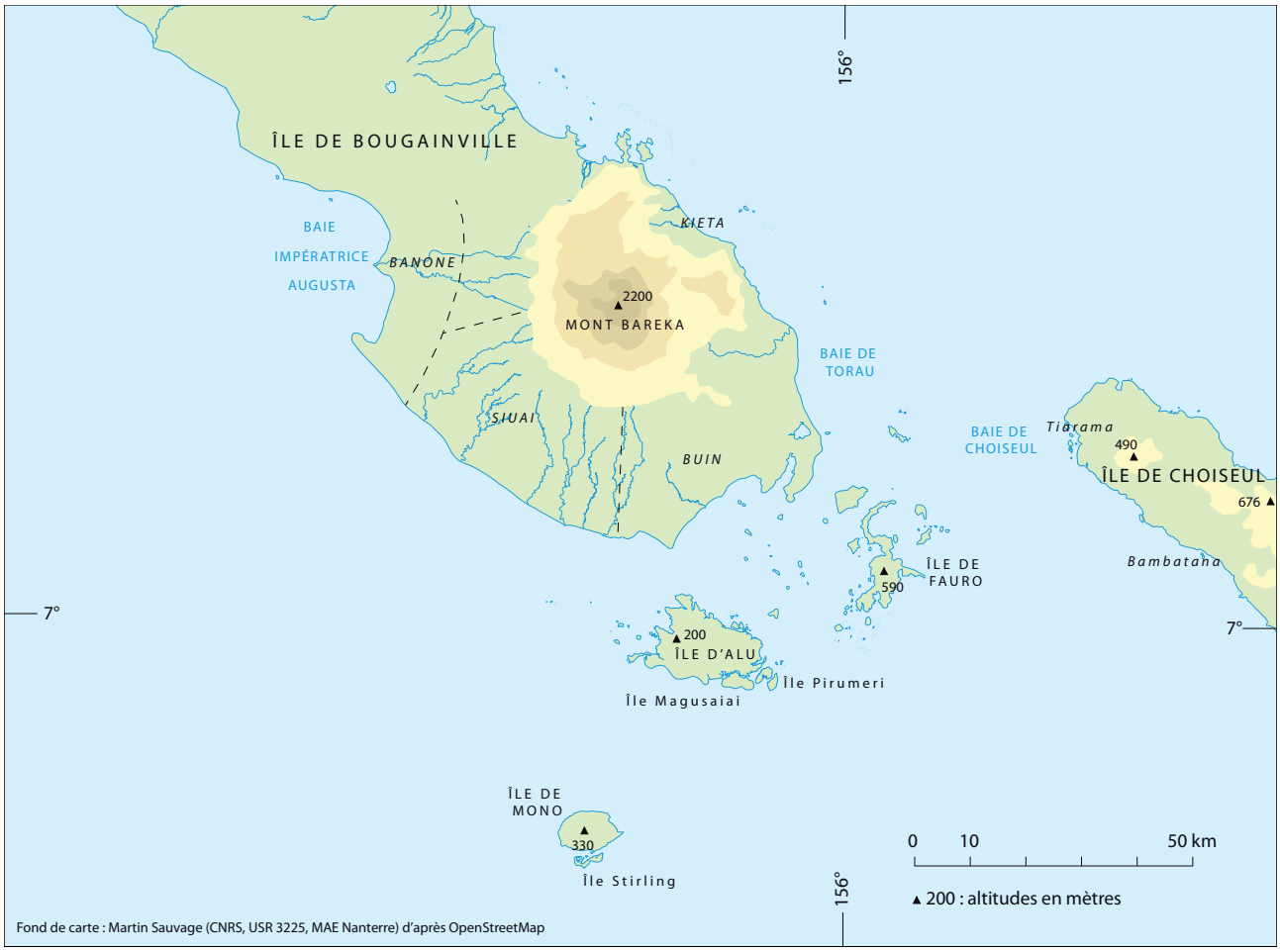


Fig. 1 – The north-western Solomons.
Fig. 1 *– Les îles Salomon du Nord-Ouest.*

minor alterations for Siwai) is only one part of a larger network model extending to other regional relations.

My model of relations between Mono-Alu and Buin is grounded on the current and ceremonial relations between four villages; two Mono-Alu villages (X and Y) and two Buin villages (X' and Y'). Villages X and X' and villages Y and Y' maintain regular, almost weekly, relationships. Figure 2 shows the everyday transfers of goods, pigs and dependents brought by the Buin people to the Mono-Alu. In return, the Buin receive shell valuables of two types: *mimisi* and *mauai*, both at the bottom of the Mono-Alu shell valuable scale. *Mimisi* is the lowest shell valuable used amongst the Mono-Alu, it is also widely used in the north-western Solomons. *Mauai* is a simplified form of shell valuable made by the Mono-Alu used only in transfers with the people of southern Bougainville. It is never used amongst the Mono-Alu. However, amongst the Buin, *mimisi* and *mauai* are commonly used: *mimisi* being highly valued and comparatively scarce, *mauai* less so.

Within this context the following were acquired: male/female dependents *(toniga)*; various goods including live pigs *(boo)*, cooked pork meat, sago cakes *(bia)*, taro *(kokong)*, canarium nuts *(kai)*, arrows *(iliu)*, spears *(potulu)*, plaited vegetal bracelets *(pago)*, several types of baskets (e.g. *aroaro*, *koko*, *kokonui*, *kisa)*, small personal net handbags *(kuisa)*, bamboo boxes *(kulukulu)*, betel containers *(puai)*, decorations worn during dances *(mitamita*, *bisibisi)*, and a white earth called *fioi* used for personal decoration. From Buin and Siwai the Mono-Alu also acquired deadly magic preparations *(leako)* which they apparently could not make. In turn, the Mono-Alu people on Mono and Fauro provided canoes to the Siwai and Buin people who do not build them.

Figure 3 shows one sequence of the ceremonial circulations during the first phases of the funerals of Mono-Alu nobles (men, women and children). A living pig was transferred from the Buin village Y' to the Mono-Alu village Y in return for *mimisi* and *mauai*. The pig was then transferred again from the Mono-Alu village Y to the Mono-Alu village X.

Whilst the funerals were in progress, Mono-Alu warriors from the bereaved village attacked a Buin village which is not in current relations with their own (fig. 4). Therefore, in my model, the Mono-Alu village X attacks the Buin village Y' (and vice versa). On their weapons, the warriors bring back the dried blood of their victims. This is called *nitu* and it is used to feed the ancestor of the deceased Mono-Alu noble person, who is also called

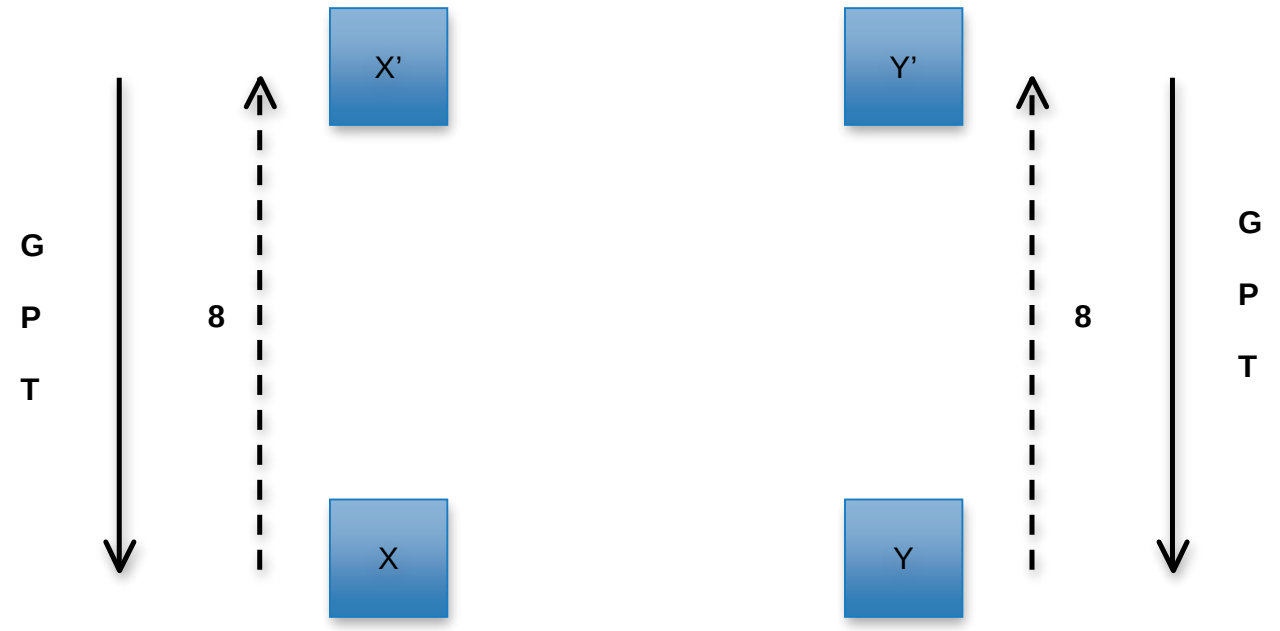


Fig. 2 – G: various goods. P: pigs; T: *toniga*; 8: *mimisi* and *mauai* (sometimes *gorau*).
Fig. 2 *– G : biens divers. P : porcs ; T :* toniga *; 8 :* mimisi *et* mauai *(parfois* gorau*).*

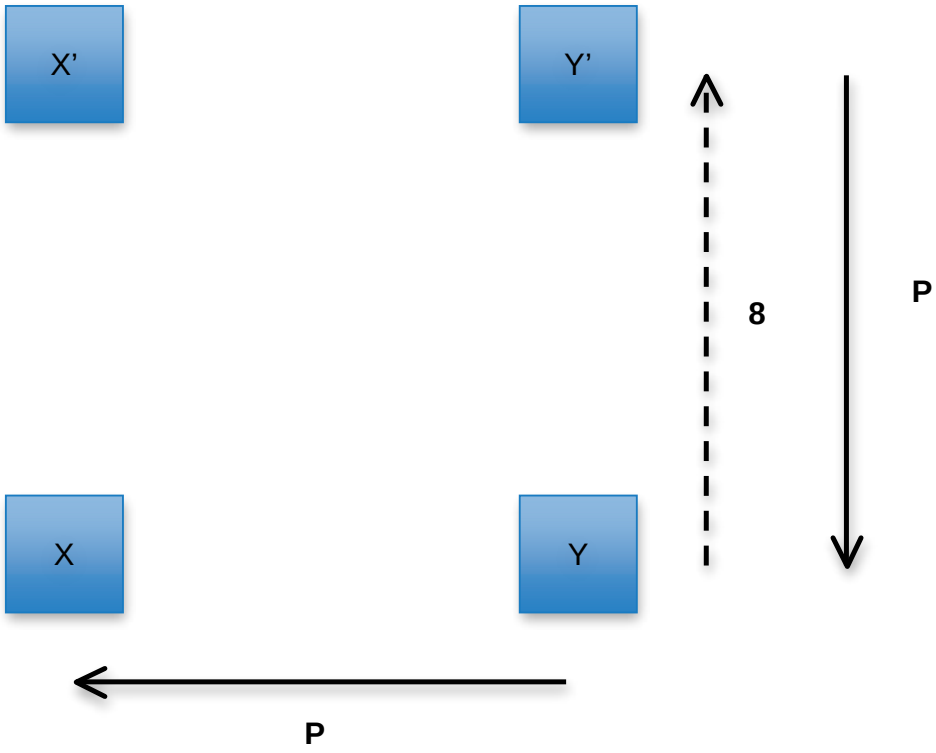


Fig. 3 – P: living pig; 8: *mimisi* and *mauai* (sometimes *gorau*).
Fig. 3 *– P : porcs vivants ; 8 :* mimisi *et* mauai *(parfois* gorau*).*

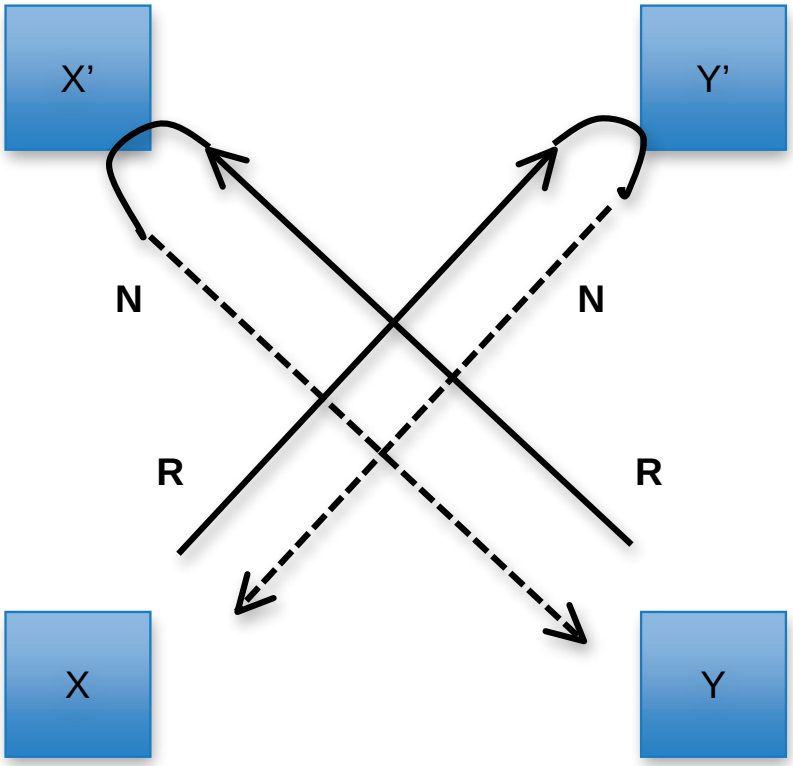


Fig. 4 – R: raid towards Buin (sometimes Siwai); N: *nitu* of the victims brought back after a raid, to Mono-Alu.
***Fig. 4** – R : raid vers Buin (parfois Siwai) ; N : apport de* nitu *des victimes à Mono-Alu après un raid.*

nitu. If the dead noble was a village chief, such raids are performed repeatedly at each stage of the reconstruction of specific features of the village linked to the new living chief: his new house and canoes, the men's common house. From a Mono-Alu point of view, the *nitu* of these raid victims are subordinated to the Mono-Alu warriors and will feed the *nitu* of the Mono-Alu nobles. The Buin (or Siwai) people never retaliate. Therefore, these violent interactions are always to the detriment of the Buin people. They are also transfers of ancestrality.[3]

In other contexts wars are waged between Mono-Alu nobles and villages (fig. 5). In contrast to the absence of retaliation from the Buin people, here retaliation is very much the rule with reciprocal violent interactions. All five different types of shell valuables, including the highly valued ones, can be transferred between the Mono-Alu villages.

Figure 6 shows the complete network model of these relationships. It displays a parallel between the targets of the violent interactions and the transfers of low valued shell valuables. For example, the Mono-Alu people transfer low valued shell valuables to Buin. In return, the Buin people transfer common goods, living pigs and dependents. They also never retaliate to deadly raids performed on their villages, raids in which the victims'dried blood, their *nitu*, is brought back to the Mono-Alu reinforcing their noble ancestors. This orientation of relations is also evidenced when a Buin boy or girl of high status (*mumira*; for Siwai: *mumi*), who is exchanged in Mono-Alu for *mimisi* and *mauai*, becomes a dependent at the bottom of the Mono-Alu social rank like a non *mumira* person. Dependents do not become ancestors in Mono-Alu or in their country of origin. This network, therefore, shows the subordination of the Buin people to the Mono-Alu people in all their relations but especially in raids/violent interactions and shell valuables, whose orientations are parallel.

For other regional relations in the north-western Solomons at that period, the ethnography is not as meticulous as that recorded by Gerald Wheeler for the Mono-Alu and Buin/Siwai societies. However, there are clear indications that their relations with other societies are sufficiently different to make this model inapplicable. A map of the regional circulation of shell valuables evidences that the transfers of low valued *mimisi* and *mauai* only concern relations with Buin and Siwai (fig. 7). Therefore, the model previously described is only one patch in a wider patchwork-like model of regional relations.

Apart from the Buin/Siwai society, the best documented relations are with the Tiarama society in the northern part of Choiseul, where there are actual battles with reciprocal violent interactions. No dependents are ever acquired from the Tiarama and their ancestors are very much feared. In the past a Tiarama noble warrior ancestor was transferred to Mono to impart superior warring capacities to the noble warriors of Mono who then

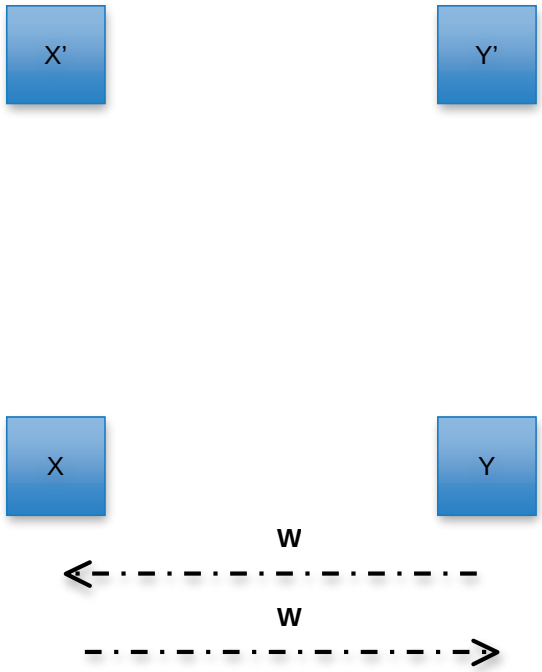


Fig. 5 – W: war between Mono-Alu villages.
Fig. 5 *– W : guerre entre villages Mono-Alu.*

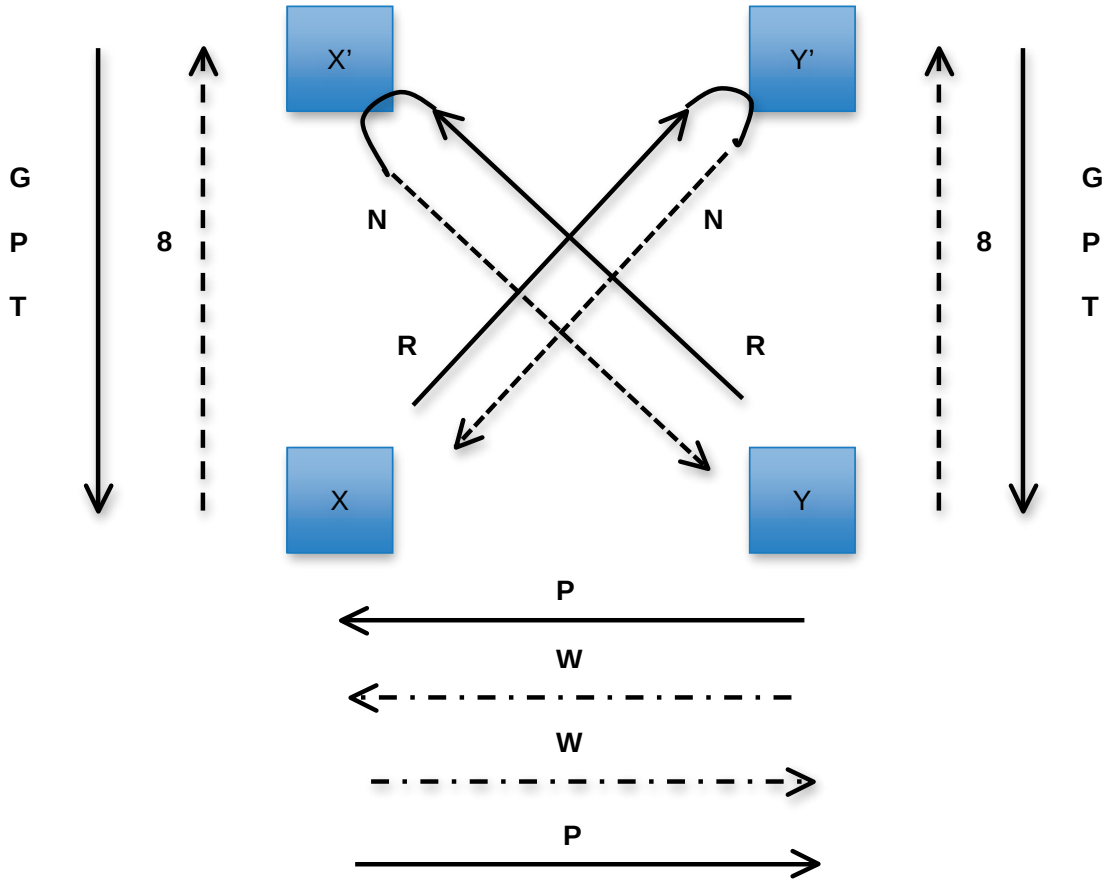


Fig. 6 – G: various goods; P: pigs; T: *toniga*; 8: *mimisi* and *mauai* (sometimes *gorau*); R: raid towards Buin (sometimes Siwai); N: *nitu* of the victims brought back after a raid, to Mono-Alu; W: war between Mono-Alu villages.
Fig. 6 – *G : biens divers ; P : porcs ; T :* toniga *; 8 :* mimisi *et* mauai *(parfois* gorau*) ; R : raid vers Buin (parfois Siwai) ; N : apport de* nitu *des victimes à Mono-Alu après un raid ; W : guerre entre villages Mono-Alu.*

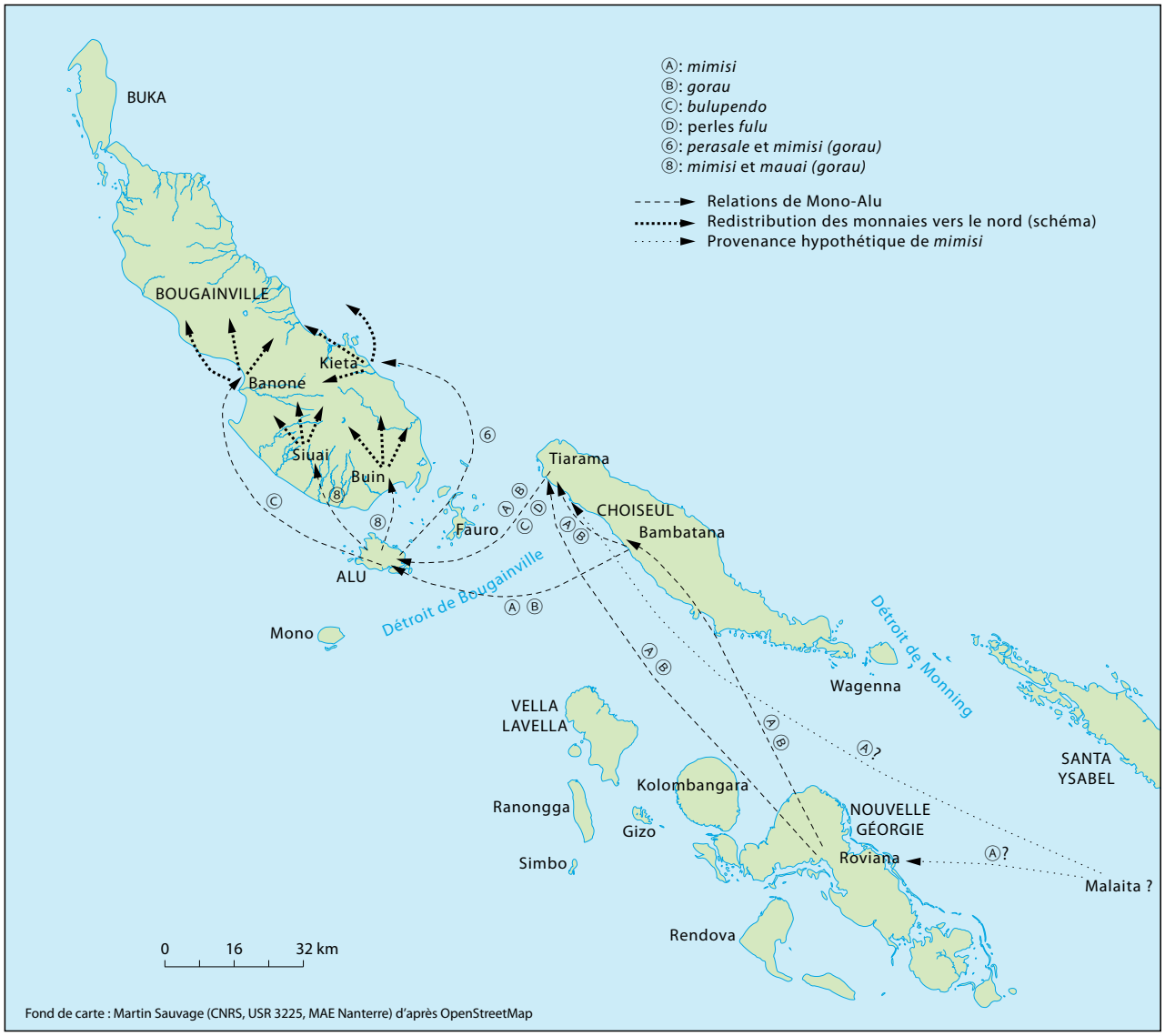


Fig. 7 – Map of the circulations of shell valuables in the north-western Solomons.
***Fig. 7** – Carte des circulations des monnaies de coquillages dans les îles Salomon du Nord-Ouest.*

managed to conquer Alu early in the early nineteenth century (Monnerie, 1996). Tiarama has a shell valuable called *bulupendo* which the Mono-Alu people consider to be highly valuable *(olatu)* and equivalent to their own highly valued *kasisi*. Tiarama is also a relay in the region-wide circulation of *mimisi*.

With Roviana on New Georgia there are indications that other forms of exchange of goods, shell valuables and violence prevail. With the Banone and Kieta on Bougainville, the relations differ again.

In conclusion, the relationships of the Mono-Alu with the Mono and Fauro, Buin and Siwai, Banone and Kieta, and Tiarama and Roviana all differ. Consequently, the network model which applies to the relationships between the Mono-Alu and the Buin/Siwai does not apply in the form described in figs. 2 to 6 above to these other regional relations. It is only useful as part of a wider, non homogenous network with a measure of continuity provided by the *fanua* relations of the matrilineal groups. Against this backdrop of continuity different types of distinctions, orientations and hierarchies are developed. They are especially clear in the types of violent interactions (oriented or reciprocal) and in the circulation of shell valuables of different values.

Between local societies (i.e. Mono-Alu and Buin/Siwai) and sets of local societies, these oriented or reciprocal interactions create 'boundary effects' (Monnerie, 1997) which delineate patches in this network. If we include all the societies mentioned, the overall model of the regional relations of Mono-Alu with southern Bougainville and northern Choiseul is made up of different patches forming a wider patchwork-like network.

Another Oceanian regional network, contrasting in several ways with the one just described, is that of Hoot ma Whaap in the far north of Kanaky/New Caledonia which I studied between 1992 and 2012. Its striking feature is not that it is heterogenous (or patchwork-like) but rather that it is homogenous.

HOOT MA WHAAP IN KANAKY/NEW CALEDONIA

Hoot ma Whaap has a long-standing regional network of relations covering the northern part of Grande Terre, which integrates the original local societies of its Kanak inhabitants.[4] It was observed by Western people soon after they settled, primarily because it had a strong and conspicuous component of violent interactions (Lambert, 1901; Guiart, 1966; Saussol, 1979; Rozier, 1990 and 1997). From among the twelve local societies which constitute Hoot ma Whaap, half are Hoot (universally considered to be the longest established); the other half are Whaap (considered to have settled at a later date). In the late nineteenth and early twentieth centuries, the tendency for the Hoot and the Whaap, during the violent interactions, was to build mutual alliances and to wage war against each other. These relations were instrumentalized by the French (i.e. the Roman Catholic missionaries and the colonial armed forces) in order to strengthen their control over the country and its people. Unfortunately, the descriptions of these past violent interactions are not detailed and they are far from being as precise and excellent as those we owe to Gerald Wheeler and which I have used in my analysis of the Mono-Alu and Buin/Siwai relations. Moreover, the European witnesses did not provide more detailed observations of all the other types of regional relations, including transfers and circulations, which also existed in the Hoot ma Whaap network at that time.

I have observed the contemporary peaceful forms of these relations and studied their oral history.[5] I noticed that there are many striking indications of homogeneity in the Hoot ma Whaap region. Firstly, there is homogeneity at the level of local society's configuration. Although ten different Austronesian languages are spoken in the area, the names of the Hoot and Whaap societies (fig. 8) all begin with *Teâ*, a word which implies valuation (it can also be a title, a name or a segment thereof). All these societies have high-ranking dignitaries who are called *teâ* (elder brother) and *mweau* (younger brother), *kaavo* (elder sister) and *hixe* (younger sister). If an enthronement ceremony is performed, a *teâ* becomes a *teâmâ*, ('supreme/collective elder brother') and becomes the high-ranking representative of his Great House. Several dyads used throughout the region express social configurations such as Hoot and Whaap, *teâ* and *mweau*, *kaavo* and *hixe* where the first element is anterior (i.e. arrival or birth) to the second one, and where valuation is closely associated with firstness. This dyadic idiom is combined with several others (verbal and non verbal) often expressing firstness; most prominent among them, the dynamic order of ceremonial precedence (Monnerie, 2001, 2003 and 2005).

I have focused my ethnographic study of these regional relations on the Whaap Teâ Aaoovaac Great House,[6] the local society commonly known as Arama. The Kanak words and concepts I will use are in *nyêlâyu*, the language of Arama, Belep *(Teâ Belep)* and Balade *(Teâ Puma)*. Several myths and other types of narratives allude to the Hoot ma Whaap region and relations. In Arama, one myth *(vajama)* describes the arrival from the sea of the ancestors of the contemporary Whaap inhabitants: before settling, they expelled the former Hoot towards the interior of the land. Another myth describes how this society (then called *Teâ Yhuen*) once received and enthroned a high status stranger to make him their new *teâmâ* by changing his name. This is a classic myth in northern Grande Terre, and it illustrates the fact that the *teâmâ* is himself part of a dyad, in the way in which he and his family relate to the previously established local high-ranking social groups who received him. Another narrative (which is not a myth) recounts the creation of the Hoot ma Whaap regional system of relations during a series of regional meetings predating the arrival of the Europeans.

However, this common regional idiom of social configuration is not only verbal. Many of the Hoot ma Whaap societies represent themselves as a Great House *(mweemwâ)*. The figure of the Great House is replicated in ceremonial performance, choreography, and architecture as well as in oratory or social concepts. Its well-known architectural form is that of a conical roofed round house topped by a finial with a single door flanked by two sculptures figuring the guardians of the door. Most important parts of the great house as architecture figure the groups and important dignitaries making up the social configuration.[7] They can have the same name and are ideally built by these groups in a prescribed order akin to the ceremonial order of precedence (Monnerie, 2010). This architectural form is not a specific Hoot ma Whaap feature; but is constructed all over Kanaky/New Caledonia—including the Loyalty Islands—where always materializing and displaying strong references to the local society.

One aspect of Hoot ma Whaap which contrasts with the north-western Solomons is the homogeneity of translocal relations. Most Great Houses are linked to each other by pathways *(daan)*. On these Pathways, Doors *(phwâmwâ)* separate and/or link the great houses; Gates *(phwâ xayot)* separate and/or link their different territories. Thus this particular regional network is conceptualized in local terms by Great Houses linked by Pathways and separated/linked by Doors and Gates (*phwâ, phwâ xayot*). This Kanak construction of a homogenous regional world with three main basic components—House, Pathway, Door—is strikingly similar in its form to the Western model known as a Petri network (Parrochia, 1993). These verbal and non-verbal concepts of regional relations prevail throughout Hoot ma Whaap alongside a shared ceremonial idiom.

Nowadays, the circulations involving Hoot ma Whaap are mostly ceremonial. The procedures involved are highly sophisticated. The largest regional ceremony is a highly-valued procedure of arrival and reception called *thiam* (Pidjo, 2003), which brings together delegations of several Great Houses who have been invited by one Great House for a ceremonial, cultural and/or political event. This canonical regional ceremony operates a dyadic structure, a Great House, receiving successively

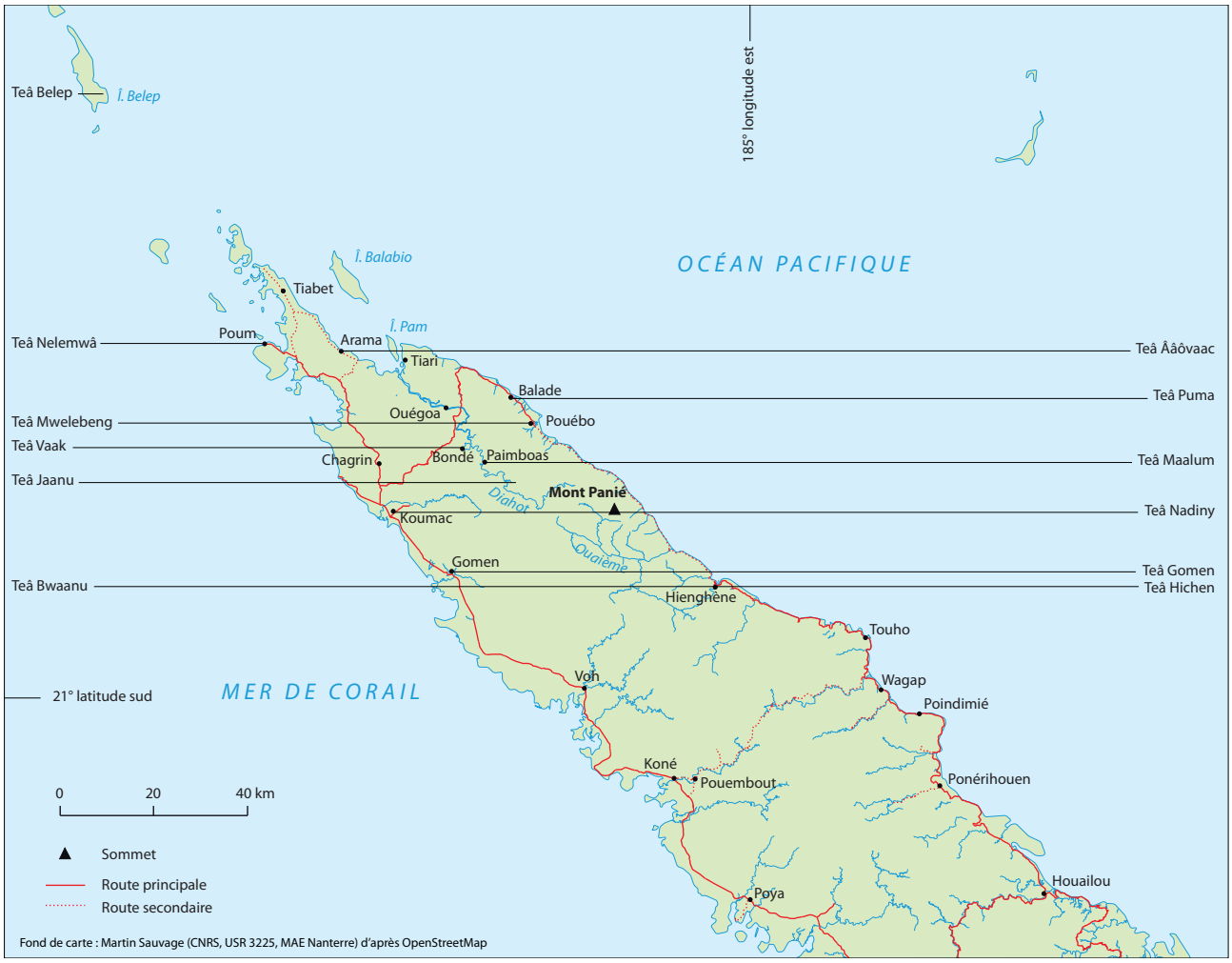


Fig. 8 – Map of northern New Caledonia: the Hoot ma Whaap region.
Fig. 8 – *Carte du Nord de la Nouvelle-Calédonie : région de Hoot ma Whaap.*

arriving delegations from other Great Houses who have ideally followed the ancestral pathways of relations to the inviting Great House.[8] The guests offer ceremonial goods and food to their hosts. The receiving and arriving delegations form two sides facing each other. Transfers and counter transfers of the same types of goods, synchronized with often beautiful and intense long poetic speeches expressing the relations between the two Great Houses, reinforcing the relations between the two ceremonial sides. This phase of reception and inclusion of the arriving side, by the receiving side, within a provisional ceremonial House *(mwâ)* is repeated with the arrival of each successive delegation. When the ceremonial event is over, usually after several days, a phase of separation reverses this process: the deconstitution of the ceremonial House. The guests then return to their original localities. Formerly *thiam* ceremonies were opportunities to ambush an incoming or receiving party, a warlike dimension that is still suggested in several aspects of contemporary ceremonies. If a ceremonial sequence is not performed in an adequate way, ancestral wrath expresses itself.

It is worth mentioning that this regional ceremonial form of *thiam* is similar in its dyadic form and basic principles of transfers and circulation to ceremonies of the cycle of life or local relations. There clearly is a regional Kanak ceremonial idiom strengthening social relations of many types, sometimes referred to in Kanak French as '*le système kanak*'. The goods that are transferred and that circulate during these ceremonies are: modern money, traditional Kanak valuables *(monnaies kanak)*, lengths of colourful cotton cloth (called *manous* in Kanak French), clothes (women's dresses, men's trousers and shirts), tobacco or cigarettes, matches, occasionally sculptures, and mats, etc. The foodstuffs are: yams, taro, rice, powdered sugar, bananas and plantains, sugar cane, many sorts of commercial foods (e.g. bread, flour, tea, coffee), turtles and dugong (specific for ceremonies involving high-ranking social entities of coastal societies), various types of meat (hunted or domestic animals), and not to forget the globalized frozen chicken. All these goods/foods are imbued with relational meanings and are regionally recognized as ceremonial when put into ceremonial circulation. The fact that they are tangible is central to their role in the construction of relationships. The composite character of relations is displayed by the variety of these ceremonial goods, as well as by the fact that they

are transferred with verbal prestations. (Monnerie, 2005; for details about the ceremonial goods used formerly see Monnerie, 2012).

The ceremonial micro-dynamics of *thiam* is that of the local Great House receiving delegations of other Great Houses and forming a temporary common social configuration. This community is designated as House, a central regional concept for localized groups, as exemplified in the Great House *(mweemwâ)*.[9] A *thiam* is therefore a valued relational event, limited in space and time, replicating concepts central to the mythology and long/short term oral history of the region as a whole. As a matter of fact, the Great Houses of the Hoot were established in the region prior to those of the Whaap and, local societies have been, and still are, involved in various dynamics of arrivals and departures of groups whether mythical, historical, ceremonial or through expulsions. These dynamics of arrivals and departures on different scales delineate fractal forms because they are repeated on various scales of space and time.

These are some of the verbal and non verbal expressions and conceptualizations by the people of this area—emic concepts in an endo-model—in a regional system whose homogeneity involves both its network and its fractal aspects. However, note that the network and fractal vocabulary and models I have used here to describe and analyse this system are static Western epistemological tools—etic concepts and exo-models—, accounting for social and cultural phenomena which are basically dynamic.

BEYOND THE DIFFERENCES AND CONTINUITIES

Beyond their differences, regional relations encompass past and active experiences of being locally anchored, going beyond this anchoring, and, returning to one's local anchoring or reacting to it in various ways. This involves dynamic relations with various forms and degrees of otherness that exist beyond the local, the familiar, the visible or the intimate. These relations are enhanced through the motions of persons and things and between the local and the translocal via pathways; either pragmatically well-trodden or navigated (as in the north-western Solomons) or highly conceptualized elements of social relations (as in the pathways of Hoot ma Whaap). All of these involve complex movements projecting, spreading and returning people, acts, things, meanings and ideas. Arguably, in Oceania, there is no conceptual fracture between relations and substances, such as those stressed by Western philosophy (Monnerie, in press). Oceanian social relations apply to all sorts of transferred and circulated things: components of persons, food, tangible substances, and objects—including valuables. Exchange has always been a major focus of research for anthropologists in Melanesia with initial explorations, covering Oceania and Eastern Indonesia (Monnerie, 2014), now feeding into new studies whose results are eagerly anticipated.

I have put forward the view that Oceania is made up of many interacting regional worlds where actions, words, ideas and different objects circulate and often merge into concepts which can be regionally shared, or still else differently interpreted, valued or prohibited. In other words, objects, which have been at the forefront of archaeological discoveries, play a role in creating, altering and maintaining relations and concepts both within local societies and in their translocal regional relations. This raises questions regarding the value and possible transferability of anthropological models to archaeology. But first of all, what can we learn from the comparison of the two regional networks I have described and analysed here?

The comparison of the north-western Solomon and the Hoot ma Whaap networks show interesting similarities and both have six main features: firstly, they are acephalous; secondly, their poles of circulation are mostly named local societies (villages in the Solomons, Great Houses in Hoot ma Whaap). Thirdly, their outlines are drawn by dynamics of circulation involving people, their actions, the objects, ideas and values they transfer. Fourthly, they involve regionally recognized objects and concepts. Fifthly, ancestors are deeply involved in these regional relations, and sixthly, the anthropological network models we use to describe them are static outlines describing recurring dynamic processes of transfers and circulation in space and time.

However, some of their differences are also well worth underlining. This study suggests the broad uses one can make of network models. Other well-known—and very different—regional relation systems, two examples of which are the Kula of the Massim archipelago, and the Sawei in Micronesia, can be analysed in terms of networks. Returning to the regions I have concentrated on, Hoot ma Whaap stands out in its well defined concepts of (Great) Houses, Doors, Pathways and dynamics of circulation: voluntary or forced, short-term or long-term arrivals or departures. These are parts of a dynamic endo-model of translocal relations which, when viewed through static anthropological exo-models, have network and fractal dimensions. With regard to the homogenous Hoot ma Whaap networks, the available ethnography provides no precise indication as to possible former orientations of violence. Here, the overall differential valuations are predicated on firstness, another form of orientation, which is relative (Monnerie, 2001 and 2003). Firstness is replicated at several levels of social acts and conceptualizations whose cores are, firstly, the elder/younger sibling relations, male and female; secondly, the succession of generations; and thirdly, the locally established *versus* the more recently arrived (or arriving) groups. In the latter which encompasses mythical, long-term or short-term historical and ceremonial space and time, we can clearly see how firstness is closely interwoven with the dynamics of arrivals and departures. This contributes to the region's social and cultural homogeneity, beyond its

linguistic fragmentation. In contrast, the north-western Solomon patchwork is largely an exo-model for repeated, consistently conceptualized (verbally and/or not verbally) acts of transfers and circulation. Here, the orientations of relations stand out, with two striking elements: differently valued shell valuables and different types of violent interactions. These orientations of relations create what I have called 'boundary effects' between local societies or sets of local societies.

Such boundary effects, which here delineate the patches of a regional network, can also appear between regions. Therefore, with regard to the homogenous Hoot ma Whaap network, the questions raised by the regional relation paradigm and network model concern relations with neighbouring regions to the south (Dui ma Bai on Grande Terre) and the east (the Loyalty Islands), especially those which concern the intensity of regional links or breaks between them. There are three striking facts about these links, which I will briefly mention: First, the possibility of performing regional *(thiam)* or cycle of life ceremonies between persons and groups from different regions. This is organised (i.e. in marriages and funerals) between Hoot ma Whaap and Lifou in the Loyalty Islands, and raises the strong hypothesis that the ceremonial idiom of Hoot ma Whaap is a regional variant of a wider pan-Kanak ceremonial idiom. Second, parallelisms in the principle of architectural representation of social configuration through the figure of the Great House (Monnerie, 2010). Third, the ceremonial uses of the same circulated objects, i.e. traditional Kanak valuables (*monnaies kanak*; Monnerie, 2012); but note that this can be coupled with differences in the way they are ceremonially handled in different regions of Kanaky/New Caledonia.

Therefore, the regional relation paradigm and network models seem, for the time being, well suited to study regional relations: they involve strong, clearly defined, verbal and non verbal concepts, circulating objects and recurrent links and circulations such as those observed in contemporary Hoot ma Whaap. They also enable the study of the orientations of relations as described for the north-western Solomons. Hypothetically, they should also help us describe and understand weak links (minimal and/or erratic circulations) and/or breaks (absence of circulation) between networks of regional relations or within them. In this way, various sorts of boundary effects can be defined. Finally, they enable analysis both at a given time in history and in the perspective of historical change and/or continuity.

Were the regional relations paradigm to be adopted for the whole of Oceania, the anthropological map would become much more adequate and precise, but also more complex than with the tripartite or bipartite paradigms. It would become comparable in overall complexity and debatability to the maps and schemas that are drawn up for the linguistic families and branches of Austronesian and non-Austronesian languages. However, in some features the maps drawn by anthropologists would differ from those drawn by linguists: Hoot ma Whaap has several different Austronesian languages, and in the north-western Solomons Austronesian and non-Austronesian languages are spoken. In this case the shapes of association discovered by linguists and anthropologists would be different, and only their complexity would be comparable. Regional relations often overlap language distinctions, and the various long-standing relations and influences between groups using non-Austronesian and Austronesian languages is now firmly established in Oceania and Indonesia.

ANTHROPOLOGY AND ARCHAEOLOGY

This text has developed anthropological approaches, within historical and field anthropology, in the context of a Pacific Archaeology conference. This raises the question of how all this concerns archaeologists? Of course, the fact that I have never practised archaeology puts me in a difficult position here, but a few remarks may be useful. Broadly, the complexity of social and cultural phenomena dealt with by anthropologists makes us, or should make us, very careful when we develop models for them. For instance, even though his approach was one of the many landmarks in the history and developments of social and cultural anthropology, gone is the time when Claude Lévi-Strauss could produce models of marriage dealing only with the reciprocal exchange of women (Lévi-Strauss, 1947). Graph models pose a similar problem: how far can we 'purify' the ethnography, leaving aside circulated items which are not deemed relevant to the theory put forward and is it legitimate to do so (Monnerie, 2014)? Anthropologists now grapple with circulations of women, men, components of persons, ideas, objects, and values in order to gain a finer understanding of the place of women, marriages, and the subtle points of exchange in various societies (Weiner, 1976 and 1992). My use of network tools in anthropology may differ from other uses, but the complexity it has underscored resonates with the complexity of social and cultural phenomenona. On a less general level, I wish to address three questions. Two of them relate to the way the regional relation and network paradigms can be applied to archaeology when it cannot be complemented by oral history and to archaeology and anthropology when they have access to oral history. The last one deals with Lapita.

First, how would the regional relation and network paradigms work, for instance in the north-western Solomons for periods not documented through oral history? Composite shell valuables are used throughout this region;[(10)] but to create these valuables the disks (and the broken small shells in *mauai*) are connected using strings which are perishable on the long term, whereas only the shell elements will be preserved. In the absence of relevant oral history, this would restrict and orient the interpretations of archaeologists concerning their finds. Therefore, the conclusions drawn from recovering such shell disks may indicate a regional object-related idiom of valuables made up of strung disks with the same or different sizes,

though this means taking into account the known form of the valuables used during historical periods. Recovering such disks may also show that some components of these valuables are more or less frequent depending upon the investigated area. Relations with the original shells and their origin places, localisation and depth of ecosystem,[11] will also provide information on the extent of circulations of such objects and of people in this part of Oceania. And of course, the discovery of workshops in which the disks were manufactured will inform on their fabrication. It seems to me that these different insights—that of the archaeologist, the historical anthropologist, and the field anthropologist—on shell valuables are complementary, addressing different horizons of knowledge and understanding of the social and cultural aspects.

Second, how do the regional relation and network paradigms work for periods documented through oral history? My own historical anthropological research in the north-western Solomons is based on some of the earliest modern ethnographic and linguistic fieldwork in Oceania at the turn of the 20th century. Throughout this text, I have stressed the importance of precise and reliable ethnographic and linguistic data, such as that provided by Gerald Wheeler. He wrote for instance, that after cremation the sequence in the funerals of nobles underwent a transformation from the immersion of the charred bone remains, to their inhumation in pots in specific places in Mono-Alu (Monnerie, 1996, p. 34–37, 100–102, and 208–16). Archaeologists who find such bone remains can date them and relate them to traces of funeral pyres. However, if they have no access to oral history, they may be tempted to draw strong conclusions about the actions that took place before internment, for instance, "there were no nobles before this period". Here, oral history, with its precise descriptions of funeral procedures and their transformations, gives us precious information. Anthropological history and archaeology have different exigencies and, above all, constraints. Their paths may cross, and often do so, when both are dealing with recent phenomena that involve oral history, such as the Roy Mata burial site in Vanuatu (Garanger, 1972 and 1996). Currently, archaeologists and anthropologists are collaborating in order to address the major local and regional reconfigurations resulting from the European-American colonisations in Oceania.

Finally, more speculatively, and more broadly, let me put forward a hypothesis from my own views of Lapita. The earliest Lapita was a forward movement of Austronesian speaking navigators into the Pacific who created the largest regional network ever to exist in Oceania. Some of its dynamics may have been vaguely similar to that of the Micronesian Sawei, but with a long term time span and, one wonders, towards which godhead? From my studies of the archaeological descriptions of the Late Lapita period, I am tempted to hypothesize the fragmentation of this original regional network and its transfers and circulations. The practice of horticulture (Noury and Galipaud, 2011, p. 97; Valentin et al., 2014) coupled with long-term residence seem to be a good candidate for this transformation. With the Late Lapita period being a time of transformation into a series of adjacent networks whose scope, type and intensity of relations remain to be established. The regional and boundary effect paradigms may help to resolve some of the many questions surrounding these transformations during the Late Lapita configurations.

CONCLUSION: BEYOND STATIC MODELS

How can we appreciate the future of networks as tools to gain a better understanding of Oceania, both locally, regionally and as a whole? In this text, I have put forward networks as my central tool for the regional relation paradigm. Together, networks and the regional relation paradigm present a much more complex view of actual social and cultural relations and their dynamics than the models developed on the basis of the tripartite paradigm such as 'Big Men' (Sahlins, 1963) or 'Great Men' (Godelier, 1982). They also provide a more relevant view, in that it does not focus merely on the 'leaders' of Oceanian societies, but emphasize the interactions between local configurations, something which I hope to have made clear at the crucial level of local and regional interactions. Within their scope, network models account for dynamics, and are a key element of anthropological understanding, in a regional relation paradigm which focuses on transfers and circulations, at local and translocal, or regional, levels.

I have also suggested some of the limitations of the network models, specifically that they are static, a feature shared by several other anthropological tools. This will lead anthropology into epistemological questions dealing with spatio-temporal dynamics of transfers and circulations and eventually, more generally, to a better assessment of the problems we have with the static models we currently use for representing the dynamics of social and cultural phenomena. Network models, however, can accommodate complex ethnographies and, when provided with precisely enough ethnographic data (verbal and non verbal), they give us important feedback about the interweaving of local and regional relations. They also help us delineating neighbouring regions through various forms of contrast. These delineations are not easy to pin down for often contrasts are tinged with elements of continuity and overlapping. Ironically, the same sort of problem occurred here, which I have underlined in my critique of the bipartite paradigm in which the north-western Solomons (Near Oceania) and Kanaky/New Caledonia (Remote Oceania) are separated despite striking similarities in their preoccupation with ranking social and cultural entities[12]. This is also the sort of problems we have always had with the tripartite paradigm of Polynesia, Micronesia and Melanesia at their 'margins'. They can be explained away through migrations only in a few well documented cases such as Tikopia on the Solomons or Ouvea on the Loyalty Islands. But are these difficulties

finding clear cut delineations between entities been perennial ones in anthropology at large? I believe this tells us as much, or more, about Western scientific ideology than about the anthropological domains we are tackling. In anthropology, 'fuzzy' often seems to prevail, such as in boundary effects; again, maybe because we have yet to reach the stage of building adequate dynamic models to deal with social and cultural phenomena.

NOTES

(1) Thanks to Sophie Chave-Dartoen and the anonymous reviewers for their suggestions on this text.

(2) Except for *mauai*, the lowest shell valuable and only used by the Mono-Alu people for transfers with Buin and Siwai. Shell valuables are shells worked into small pierced disks and then strung on durable string. Again, with the exceptions of *mauai*, these valuables are composites made up of two, or more, different types of shells, and sometimes other vegetal elements. For more information on this complex system, including full identification and the Latin names of some of the shells used, see Monnerie 1996 and 2002.

(3) I consider it highly likely that the victims of raids do not become ancestors in Buin. If this hypothesis is right, it means that while the raids increase Mono-Alu noble ancestry, they simultaneously deplete potential Buin ancestry. However this is not explicitly stated in the ethnography. We currently have no information the post mortem treatment of Buin victims or their successful/unsuccessful transformation into socially valued ancestors.

(4) They have used the name Kanak to refer to themselves since the independence movement in the 1980's.

(5) I use this expression to refer to a wide array of narratives relating to the past.

(6) I use capitals for Kanak concepts of social configurations in their abstract meaning which is, however, always closely linked to a non verbal, concrete/tangible existence, for which I use lower case. Therefore, the great house is a building, but the Great House we can translate as 'local society' (Monnerie, 2010).

(7) For instance, the *teâmâ* is both its finial and its main pillar which is planted in a hole in the ground which is the group having received it.

(8) When a modern road has been used—which is almost always the case today—the orator of the arriving delegation, in his speeches, is expected to recite the stages of the ancestral Pathway (Monnerie, 2005).

(9) 'House' and 'canoe', are widespread concepts for localized groups in Austronesian speaking people throughout Oceania and Indonesia.

(10) The use of shell rings is also described, one type is used amongst the Mono-Alu, called *gorau*, which sometimes replaces *mimisi* (Monnerie, 1996 ; here : fig. 7). This complicates the regional picture further, as the ethnography is sketchy, except for Simbo/Eddystone, which was described by the great A. M. Hocart in 1908–1909 and analyzed by Cécile Barraud (Barraud, 1972).

(11) For instance, the red *kasisi* shells that make up a large part of the highly valued *kasisi* valuables and that are only used amongst the Mono-Alu, were acquired at great depths and were generally accompanied by chiefly ceremonies. The first feature can be deduced by archaeology, the second only with the help of oral history (Monnerie, 1996 and 2002).

(12) In Marshall Sahlins's classic 1963 model, these are features of the (ideal) 'Polynesian' types of political leaders and systems in the tripartite paradigm.

BIBLIOGRAPHICAL REFERENCES

Barraud C. (1972) – De la chasse aux têtes à la pêche à la bonite : essai sur la chefferie à Eddystone, *L'Homme*, 12, 1, p. 67–104.

D'arcy P. (2006) – *The People of the Sea: Environment, Identity and History in Oceania*, Honolulu, University of Hawai'i Press, 312 p.

Dumont L. (1978) – La communauté anthropologique et l'idéologie, *L'Homme*, 18, 3–4, p. 83–110.

Dumont L. (1983) – *Essais sur l'individualisme : une perspective anthropologique sur l'idéologie moderne*, Paris, Seuil, 310 p.

Garanger J. (1972) – *Archéologie des Nouvelles-Hébrides, contribution à la connaissance des îles du Centre*, Paris, musée de l'Homme (Publications de la Société des océanistes, 30), 156 p.

Garanger J. (1996) – *Tongoa, Mangaasi et Eretoka : histoires d'une Préhistoire, in Vanuatu. Océanie* : *arts des îles de cendre et de corail, une exposition au musée national des Arts d'Afrique et d'Océanie*, Paris, Réunion des musées nationaux (Grands thèmes), p. 68–75.

Godelier M. (1982) – *La production des Grands Hommes* : *pouvoir et domination masculine chez les Baruya de Nouvelle-Guinée*, Paris, Fayard (L'espace du politique), 370 p.

Guiart J. (1966) – *Mythologie du masque en Nouvelle-alédonie*, Paris, Société des océanistes (Publications de la Société des océanistes, 18), 150 p.

Lambert P. (1900) – *Mœurs et superstitions des Néo-calédoniens*, Nouméa, Nouvelle imprimerie nouméenne, 359 p.

Lévi-Strauss C. (1949) – *Les structures élémentaires de la parenté*, Paris, Presses universitaires de France (Bibliothèque de philosophie contemporaine), 639 p.

Monnerie D. (1996) – *Nitu, les vivants, les morts et le cosmos selon la société de Mono-Alu (îles Salomon)*, Leiden, Center for Non-Western Studies (CNWS Publications), 446 p.

Monnerie D. (1997) – Identités sociales et relations régionales en Océanie (Îles Salomon du Nord-Ouest), in J. Bonnemaison, L. Cambrézy and L. Quinty-Bourgeois (eds.), *Le territoire, lien ou frontière* ? *Identités, conflits ethniques, enjeux et recompositions territoriales*, Paris, ORSTOM (Colloques et séminaires), p. 739–51.

Monnerie D. (1998) – Oceanian Comparison Reconsidered: The Mono-Alu Problem, *Social Anthropology*, 6, 1, p. 91–108.

Monnerie D. (2001) – Représentations de la société, statuts et temporalités à Arama (Nouvelle-Calédonie), *L'Homme*, 157, p. 59–85.

Monnerie D. (2002) – Monnaies de Mono-Alu (îles Salomon) : valorisations, discontinuités et continuités dans les objets et les relations sociales en Mélanésie, *L'Homme*, 162, p. 59–85.

Monnerie D. (2003) – Social Organisation and the Naming System. A New Caledonian Case: Arama, *Zeitschrift für Ethnologie*, 128, 2, p. 249–68.

Monnerie D. (2005) – *La parole de notre maison* : *discours et cérémonies kanak aujourd'hui (Nouvelle-Calédonie)*, Paris, CNRS and Maison des sciences de l'homme (Chemins de l'ethnologie), 286 p.

Monnerie D. (2010) – Symboles et figures, deux modes sociaux de signification. L'exemple de la Grande Maison d'Arama (Nouvelle-Calédonie), *Journal de la Société des océanistes*, 130, 1, p. 147–63.

Monnerie D. (2011) – Quels changements de paradigmes pour les études océanistes ? À propos du livre de Paul D'Arcy, 'The People of the Sea. Environment, Identity and History in Oceania', *Journal de la Société des océanistes*, 133, p. 379–89.

Monnerie D. (2012) – Objets cérémoniels, chaînes opératoires et élaboration des relations sociales (Arama et Hoot ma Whaap, Kanaky Nouvelle-Calédonie, Mélanésie), in S. Revolon, P. Lemonnier and M. Bailly (eds.), *Objets irremplaçables*, Paris, Maison des sciences de l'homme (Techniques et culture, 58), p. 122–41.

Monnerie D. (2014) – Les échanges en Océanie et l'anthropologie, in L. Dousset, B. Glowcewski and M. Salaün (eds.), *Les sciences humaines et sociales dans le Pacifique sud : terrains, questions et méthodes*, Marseille, Pacific-Credo Publications (Cahiers du Credo), p. 127–59.

Monnerie D. (2016) – Relations et substances : l'anthropologie et les enseignements des cérémonies kanak (Nord de la Grande Terre, Kanaky Nouvelle-Calédonie), in C. Barraud, A. Iteanu and I. Moya (eds.), *Puissance et impuissance de la valeur. L'anthropologie comparative de Louis Dumont*, Paris, CNRS éditions, p. 235–60.

Noury A., Galipaud J.-C. (2011) – *Les Lapita, nomades du Pacifique*, Marseille, IRD, 128 p.

Parrochia D. (1993) – *Philosophie des réseaux*, Paris, Presses universitaires de France (La politique éclatée), 300 p.

Pidjo J.-M. (2003) – *Le* mwa teâma *mwalebeng et le fils du soleil :organisation de l'espace foncier kanak en pays mwalebeng*, Nouméa, Le-Rocher-à-la-voile and Éditions du Cagou (Essais pour servir l'intelligence de notre temps, 2), 207 p.

Robbins J. (1994) – Equality as a Value: Ideology in Dumont, Melanesia and the West, *Social Analysis*, 36, p. 21–70.

Rozier C. (1990) – *La Nouvelle-Calédonie ancienne*, Paris, Fayard and Le Sarment (Des chrétiens), 322 p.

Rozier C. (1997) – *L'Église sur le Caillou avant les communards*, Nouméa, Éditions Île de Lumière, 424 p.

Sahlins M. (1963) – Poor Man, Rich Man, Big Man, Chief: Political Types in Melanesia and Polynesia, *Comparative Studies in Society and History*, 5, 3, p. 285–303.

Saussol A. (1979) – *L'héritage : essai sur le problème foncier mélanésien en Nouvelle-Calédonie*, Paris, musée de l'Homme (Publications de la Société des océanistes, 40). 493 p.

Valentin F., Herrscher E., Bedford S., Spriggs M., Buckley H. R. (2014) – Evidence for Social and Cultural Change in Central Vanuatu between 3000 and 2000 BP: Comparing Funerary and Dietary Patterns of the First and Later Generations at Teouma, Efate, *Journal of Island and Coastal Archaeology*, 9, p. 381–99.

Weiner A. B. (1976) – *Women of Value, Men of Renown: New Perspectives on Trobriand Exchange*, Austin, University of Texas Press, 299 p.

Weiner A. B. (1992) – *Inalienable Possessions: the Paradox of Keeping while Giving*, Oakland, University of California Press, 264 p.

Wheeler G. C. (1926) – M*ono-Alu Folklore (Bougainville Strait, Western Solomon Islands)*, London, Georges Routledge & Sons, 396 p.

Denis Monnerie
UMR 7367, laboratoire DynamE,
institut d'ethnologie,
université de Strasbourg
monnerie@unistra.fr

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 189-202
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Ancestors for the Present ?

Exploring Later Prehistory on New Britain, Papua New Guinea

Jim Specht

Abstract: The cultural diversity of the western Pacific islands is well known, but surprisingly little archaeological attention has been directed to its history and causes. New Britain in Papua New Guinea is no exception. New Britain is the largest island to the east of New Guinea and is home to over thirty ethnolinguistic groups. Its prehistory after Lapita pottery up to the time of European colonial settlement in the late 19th century is an under-researched period, and the paper offers a review of the limited data for the last 2,000 or so years. There are several issues confronting researchers of this period regarding the units of study and the use of historical and ethnographic records. Surveys of the post-Lapita period have suggested that the cultural diversity encountered by Europeans in the 19th century was the end product of processes that began with the demise of Lapita pottery about 2,500–2,000 years ago. The paper examines the archaeological record of four areas for continuities and discontinuities in conjunction with records of volcanic events and oral history. The picture that emerges is probably a gradualist development for the south coast, but punctuated and discontinuous around the north coast volcanic centres and in the Passismanua area in the centre of the island. The current evidence offers no obvious insights into the emergence of the cultural diversity of the region encountered in the 19th century.

Keywords: Papua New Guinea, New Britain, cultural diversity, archaeology, Lapita, post-Lapita.

Des ancêtres pour le présent ? La fin de la Préhistoire sur l'île de la Nouvelle-Bretagne, Papouasie-Nouvelle-Guinée

Résumé : La diversité culturelle du Pacifique insulaire occidental est bien documentée mais, étonnamment, peu de travaux archéologiques ont été consacrés à l'histoire et aux causes de ce phénomène. La Papouasie Nouvelle-Guinée et la Nouvelle-Bretagne n'y font pas exception. La Nouvelle-Bretagne est l'île la plus vaste à l'est de la Nouvelle-Guinée et abrite trente groupes ethnolinguistiques. Sa Préhistoire, de la fin de la production des poteries Lapita jusqu'au contact européen, constitue une période sous étudiée, et c'est pourquoi cet article propose un examen des données disponibles pour les deux derniers millénaires. L'étude de la période post-Lapita semble montrer que la diversité culturelle rencontrée par les Européens au xixe siècle est l'aboutissement d'un processus qui a débuté après l'arrêt de la production de la poterie Lapita, il y a 2 500-2 000 ans. Des indices de continuité ou discontinuité culturelle ont été recherchés parmi les données archéologiques disponibles pour quatre régions de l'île, et mis en relation avec les données sur les évènements volcaniques et l'histoire orale. La vue d'ensemble qui en ressort est celle d'un développement graduel sur la côte sud de l'île et d'un développement discontinue dans les centres volcaniques de la côte nord et la région de Passismanua au centre de l'île. Les connaissances actuelles sont en définitive insuffisantes pour discuter de l'émergence de cette diversité culturelle rencontrée dans la région au xixe siècle.

Mots-clés : Papouasie Nouvelle-Guinée, diversité culturelle, archéologie, Lapita, Post-Lapita.

The cultural diversity of the Western Pacific islands is well known, but surprisingly little archaeological attention has been directed to its history and causes. Much of the diversity reflects the hundreds of languages spoken throughout the region, which contrast with the situation in island groups further east where single languages prevail (Pawley, 1981), though there are marked differences in human phenotypes, material culture and social practices throughout the western islands. Archaeological reviews of the region by Matthew Spriggs (Spriggs, 1997, chapter 6) and Patrick Kirch (Kirch, 2000, p. 117–64) have identified the period following the end of the dentate-stamped phase of Lapita pottery (c. 2750 cal. BP) as the likely time when this

diversity started to develop, with M. Spriggs discussing at length the possible processes that led to the break-up of the Lapita cultural complex and the rise of diversity (see Garling, 2007). Central to this view of diversity emerging in the post-Lapita period are two premises. The first is that the sites yielding Lapita pottery belonged to related communities within a dialect chain of early Oceanic Austronesian languages who were in communication with each other and shared many aspects of culture. The second premise sees the end of the dentate-stamped phase of pottery decoration as marking the severing of ties between these communities and their gradual divergence from the common cultural complex, as expressed through both languages and material culture. These premises, however, deny the possibility that cultural diversity was already a feature of the New Guinea Islands' communities before the appearance of Lapita pottery, and omits from consideration those groups that were contemporary with Lapita pottery but did not use pottery or adopt its production, such as those in the interior of New Britain (Pavlides, 2006) and on north Guadalcanal in Solomon Islands (Roe, 2000). There is also the significant issue of defining which aspects of cultural diversity may be amenable to archaeological investigation or, to reverse the question, which aspects of the archaeological record can be interpreted as the products of cultural diversity. This paper looks at these issues through a review of the archaeological record for the island of New Britain in Papua New Guinea (fig. 1) to see what we might learn about the rise of the cultural diversity encountered by Europeans from the seventeenth century onwards.

NEW BRITAIN: THE CONTEXT

At about 36,000 km^2 in area, New Britain is the largest island east of New Guinea in the equatorial tropics, comparable in size to Taiwan. The three main mountain ranges (Baining, Nakanai and Whiteman) consist primarily of limestone with intrusive volcanic formations in the Whiteman Range, and create a 'spine' that separates volcanic land forms in the north from uplifted marine formations on the south side (fig. 1). Large areas of karst in the three ranges are uninhabited, and most of the population is located on the coasts. There are thirty-seven Austronesian and Papuan languages spoken on the island (Ross, 1996, p. ix), though up to fifty languages or dialects have also been proposed (Lewis et al., 2014; Papua New Guinea map 12).

The main thrust of archaeological research on New Britain over the last fifty years has addressed a limited range of topics, primarily the colonisation of the island in the Late Pleistocene, sites with Lapita pottery, the obsidian industries of Willaumez peninsula in the Early-Middle Holocene, and the management of risk in this tectonically unstable region. The period following Lapita pottery through to the 17th century, on the other hand, has

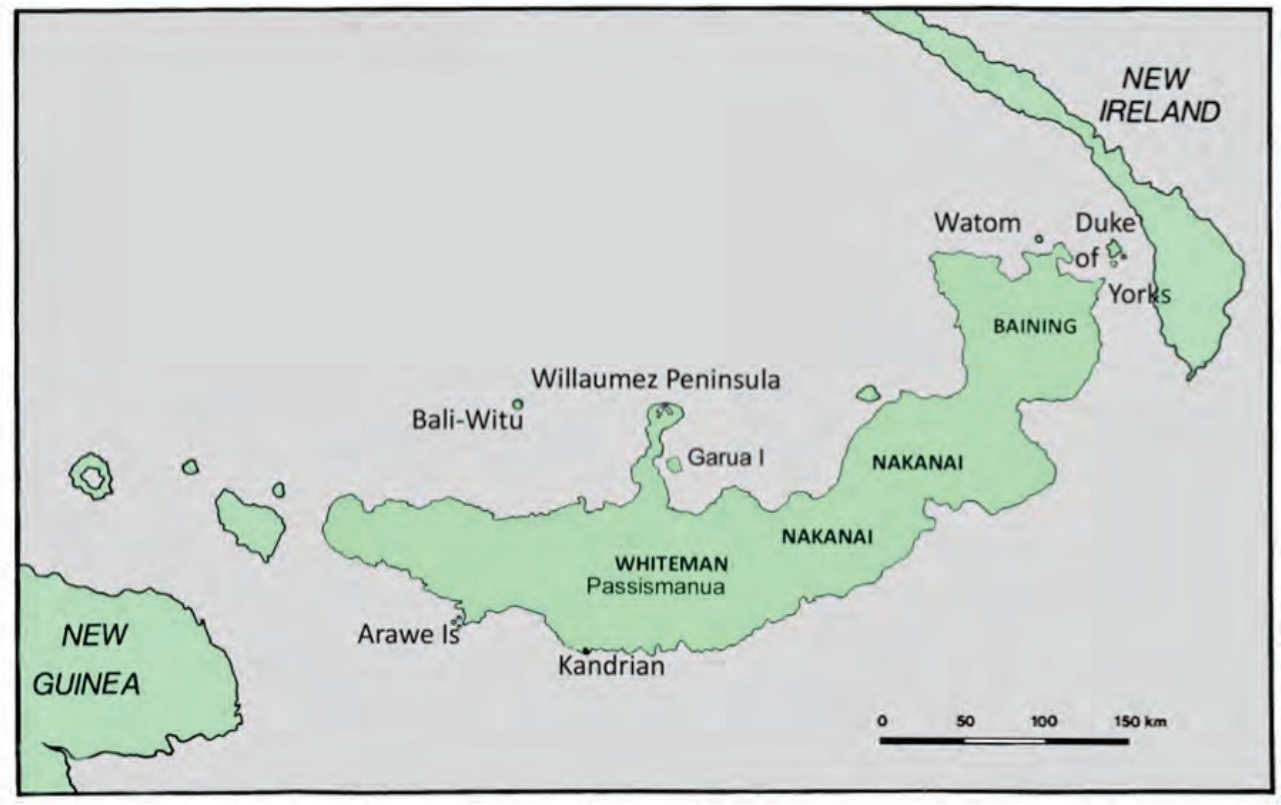


Fig. 1 – Map of New Britain showing the locations of the four case-study areas.
Fig. 1 *– Carte de la Nouvelle-Bretagne avec la localisation des quatre zones étudiées.*

received less attention. This contrasts with extensive research further east in the Pacific islands, where the recent past is often prominently visible in the landscape as significant stone and earthen monuments that have been extensively studied (Kirch, 2000). Few comparable monuments have been reported on New Britain, and only two have been investigated: a field system in the Kove area of northern New Britain (Swadling, 1991), and complexes of stone arrangements and rock art on Uneapa Island, northwest of Willaumez peninsula (Riebe, 1967; Byrne, 2005, 2008 and 2013). With these exceptions, there have been no field projects specifically addressing the last 2,000-2,500 years comparable to those conducted in Solomon Islands (e.g., Sheppard et al., 2000 and 2004; Thomas, 2009; Blake and Gibbs, 2013), and the Tanga Islands of New Ireland (Garling, 2003 and 2007).

ON THE LIMITATIONS OF ARCHAEOLOGY

The human settlement of Polynesia has a short time depth that makes the region an ideal context for an 'historical anthropology' that combines evidence from linguistics, archaeology, human biology and anthropology, and this approach has become a major methodological framework for interpreting the region's archaeological record (e.g., Green, 1997; Kirch, 2010; Kirch and Green, 2001). The success of this strategy has been largely due to what P. Kirch calls the 'phyletic unity' of Polynesia, compared with the 'multi-phyletic' situation in Melanesia (Kirch, 2000, p. 211). The Polynesian islands that are P. Kirch's main focus are inhabited by single ethnolinguistic groups, and in many cases have rich descriptions of cultural practices from the time of initial European intrusion into those islands. In contrast, the islands of the Western Pacific have multiple ethnolinguistic groups, many islands have much greater time depth of settlement than those of Polynesia, and there are comparatively few accounts of their societies dating to the initial and early stages of European intrusion; indeed, for many, none exists even today. While acknowledging the cultural complexity of the Melanesian islands, of which New Britain is a part, P. Kirch (Kirch, 2000, p. 307) nevertheless supports the application of historical anthropology in the region (Kirch, 2000, p. 345, footnote 10).

Languages play a major role in the perception of cultural diversity in the Western Pacific islands. Languages, however, do not constitute meaningful units for archaeological analysis, nor do the ethnolinguistic groups known in the literature as the 'Tolai', the 'Bakovi', the 'Baining', and so on. To use these units as a framework for investigating prehistory of New Britain over the last 2,500–2,000 years would require tracking the ancestors of these people through distinctive and unique markers for each group that are likely to survive in the archaeological record. In rare instances this may be feasible, particularly in the latest stages of pre-contact history, but is highly unlikely the further back in time that we explore.

Since language and ethnolinguistic boundaries do not necessarily mark exclusive distributions of material culture, what should be the unit of analysis? On the south side of New Britain, communities from Gasmata to the Arawe Islands speak different but related languages and share several artefact categories in common. These communities, known among themselves and by others as 'Arawe' (Chowning, 1978, p. 296), extend for about 200 km along the coast, and inland to varying distances. While this grouping could be treated as comparable to P. Kirch's phyletic units, table 1 shows that many of the features that people use to identify the 'Arawe' are either not unique to this group or do not have a recognisable archaeological expression under normal survival conditions. Of the categories likely to be recovered archaeologically, several are not exclusive to the 'Arawe' area. Stone bark cloth beaters are also used in the Kilenge area at the western tip of New Britain (Adrian Gerbrands, personal communication, 1967). Waisted and lugged ground stone axe heads are said by present-day people to have been imported from unnamed places on the north side of the island, where identical forms are widespread. Similarly, male adornments of paired, full-circle boars' tusks may have been produced on New Britain, but it is not clear whether their production was exclusive to the 'Arawe' (cf. Harding, 1967; Beran, 2014). Other items that could have an archaeological presence are the stone discs and rings with a central perforation that the 'Arawe' identify as *mokmok* or *singa* stones, items of power and status worn in ceremonial regalia by senior men or used in sorcery (Gosden and Knowles, 2001, p. 28; Knowles and Gosden, 2002, fig. 4). They occur in two forms: the first is a rounded stone with a perforation of irregular form that is said to be of natural origin; the second is clearly of human manufacture and is similar to club-heads of mainland New Guinea, though people in the 'Arawe' area deny that their ancestors used stone-headed clubs (Specht, 2005). The first form seems restricted to their area, but the second form is found widely throughout western New Britain. Neither has been recovered from dated archaeological contexts, probably because, together with shell valuables, they are curated over many generations.

The 'Arawe' case leads us to the problem of defining the nature of New Britain's societies just prior to or at contact. Detailed ethnographic, linguistic and historical studies are lacking for many parts of the island and those available present pictures that reflect decades of interaction with European and others, and are unreliable guides to the situation prior to European incursion into the Pacific Islands (cf. Spriggs, 2008). The New Guinea islands' region, of which New Britain is a part, experienced various forms of contact with European visitors from AD 1700 onwards, but particularly during the 19th century with regular visits by whalers, who engaged in trade with local people and introduced exotic goods into the material culture repertoire (Gray, 1999). As early as the 1820s, people produced artefacts for sale to these

visitors (Specht, 2000, p. 26). Towards the end of the century trading stations and Christian missions were established, and Germany assumed colonial control of the region. Both the missions and the German administration actively sought to change cultural practices and lifestyles on the island (e.g., Brown, 1908; Salisbury, 1970; Firth, 1982). Some communities became involved in the labour trade to work on plantations in Samoa and elsewhere, leading to the removal of men for several years and in some cases permanently (Panoff, 1979; Meleisea, 1980). How these removals and other actions of the European intruders impacted upon the indigenous societies is not known. The first accounts of the societies after such impacts were recorded decades later and should be treated with caution as potentially misleading.

Few studies of particular communities by anthropologists and amateurs cover aspects of material culture in a manner that would facilitate their recognition in the archaeological record. The most comprehensive early description of New Britain societies is a broad-scale review with extensive spatial gaps in its coverage (Parkinson, 1907 and 1999). Two of the few volumes specifically about New Britain focus on art forms drawing extensively on museum and private collections of artefacts (Heermann, 2002 and 2013). These collections are often of limited assistance. Many were made during the German colonial era (e.g., Welsch, 1998; Specht, 2000; Buschmann, 2009), long after the arrival of European traders and settlers and carry little information about the peoples' histories before that time. Furthermore, they were a biased representation of material culture at the time of their acquisition, few are well provenanced and most are of organic materials that are unlikely to leave a recognisable archaeological expression.

APPROACH AND FOUR CASE STUDIES

In light of the above critique an alternative approach is needed, one that is not tied specifically to tracing the ancestry of contemporary ethnolinguistic groups that constitute the perceived cultural diversity of the island and its region. The approach adopted here is to examine the archaeological record of New Britain to determine whether we can reasonably infer continuities and discontinuities reflecting cultural persistence or the emergence of diversity. Within this approach there is an added complication for many parts of the island of natural extreme events, particularly volcanic eruptions that have caused local or more widespread disruption or destruction of settlements. These extreme events must be factored into interpretations of the archaeological record in relevant areas (Torrence et al., 2000; Torrence and Doelman, 2007). In this approach the past is treated as a sequence of stable times and extreme events mediated by cultural responses.

Stephen Shennan (Shennan, 2013) has pursued a similar strategy with regard to the occupation and abandonment of European Neolithic settlements in the context of demographic expansion and contraction relative to carrying capacity, drawing on precise and reliable dating, well established local and regional sequences together with palaeo-genetic data. His proposed approach rejects a gradualist model in favour of what he terms an 'autonomy model' within which 'boom and bust' patterns are explored on a time-scale of centuries. This approach has relevance to the New Britain situation but on a smaller scale. There are also differences between Stephen Shennan's case study and New Britain, which currently has

Material culture category	Main area of distribution	Archaeological survival
Blow-pipe and darts for hunting	Gasmata to Arawe Islands	No
3-piece wooden shields	Gasmata to Arawe Islands	No
Bark cloth waist bands with painted vine leaf designs	Gasmata to Arawe Islands	No
Vine-strand looped bags	Gasmata to Arawe Islands	No
Twisted cane axe handles	Western half of island?	No
Stone club heads - discoid	New Britain generally?	Yes – but not diagnostic
Lugged/waisted ground stone axe blades	West of line from Hoskins Peninsula to Gasmata?	Yes –not diagnostic; imported, traded widely
Pairs of full-circle boars' tusks as male adornment	Gasmata to western tip of the island beyond 'Arawe'	Yes –singly or in pairs, only locally diagnostic
Stone bark cloth beaters	Western part of island?	Yes – but not diagnostic?
Gold-lip pearl shell valuables	Gasmata to Arawe Islands	Yes - diagnostic
Stone rings – mokmok/singa	Gasmata to Arawe Islands	Yes - diagnostic
Head-binding of infants	Gasmata to Arawe Islands	Yes - diagnostic

Table 1 – Selected artefact categories that characterise the 'Arawe' area on the south coast of New Britain, their likely chances of surviving in the archaeological record as diagnostic for identifying an 'Arawe' group.
***Tabl. 1** – Catégories d'artefacts sélectionnées caractéristiques de la zone « Arawe » sur la côte sud de l'île de la Nouvelle-Bretagne et leurs probabilités d'être préservées en tant qu'indicateurs typologiques dans les archives archéologiques pour identifier un groupe « Arawe ».*

limited well-dated and detailed artefact sequences for many areas, and palaeo-genetic data are lacking.(1) The 'boom and bust' phases of the European context that Stephen Shennan considers to reflect issues of carrying capacity can be replaced by the repeated impacts of sudden-onset, extreme natural events (volcanic eruptions) that had serious implications for communities in terms of the viability of their settlements (the 'bust' element). Periods between such events (the 'boom' aspect) allowed reoccupation of the landscape after sufficient recovery to sustain the human populations (cf. Torrence and Doelman, 2007; Torrence, 2014). Rather than restrict coverage here to the period following Lapita pottery (as defined by the end of the distinctive dentate-stamped decoration: c. 2750 cal. BP) or of pottery production in general on New Britain (arguably c. 2000 cal. BP), the paper extends its scope to earlier times where information is available. It focuses on four of the better documented areas of New Britain, as follows:

– Watom Island at the eastern end of the island;

– Willaumez and Hoskins peninsulas on the central north side of New Britain;

– The Passismanua interior region between Kandrian and Willaumez peninsula, on the southern fall of the Whiteman Range;(2)

– The south coast from Kandrian to the Arawe Islands.

Selection of these four areas does not deny the significance of work conducted elsewhere, especially in the Duke of York Islands (White, 2007), Kove Islands (Lilley, 1991) and the Bali-Witu Islands (Byrne, 2013) and reference will be made to them where relevant.

The four study areas divide broadly between the north coast with a string of Quaternary volcanoes (areas 1 and 2), and limestone formations of marine origin in the centre of the island (the Whiteman Range; area 3) and along the south coast (area 4; Davies, 1973; Ryburn, 1974, 1975, and 1976). More is known of the volcanic history of the Rabaul and Willaumez peninsula – Hoskins areas (Lowder and Carmichael, 1970; Nairn et al., 1995; Machida et al., 1996; McKee et al., 2011) than about the history of the limestone areas, particularly their uplift history, which is restricted to one study on the south coast at Palmalmal (Riker-Coleman et al., 2006). Palaeo-environmental data are limited to three studies associated with archaeological sites (Lentfer and Green, 2004; Lentfer and Torrence, 2007; Lentfer et al., 2010), and one pollen study (Jago and Boyd, 2005) that does not extend back beyond the Late Holocene.

Case study 1: Watom Island

The oldest evidence for human presence in this area at the eastern end of New Britain is c. 3000–3200 cal. BP at Lapita pottery sites in the Duke of York Islands and on Watom Island (Anson et al., 2005; White, 2007). The lack of research on earlier periods reflects the enormous depths of tephra from the Rabaul volcanoes that locally blanket the area and conceal older land surfaces. These deposits derive from a series of eruptions that culminated in the formation of the Rabaul caldera. Since human occupation of the New Guinea islands began around 40,000 years ago, there have been about forty eruptive phases from the Rabaul volcanic centres (Nairn et al., 1995, table 2), continuing through to the present day. The last major eruption prior to European occupation of the area was around 1300–1100 cal. BP, when airfall tephras and a massive pyroclastic flow (the Rabaul ignimbrite) devastated the landscape up to 50 km distant from the source volcano (Nairn et al., 1995, p. 257 and p. 269; Anson et al., 2005). Deposits from this eruption covered Watom to at least one metre depth. The Duke of York islands on the eastern side of the caldera may have escaped the impact of the pyroclastic flow, but also received substantial airfall deposits of tephra (White, 2007, p. 10).

The Rabaul Ignimbrite would have obliterated all animals, vegetation and humans living on Watom Island. Based on a radiocarbon date for a small hearth on the surface of reworked tephra at the Maravot (SAD) area of the Rakival-Reber site complex, Watom was re-occupied by 730–550 cal. BP by people who did not make or use pottery (Specht, 1968, p. 124, sample ANU-72; see Anson et al., 2005, p. 34). The identity of this population is not known.

There is currently no evidence for human activity on Watom after this date until a group of twelve burials in the Vunaburigai (SAB) area of Rakival village. These were wrapped in strings of *Nassarius* shells (*tambu* in the local Tolai language and in New Guinea *Tok Pisin*) and covered with ochre. The strings of shells and use of red ochre reflect distinctly different funerary practices from those of the late Lapita cemetery at Kainapirina (SAC) of about 2,000 years earlier (Green et al., 1989). The Vunaburigai burials were identified by the Tolai villagers as their recent ancestors, and this is likely in view of a ^{14}C date on bone from burial 3, a female, which places it at 306 ± 30 BP (Wk-22346: Frédérique Valentin, personal communication). This date sits well within the time frame of widespread Tolai origin stories of their ancestors' migration into east New Britain from New Ireland. When this occurred is uncertain, but Salisbury (Salisbury, 1972) argues it was possibly about 400 or so years ago, perhaps as early as the thirteenth century AD, though Neumann (Neumann, 1992) prefers a later date.

There is a problem with Salisbury's suggestion, as oral histories recorded by the author on Watom Island in 1965 claimed that when the Tolai ancestors arrived the island was already occupied by people described as 'Baining'. This term has been applied to Papuan language-speaking groups living on the coast and in the interior mountains of the Gazelle peninsula of New Britain (cf. Rohatynskyj, 2001).(3) As there is nothing culturally distinctive about the Maravot hearth dated to 730–550 cal. BP, we cannot attribute it to either Tolai or Baining activity. What is clear, however, is that there is a strong case for the annihilation of the island's population by the Rabaul Ignimbrite event, followed by re-occupation by at least one, possibly, two different populations. Watom thus could have experienced settlement by

possibly three separate populations over the last 3,000 years, and the distinction between Tolai and Baining evident in historic times was not the result of in situ cultural diversification, but of migration.

Case study 2: the Willaumez peninsula

The deposits of obsidian in the Talasea area of central Willaumez peninsula have been the focus of a long-term archaeological study over more than thirty years (e.g., Specht, 1981; Summerhayes et al., 1998; Torrence et al., 1992 and 2009; Torrence and Stevenson, 2000; Torrence, 2002; Torrence and Doelman, 2007). This obsidian has been exploited since the Late Pleistocene (Summerhayes and Allen, 1993; Torrence et al., 2004), despite repeated severe volcanic events that caused extensive damage to the environment and affected viability of occupation of the area (Machida et al., 1996; Torrence et al., 2009).

The Early and Middle Holocene periods were marked by production of a range of stemmed obsidian tools made using prismatic blades and, in the case of the finest examples, Kombewa flakes (Araho et al., 2002; Rath and Torrence, 2003; Torrence et al., 2013). The Kombewa technique is currently known in the Western Pacific islands at only two other areas: at the Mopir obsidian source near Mount Witori (Mulrooney et al., 2016), and at the obsidian sources of Manus Province, several hundred kilometres north of New Britain across the Bismarck Sea (Torrence et al., 2013).

Production of these tools survived the impact of the W-K1 eruption of c. 6,000 years ago that occurred at Witori volcano to the south of Cape Hoskins, some 60 km southeast from Talasea, but their precise end-date is currently uncertain. Their production might have ended before the W-K2 eruption that blanketed the obsidian source areas with thick deposits of tephra and pyroclastic flow products around the modal date of 3315 cal. BP (Petrie and Torrence, 2008, tables 5 and 6), or the eruption itself caused their demise. Whatever the case, the event devastated a large portion of central New Britain (Torrence et al., 2009) locally burying the landscape under metres of tephra and affecting, but to a lesser extent, even the south coast (Machida et al., 1996, fig. 3; Boyd et al., 1999a, fig. 3). Following this, sites with Lapita pottery appeared throughout the peninsula, and pottery production continued in modified form until about 2000 cal. BP and possibly slightly later (Specht and Gosden, 1997; Torrence and Stevenson, 2000; Specht and Torrence, 2007a and 2007b). Several small stemmed obsidian tools occur in pottery contexts on Willaumez peninsula (Kononenko et al., 2010), though this does not necessarily indicate that some of the people re-settling the area were derived from the pre-eruption population. These later tools were small and simple, and were not made by the Kombewa technique.

Following the W-K2 event there was a period of relative calm until two major volcanic events again interrupted occupation around the obsidian sources. Dakataua volcano at the northern end of the peninsula erupted violently around a modal date of 1300 cal. BP (Petrie and Torrence, 2008, table 5), burying the obsidian source region under about 0.75 m of tephra (the Dk tephra: Machida et al., 1996; McKee et al., 2010). This had a 'profound effect' on settlements (Petrie and Torrence 2008, p. 742) that would have been evacuated because of severe environmental damage. Just a few decades later, another large-scale eruption of Witori volcano (W-K4) occurred. While the impact of this event on the obsidian source areas was relatively minor, its timing so soon after the Dk event could have affected recovery of the area and hindered re-establishment of settlements (Petrie and Torrence, 2008, p. 741). On Garua Island the combined effects of the two eruptions appear to have delayed reoccupation for over 200 years, suggesting that they tipped the balance against rapid re-settlement of the obsidian source areas (Petrie and Torrence, 2008, table 7). This contrasts with the isthmus area at the southern end of the peninsula, which escaped the impact of the Dk event, and was reoccupied about 100 years after the W-K4 event. The cultural deposits that formed on the W-K4 tephra are thick and widespread as a distinctive dark grey to black horizon and suggest intensive occupation, perhaps representing refugees escaping from the Dk event for the safety of the isthmus (Petrie and Torrence, 2008, p. 742).

Both the isthmus and obsidian source areas have occupation dates extending through the millennium following the Dk and W-K4 events (Petrie and Torrence, 2008, tables 2 and 3), and dates for the FAQ hilltop site on Garua island extend into the period of European visits to and colonisation of the New Guinea region (Beta-63618: 550 ± 60 BP; Beta-63619: 470 ± 60 BP; and Beta-63620: 370 ± 50 BP; all samples were marine shell). These dates suggests continuous settlement of the Willaumez peninsula obsidian source areas since the Dk/W-K4 events, perhaps with minor interruptions by the Wanguwangu series of smaller eruptions of Dakataua (Machida et al., 1996, table 1) that may have required short periods of abandonment.

The reoccupation of the obsidian source areas after the volcanic events may be reflected in oral traditions of the Talasea area that record the movement of the ancestors of the present-day Bakovi people northwards from the area of the peninsula known as their origin place (Specht, 1980 and 1981). The obsidian source areas might have been uninhabited at the time, as the oral histories do not record conflicts with other people occupying them. There is, however, no archaeological evidence to indicate when this movement might have occurred.

The oral histories attribute the population movement to reoccupation following a volcanic event, and this is plausible, if the areas around the sources had been abandoned. Equally possible is the smallpox epidemic that swept through west New Britain in 1895–1896 and "tore enormous gaps [in the populations] in the western part" of New Britain (Parkinson, 1999, p. 90). This epidemic was introduced from the New Guinea mainland and spread eastwards as far as Cape Hoskins.[4] It is not mentioned in the Bakovi oral histories, but it may have contributed to the abandonment of Garua Island, which

was unoccupied in 1923 when Dyson Hore-Lacy leased the island to develop a coconut plantation (Hore-Lacy, 1992, p. 13).

The situation on the isthmus is somewhat less clear. According to oral accounts recorded in 2002 at Patanga village on Willaumez peninsula, the smallpox epidemic caused many deaths and the abandonment of a substantial part of the isthmus, which remained uninhabited until it was taken over by expatriate interests for development as Numundo plantation.[5] Again, volcanic events might have played a role. Over the last 500 years the isthmus has received W-H series of tephras from the Witori complex (Machida et al., 1996, figs. 4 and 5E and F). Although individually they were less severe than the W-K series (Machida et al., 1996, table 1), their collective impacts may have caused moderate to severe landscape damage and contributed to the abandonment of the isthmus.

There were thus at least two major changes in the artefact inventory around the obsidian source areas either just before or after the W-K2 eruption, with the loss of the main stemmed tool forms and the introduction of pottery production. It is debatable whether they were purely local developments, were caused by volcanic events resulting in population discontinuities and replacements or, according to the standard interpretation of Lapita pottery, to the arrival of new people(s) in the New Guinea islands' region (Spriggs, 1997; Kirch, 1997; Green, 2003), or some combination of these explanations. While there has been an emphasis on similarity between Lapita pottery sites, we can also view them as an expression of diversification, for not all areas adopted the pottery. The loss of pottery production, therefore, along with the demise of obsidian stemmed tools can be seen as the opposite of diversification by making material culture suites more uniform across parts of the island.

Case study 3: the inland Passismanua area

This is the only area studied here that is not coastal, though the two languages spoken in the area (Kaulong and Sengseng) extend to the south coast and belong to the north New Guinea cluster of the Austronesian family (Ross, 1996, p. ix). Both fall into the 'aberrant' group of Austronesian languages in island Melanesia, with Kaulong regarded as the most innovative Oceanic language as it retains only 5% of the two hundred word list (Pawley, 2006).

The inland Sengseng and Kaulong people live between 250–500 m above sea level on the foothills of the Whiteman Range (Goodale, 1995). The population is scattered in small family hamlets and men's houses separated by several kilometres from each other, with data for the late 20th century indicating very low population densities of two to four persons per square kilometre (Chowning, 1980; Bourke et al., 1996, p. 33 and 37).

The limestone of the Whiteman Range contains many nodules and seams of white-orange-brown chert that has been exploited since the Late Pleistocene, and during the middle Holocene was used to make a range of stemmed and waisted tools (Pavlides, 2004 and 2006; Bulmer, 2005; Specht, 2011). Although these do not include prismatic blades and Kombewa flakes such as were made in the obsidian source areas of the north coast, their origin is arguably related in some way to that of the obsidian industries, though this possible relationship remains to be investigated.

The Passismanua area lies within the zone of 'moderate impact' of the W-K2 event (Boyd et al., 1999a, fig. 3), with about 30–50 cm of tephra being deposited (Pavlides, 2004, fig. 2). As with the Willaumez peninsula, production of the stemmed and waisted chert tools ceased before or at that time, after which only a few examples of different design and much smaller than the earlier examples entered the archaeological record (Kononenko et al., 2010).

The W-K2 tephra probably had a significant effect on the landscape and populations causing abandonment of the area. The three oldest charcoal dates for occupation of the Auwa (FGT) and Airstrip (FIF) sites following the tephra fall have a pooled mean of 2557 ± 48 cal. BP (Specht, 2011, p. 57). This may indicate a longer gap before reoccupation than on either Garua Island or the isthmus of Willaumez peninsula, presumably reflecting the initial low population density. The assemblages associated with these dates include a few sherds of plain pottery that was almost certainly imported from locations on the south coast around Kandrian where several Lapita and post-Lapita pottery sites have been reported (Boyd et al., 1999b; Summerhayes, 2000). The presence of the stemmed chert tools in post-W-K2 contexts may indicate some form of continuity with the population that produced the earlier stemmed and waisted chert tools, though the long gap in time between the W-K2 tephra and re-occupation may indicate otherwise. Traces of later tephras at the Passismanua sites were not sufficiently deep to have required further abandonment of the area. The sites thus share several aspects in common with those on Willaumez peninsula, but there are similar uncertainties in interpretation.[6]

Case study 4: Kandrian and the Arawe Islands

The south coast of New Britain is formed primarily of Pleistocene age, uplifted coral reefs with swamps in low-lying areas. The Kandrian sector consists of the coastal plain and three small islands, though local oral history records that a phase of tectonic activity uplifted the coast line and joined a fourth island to the mainland; this hill is known locally as the 'fourth island' (Boyd et al., 1999b). The Arawe Islands consist of about twenty small islands, of which six are inhabited today, and appear not to have experienced this recent uplift. Both areas lie south of the main impacts of the north coast volcanic events, though thin layers of several tephras were deposited around Kandrian (Lentfer et al., 2010, table 4) and as far away as Lolmo cave in the Arawe Islands (Gosden et al., 1994; Boyd et al., 1999a, fig. 3). These tephra falls, however, were probably little more than irritants and inconveniences, and did not have

the same scale of landscape impacts as was experienced in the previous two case studies.

The oldest recorded evidence for human presence on the south coast dates to about 6500 cal. BP in Lolmo cave, with use of the cave extending down to the time of Lapita pottery (Gosden et al., 1994). This pottery has been found at a dozen or more localities around Kandrian and on the Arawe Islands, and on Adwe and Kumbun Islands in the Arawe group the Lapita deposits extend down below the water table and have remains of stilt structures built over the intertidal reef (Gosden et al., 1989 and 1994; Gosden and Webb, 1994; Specht and Gosden, 1997). The later Arawe islands' sites of Maklo and Winkapiplo, dated to approximately 1560 to 740 cal. BP, also have waterlogged deposits with plant remains and artefacts in contexts similar to those on Adwe and Kumbun islands, though no stilt structures have been formally recognised (cf. Matthews and Gosden, 1997).

Following the end of Lapita pottery there was a gap of possibly 1500 years before pottery was again used around Kandrian area and in the Arawe islands, but this time it was imported from the New Guinea mainland (Gosden and Webb, 1994). This pottery was initially type X (Lilley, 1988 and 2002; Specht et al., 2006), later followed by pottery mainly from the Sio-Gitua and Madang industries (May and Tuckson, 1982), as well as a few sherds of pottery of unknown age and origin. On the south coast type X occurs as far as Kandrian, and on the north coast on Willaumez peninsula, in both cases in very small quantities (Specht et al., 2006; Specht and Torrence, 2007b). Sio-Gitua and Madang pottery occurs at several sites in the Arawe islands, but not the Kandrian area, and on the north coast it is reported from the Kove islands (Lilley, 1991) and on Willaumez peninsula (Specht and Torrence, 2007a). This evidence for contacts with the New Guinea mainland represents a break from Lapita times, when contacts were primarily with other New Guinea islands and island groups to the south (cf. White, 1996 for obsidian distributions). It also reflects the earlier, pre-Lapita contacts of the producers of obsidian stemmed tools with the New Guinea mainland (Torrence et al., 2013).

A possible sign of cultural continuity of practices, and arguably population, in the Arawe islands is the presence at Maklo and Winkapiplo of evidence for the production of *Tectus niloticus* (formerly *Trochus niloticus*) shell arm rings and other shell artefact categories that were also produced in the Lapita pottery period and are still made in the area today (Smith, 2001). In contrast, there is little evidence for such production at the Kandrian sites. It is tempting to see the continuity of production in the Arawe Islands as consistent with continuity of population there since the appearance of Lapita pottery in this region, though the widespread production of *Tectus niloticus* arm rings in both time and space shows it is not necessarily distinctive of any particular ethnolinguistic group. The lack of evidence for their production in the Kandrian Lapita pottery sites contrasts with the Arawe Islands, but perhaps reflects differentiation of production rather than cultural difference or divergence.

DISCUSSION

Cultural diversity

The cessation of pottery production or use in the study areas, the contrast in burial practices noted between those of the Kainapirina and Vunaburigai areas on Watom Island, and the shift in lithic technologies in the Passismanua and Willaumez peninsula study areas may be signs of discontinuities in cultural practices indicative of cultural diversification in the post-Lapita period. With the exception of the Vunaburigai burials, however, none of the evidence specifically indicates the emergence of the cultural diversity encountered by European visitors and settlers. Given the problems of identifying ethnolinguistic groups in the archaeological record discussed at the start of the paper and the generally poor quality of archaeological data currently available, this is not surprising. Within any ethnolinguistic group, at whatever scale, there is likely to be some form of differentiation of practices and specialised production, with distribution both within and beyond the group. A further complication is that many items of the material culture that is distinctive about particular ethnolinguistic groups of New Britain, such as shield forms and ritual accoutrements, comprise organic materials that have little or no likelihood of survival in the archaeological record except in special circumstances, as with an incised piece of wood preserved in waterlogged conditions in a pre-Lapita context at the Apalo site in the Arawe Islands (Specht et al., 2015).

'Boom' and 'bust'?

The two study areas located in northern New Britain share histories punctuated by volcanic disasters that occasioned landscape destruction, population disruption, abandonment of large areas and possibly local extinction of communities. The abandonment periods differed in length depending on the severity of the impacts of the volcanic events. On Willaumez peninsula reoccupation probably resulted from the attraction of the obsidian sources, but the situation elsewhere is less clear. The long gap in occupation on Watom Island was longer than on Willaumez peninsula, perhaps reflecting the extreme severity of the Rabaul Ignimbrite event. In the Passismanua area the long gap after the W-K2 event might indicate that the chert sources lacked the 'pull' of the obsidian sources, on account of their dispersed nature and lack of predictable quality. It could also reflect an extremely low population level prior to the W-K2 eruption, similar to or lower than those of recent times, though the limited data should make us cautious. The reoccupation chronology developed for Willaumez peninsula is based on a large number of dates, whereas for the Passismanua area there are only three dates for this event, two of which come from the same locality, Auwa.

On the south coast neither Kandrian nor the Arawe islands shows signs of abandonment due to the impacts

of tephra falls, and the evidence could be interpreted as one of cultural continuity from the Lapita pottery period onwards. In common with every other area of New Britain where Lapita pottery has been found, the main change over the last 2500 years was abandonment of pottery production for whatever reason, though production of *Tectus niloticus* shell arm bands continued. Whether there was continuity of occupation by the same population over the last 2500 years is simply not known. Stephen Shennan (Shennan, 2013, p. 301) emphasises that gradualist assumptions often have proved erroneous when a substantial corpus of reliable dates, detailed local and regional sequences and evidence from other disciplines can be brought into consideration. In time, this may well prove to be the case for parts of New Britain.

Some demographic issues

A key element of S. Shennan's study was palaeo-demographic data, but such data for past population sizes are notoriously difficult to reconstruct (Kirch and Rallu, 2007, p. 5–9; Crombé and Robinson, 2014). Preferred methods have been through proxy measures from osteological and palaeo-genetic studies, settlement size and frequency, dating curves and carrying capacity estimates. S. Shennan benefitted from palaeo-genetic studies that indicated probable population changes during the European Neolithic, and a major database of radiocarbon dates (Shennan, 2013, fig. 2 and fig. 3). There are no comparable palaeo-genetic data for New Britain, and only one area (Willaumez peninsula) has a substantial body of dates (Petrie and Torrence, 2008). For her study of Garua Island, adjacent to Willaumez peninsula, Robin Torrence (Torrence, 2002) used changes in the distribution and frequency of discard of obsidian across the landscape as a proxy for changes in land use, arguing for a shift through time from widely dispersed to more clustered distributions, though this does not necessarily reflect changes in population size or density, but could reflect changes in settlement patterns that were unrelated to these factors. With regards to carrying capacity, the abandonment-reoccupation sequences were caused by volcanic events, and not by population growth exceeding the local carrying capacity. The volcanic impacts would have affected subsistence resources of all kinds, and would have constrained population sizes and distributions for some after the eruptions until the terrestrial and in-shore marine biotas recovered.

The lack of palaeo-genetic data for New Britain is not necessarily a major disadvantage. A study of contemporary human genetics of northern island Melanesia, particularly New Britain (Friedlaender, 2007; Hunley et al., 2008) did not include any samples from the four study areas covered by this paper, but it offers some insights into some of the difficulties of using such data. One of the main conclusions of the study was that "Genes have tended to move freely between nearby populations, regardless of the languages they speak" (Hunley et al., 2008, p. 10). The authors discount as "most unlikely" the possibility that "Oceanic languages have simply been adopted by formerly Papuan-speaking groups" as there has been clear gene flow between neighbouring groups speaking Oceanic and Papuan languages. These conclusions have obvious implications for the interpretation of palaeo-genetic data in general.

CONCLUSION

While there are major gaps in data for the last 3,000 years, there have been changes in the material culture repertoires of all four study areas, though these do not necessarily reflect the appearance or emergence of different ethnolinguistic groups. That process may lie beyond the scope of archaeology to identify. In his review of what might have happened in the post-Lapita pottery period, Matthew Spriggs (Spriggs, 1997, p. 185) suggested that "Lapita culture was never a completely homogeneous entity", but "by about 2500–2000 BP the region [island Melanesia] was as homogeneous as it was ever going to get." This apparent near-homogeneity across a wide area was the result of the rapid dispersal of the Lapita cultural complex, but it lasted only for several centuries. This emphasis on homogeneity, however, implies a lack of it prior to the appearance of Lapita pottery—in other words, some degree of diversity. Perhaps rather than view the cultural diversity of the entire region as a product only of the last two millennia or so, it would be more useful to see it as a longer-standing condition that was briefly interrupted by the appearance and dispersal of the Lapita cultural complex.

Acknowledgments: A short version of this paper was prepared for the conference "Spatial dynamics in Oceania: discovery, appropriation and the emergence of traditional societies" held at the Institut national d'Histoire de l'Art, Paris on 30th January-1st February 2014. I thank Frédérique Valentin and Guillaume Molle for organising the conference. The paper owes much to discussions with the late Roger Green, Chris Gosden and Robin Torrence, and my thanks particularly go to Robin for her comments on an early draft, and to Louis Lagarde and another reviewer for their constructive critiques and advice.

NOTES

(1) Friedlaender (Friedlaender, 2007) provides extensive data on genetic studies of contemporary people on New Britain, though not covering all the areas discussed in this paper.

(2) The Passismanua area is allegedly named after the visit of a German man-of-war ship to Kandrian, probably the *Möwe-hafen*, which anchored near Kandrian. The name is New Guinea *Tok Pisin*, and is a corruption of 'passage' (*passis*, i.e. anchorage) 'of the man-of-war' *(manua)*.

(3) Other speakers referred to Tolai raids on the mainland to seize Baining people as slaves, a practice that was eventually stopped by the Christian missions and German adminis-

tration. In the 1890s Governor Hahl (Sack and Clark, 1979, p. 26–27) sought to restrict Tolai raids on Baining mainland communities in which Watom islanders of Tolai origin were involved. The Watom-Baining link was early recognised by missionary Danks, who proposed in 1884 that the Wesleyans should establish themselves on the island in the hope that a friendly relationship with the islanders would facilitate the mission's expansion among the mainland Baining people (Deane, 1933, p. 219).

(4) The Annual Reports of the German administration of German New Guinea and the Bismarck Archipelago place the epidemic in the 1895–1896 year (Sack and Clark 1979, p. 122). According to Parkinson (Parkinson, 1999, p. 90), it was introduced to the Bali-Witu islands by visitors from Willaumez peninsula. In 2002, on a visit to the Bali-Witu group with Robin Torrence, I was told that at least one island was so badly affected that the islanders abandoned it. The German administration vaccinated not only "coloured labourers on the plantations but also many natives in the surrounding area" [today's Rabaul-Kokopo area], clearly focusing on protecting the economic viability of the colony, rather than addressing the needs of all its inhabitants. The Annual Report for 1899–1900 recorded a chicken pox epidemic in the Rabaul-Kokopo area, but noted that "smallpox proper has not been observed in the Archipelago" during this period (Sack and Clark 1979, p. 187).

(5) The severity of the smallpox epidemic is difficult to calculate as there are no reliable data. J.-L. Rallu (Rallu, 2007, p. 25–26) cites mortality rates of 300 per 1000 persons among non-immunised populations, but it is difficult to estimate this impact on New Britain communities as there are no demographic data. The abandonment of a large part of the isthmus, however, suggests it was severe.

(6) There appears to be no specific memory of the smallpox epidemic in the Sengseng or Kaulong areas, though Parkinson (Parkinson, 1999, p. 91) recorded that it extended along the south coast to the east of Kandrian. It is possibly reflected in comments made to me in 1979–1981 by inland Sengseng people that they avoided travelling to the south coast if possible as this would take them through an area known for sorcery that caused severe illness. An alternative explanation for this attitude is that the inland Sengseng were avoiding malaria, as their own territory appeared to be comparatively free of malaria vectors in 1979–1981.

BIBLIOGRAPHICAL REFERENCES

Anson D., Walter R., Green R. C. (2005) – *A Revised and Redated Event Phase Sequence for the Reber-Rakival Lapita Site, Watom Island, East New Britain Province, Papua New Guinea*, Dunedin, University of Otago (University of Otago Studies in Prehistoric Archaeology, 20), 56 p.

Araho N., Torrence R., White J. P. (2002) – Valuable and Useful: Mid-Holocene Stemmed Obsidian Artefacts from West New Britain, Papua New Guinea, *Proceedings of the Prehistoric Society*, 68, p. 61–81.

Beran H. (2014) – Where do Mainland New Guineans get their Circular Boars' Tusks from?, *Pacific Arts*, 13, 2, p. 5–20.

Blake N., Gibbs M. (2013) – Late Prehistoric Burial Structure and Evidence of Spanish Contact at Makira, Southeast Solomon Islands, *Journal of Pacific Archaeology*, 4, 2, p. 69–78.

Bourke R. M., Hide R. L, Allen B. J., Fritsch D., Grau R., Hobsbawn P., Levett M., Lyon S., Nama L., Nen T. (1996) – *West New Britain Province: Text Summaries, Maps, Code Lists and Village Identification*, Canberra, The Australian National University (Agricultural Systems of Papua New Guinea Working Paper, 13), 126 p.

Boyd W E., Lentfer C. J., Luker G. O. (1999) – Environmental Impacts of Major Catastrophic Holocene Volcanic Eruptions in New Britain, P.N.G.: A Preliminary Model for Palaeoenvironmental Change, in J. A. Kesby, J. M. Stanley, R. F. McLean and L. J. Olive (eds.), *Geodiversity: Readings in Australian Geography at the Close of the 20th Century*, Canberra, School of Geography and Oceanography, University College and Australian Defence Force Academy (Special Publication Series, 6), p. 361–72.

Boyd W. E., Specht J., Webb J. (1999) – Holocene Shoreline Change and Archaeology on the Kandrian Coast of West New Britain, Papua New Guinea, in J. Hall and I. J. McNiven (eds.), *Australian Coastal Archaeology*, Canberra, ANH Publications (Research Papers in Archaeology and Natural History, 31), p. 283–87.

Brown G. (1908) – *George Brown, D. D., Pioneer-Missionary and Explorer, an Autobiography*, London, Hodder and Stoughton, 536 p.

Bulmer S. (2005) – The Stones of Pasismanua Revisited, in C. Gross, H. D. Lyons and D. A. Counts (eds.), *A Polymath Anthropologist: Essays in Honour of Ann Chowning*, Auckland, University of Auckland (Research in Anthropology and Linguistics, Monograph 6), p. 23–34.

Buschmann R. F. (2009) – *Anthropology's Global Histories: The Ethnographic Frontier in German New Guinea, 1870–1935*, Honolulu, University of Hawai'i Press, 234 p.

Byrne S. (2005) – Recent Survey and Excavation of the Monumental Complexes on Uneapa Island, West New Britain, Papua New Guinea, *Papers from the Institute of Archaeology*, 16, p. 95–101.

Byrne S. E. (2008) – *A Practice-Centred Approach to Uneapa Island's Archaeology in* a *Long-term Context*, doctoral thesis, University College, London, 511 p.

Byrne S. (2013) – Rock Art as Material Culture: A Case Study on Uneapa Island, West New Britain, Papua New Guinea, *Archaeology in Oceania*, 48, p. 63–77.

Chowning A. (1978) – Changes in West New Britain Trading Systems in the Twentieth Century, *Mankind*, 11, 3, p. 296–307.

Chowning A. (1980) – Culture and Biology among the Sengseng, *Journal of the Polynesian Society*, 89, p. 7–31.

Crombé P., Robinson E. (2014) – ^{14}C Dates as Demographic Proxies in Neolithisation Models of Northwestern Europe: A Critical Assessment Using Belgium and Northeast France as a Case-Study, *Journal of Archaeological Science*, 52, p. 558–66.

Davies H. L. (1973) – *Gazelle Peninsula, New Britain. Sheet SB/56-2. 1:250,000 Geological Series - Explanatory Notes*, Canberra, Australian Government Publishing Service, 24 p.

Deane W. (1933) – *In Wild New Britain: The Story of Benjamin Danks, Pioneer Missionary, from His Diary*, Sydney, Angus & Robertson, 293 p.

Firth S. (1982) – *New Guinea under the Germans*, Melbourne, Melbourne University Press, 216 p.

Friedlaender J. S. (2007) – *Genes, Language, and Culture History in the Southwest Pacific*, Oxford, Oxford University Press (Human Evolution Series), 248 p.

Garling S. (2003) – Tanga Takes the Stage: Another Model 'Transitional Site'? New Evidence and a Contribution to the 'Incised and Applied Relief Tradition' in New Ireland, in C. Sand (ed.), *Pacific Archaeology: Assessments and Prospects*, proceedings of the International Conference for the 50th Anniversary of the First Lapita Excavation (Koné-Nouméa, 2002), Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 213–33.

Garling S. J. (2007) – *Post-Lapita Evolutions or Revolutions? Interaction and Exchange in Island Melanesia: The View from the Tanga Islands*, doctoral thesis, Australian National University, Canberra, 289 p.

Goodale J. C. (1995) – *To Sing with Pigs Is Human: The Concept of Person in Papua New Guinea*, Seattle, University of Washington Press, 286 p.

Gosden C., Knowles C. (2001) – *Collecting Colonialism: Material Culture and Colonial Change*, Oxford, Berg Publishers, 260 p.

Gosden C., Allen J., Ambrose W., Anson D., Golson J., Green R. C., Kirch P. V., Lilley I., Specht J., Spriggs M. (1989) – Lapita Sites of the Bismarck Archipelago, *Antiquity*, 63, 240, p. 561–86.

Gosden C., Webb J. (1994) – The Creation of a Papua New Guinean Landscape: Archaeological and Geomorphological Evidence, *Journal of Field Archaeology*, 21, p. 29–51.

Gosden C., Webb J., Marshall B., Summerhayes G. R. (1994) – Lolmo Cave: A Mid- to Late Holocene Site, the Arawe Islands, West New Britain Province, Papua New Guinea, *Asian Perspectives*, 33, 1, p. 97–119.

Gray A. (1999) – Trading Contacts in the Bismarck Archipelago during the Whaling Era, 1799-1884, *Journal of Pacific History*, 34, 1, p. 23–43.

Green R. C. (1997) – Linguistic, Biological, and Cultural Origins of the Initial Inhabitants of Remote Oceania, *New Zealand Journal of Archaeology*, 17, p. 5–27.

Green R. C. (2003) – The Lapita Horizon and Traditions: Signature for One Set of Oceanic Migrations, in C. Sand (ed.), *Pacific Archaeology: Assessments and Prospects,* proceedings of the International Conference for the 50th Anniversary of the First Lapita Excavation (Koné-Nouméa, 2002), Nouméa, service des Musées et du Patrimoine de Nouvelle-Calédonie (Les Cahiers de l'archéologie en Nouvelle-Calédonie, 15), p. 95–120.

Green R. C., Anson D., Specht J. (1989) – The SAC Burial Ground, Watom Island, Papua New Guinea, *Records of the Australian Museum*, 41, p. 215–21.

Harding T. G. (1967) – *Voyagers of the Vitiaz Strait: A Study of a New Guinea Trade System*, Seattle, University of Washington Press (American Ethnological Society Monograph, 44), 282 p.

Heermann I. (2002) – *Form Colour Inspiration: Oceanic Art from New Britain*, Stuttgart, Arnoldsche Verlagsanstalt, 208 p.

Heermann I. (2013) – Artistic Traditions of the Bismarck Archipelago, in K. Conru (ed.), *Bismarck Archipelago Art*, Milano, 5 Continent Editions, p. 67–317.

Hore-Lacy I. (1992) – *Commander Dyson Hore-Lacy 1897–1992: Edited and Collated Reminiscences in Appreciation of a Remarkable Individual*, Mont Albert (Tasmania), Ian Hore-Lacy, 66 p.

Hunley K., Dunn M., Lindstrom E., Reesink G., Terrill A., Healy M. E., Koki G., Friedlaender F. R., Friedlaender J. S. (2008) – Genetic and Linguistic Coevolution in Northern Island Melanesia, *PLoS Genetics*, 4, 10, 14 p., doi:10.1371/journal.pgen.1000239 [online].

Jago L., Boyd W. E. (2005) – How a Wet Tropical Rainforest Copes with Repeated Volcanic Destruction, *Quaternary International*, 64, 3, p. 399–406.

Kirch P. V. (1997) – *The Lapita Peoples: Ancestors of the Oceanic World*, Oxford, Blackwell (The Peoples of South-East Asia and the Pacific), 353 p.

Kirch P. V. (2000) – *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*, Berkeley, University of California Press, 446 p.

Kirch P. V. (2010) – Peopling of the Pacific: A Holistic Anthropological Perspective, *Annual Review of Anthropology*, 39, p. 131–48.

Kirch P. V., Green R. C. (2001) – *Hawaiki, Ancestral Polynesia: An Essay in Historical Anthropology*, Cambridge, Cambridge University Press, 375 p.

Kirch P. V., Rallu J.-L. (2007) – Long-Term Demographic Evolution in the Pacific Islands, in P. V. Kirch and J.-L. Rallu (eds.), *The Growth and Collapse of Pacific Island Societies*: *Archaeological and Demographic Perspectives*, Honolulu, University of Hawai'i Press, p. 1–14.

Knowles C., Gosden C. (2002) – Art and Design among the Arawe, in I. Heermann (ed.), *Form Colour Inspiration: Oceanic Art from New Britain*, Stuttgart, Arnoldsche Verlagsanstalt, p. 152–63.

Kononenko N., Specht J., Torrence R. (2010) – Persistent Traditions in the Face of Natural Disasters: Stemmed and Waisted Stone Tools in Late Holocene New Britain, Papua New Guinea, *Australian Archaeology*, 70, p. 17–28.

Lentfer C., Green R. C. (2004) – Phytoliths and the Evidence for Banana Cultivation at the Lapita Reber-Rakival Site on Watom Island, Papua New Guinea, in V. J. Attenbrow and R. Fullagar (eds.), *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific. Papers in Honour of Jim Specht*, Sydney, Australian Museum (Records of the Australian Museum, Supplement 29), p. 75–88.

Lentfer C., Pavlides C., Specht J. (2010) – Natural and Human Impacts in a 35,000-Year Vegetation History in Central New Britain, Papua New Guinea, *Quaternary Science Reviews*, 29, 27–28, p. 3750–67.

Lentfer C., Torrence R. (2007) – Holocene Volcanic Activity, Vegetation Succession, and Ancient Human Land Use: Unraveling the Interactions on Garua Island, Papua New Guinea, *Review of Palaeobotany and Palynology*, 143, 3–4, p. 83–105.

Lewis P. M., Simons G. F., Fennig C. D. (2014) – Papua New Guinea, Map 12, *Ethnologue: Languages of the World*, 17th edition, Dallas, SIL International, http://www.ethnologue.com/map/PG_12 [online].

Lilley I. (1988) – Type X: Description and Discussion of a Prehistoric Ceramic Ware from Northeastern Papua New Guinea, *Bulletin of the Indo-Pacific Prehistory Association*, 8, p. 90–100.

Lilley I. (1991) – Lapita and Post-Lapita Developments in the Vitiaz Straits-West New Britain Area, *Bulletin of the Indo-Pacific Prehistory Association*, 11, p. 313–22.

Lilley I. (2002) – Lapita and Type Y in the KLK Site, Siassi, Papua New Guinea, in S. Bedford, C. Sand and D. Burley (eds.), *Fifty Years in the Field: Essays in Honour and Celebration of Richard Shutler Jr's Archaeological Career*, Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 25), p. 79–90.

Lowder G. G., Carmichael I. S. E. (1970) – The Volcanoes and Caldera of Talasea, New Britain: Geology and Petrology, *Geological Society of America Bulletin*, 81, p. 17–38.

Machida H., Blong R, Specht J., Moriwaki H., Torrence R., Hayakawa Y., Talai B., Lolok D., Pain C. F. (1996) – Holocene Explosive Eruptions of Witori and Dakataua Caldera Volcanoes in West New Britain, Papua New Guinea, *Quaternary International*, 34–36, p. 65–78.

Mckee C. O., Neall V. E., Torrence R. (2011) – A Remarkable Pulse of Large-Scale Volcanism on New Britain Island, Papua New Guinea, *Bulletin of Volcanology*, 73, p. 27–37.

Matthews P. J., Gosden C. (1997) – Plant Remains from Waterlogged Sites in the Arawe Islands, West New Britain Province, Papua New Guinea: Implications for the Prehistory of Plant Use and Domestication, *Economic Botany*, 51, p. 121–33.

May P., Tuckson M. (1982) – *The Traditional Pottery of Papua New Guinea*, Sydney, Bay Books, 380 p.

Meleisea M. (1980) – *O tama uli: Melanesians in Samoa*, Suva, Institute of Pacific Studies, University of the South Pacific, 57 p.

Mulrooney M, Torrence R., Mcalister A. (2016) – The Demise of a Monopoly: Implications of Geochemical Characterisation of a Stemmed Obsidian Tool from the Bishop Museum Collections, *Archaeology in Oceania*, 51, 1, p. 62–69.

Nairn I. A., Mckee C. O., Talai B., Wood C. P. (1995) – Geology and Eruptive History of the Rabaul Caldera Area, Papua New Guinea, *Journal of Volcanology and Geothermal Research*, 69, 3–4, p. 255–84.

Neumann K. (1992) – *Not the Way it Really Was: Constructing the Tolai Past*, Honolulu, University of Hawaii (Pacific Islands Monograph Series, 10), 310 p.

Panoff M. (1979) – Travailleurs, recruteurs et planteurs dans l'archipel Bismarck de 1885 à 1914, *Journal de la Société des océanistes*, 35, 64, p. 159–73.

Parkinson R. R. H. (1999) – *Thirty Years in the South Seas: Land and People, Customs and Traditions in the Bismarck Archipelago and on the German Solomon Islands*, Bathurst, Crawford House Publishing and Sydney, Oceania Publications, University of Sydney, 378 p.

Parkinson R. R. H. (1907) – *Dreißig Jahre in der Südsee: Land und Leute, Sitten und Gebräuche im Bismarckarchipel und auf den deutschen Salomoinseln*, Stuttgart, Strecker & Schröder, 876 p.

Pavlides C. (2004) – From Misisil Cave to Eliva Hamlet: Rediscovering the Pleistocene in Interior West New Britain, *German New Guinea: The Annual Reports*, 2004, p. 97–108.

Pavlides C. (2006) – Life before Lapita: New Developments in Melanesia's Long-Term History, in I. Lilley (ed.), *Archaeology of Oceania: Australia and the Pacific Islands*, Oxford, Blackwell, p. 205–27.

Pawley A. (1981) – Melanesian Diversity and Polynesian Homogeneity: Explanations for Language, in J. Hollyman and A. Pawley (eds.), *Studies in Pacific Languages and Culture in Honour of Bruce Biggs*, Auckland, Linguistic Society of New Zealand, p. 269–309.

Pawley A. (2006) – Explaining the Aberrant Languages of Southeast Melanesia: 150 years of Debate, *Journal of the Polynesian Society*, 115, p. 215–58.

Petrie C. A., Torrence R. (2008) – Assessing the Effects of Volcanic Disasters on Human Settlement in the Willaumez Peninsula, Papua New Guinea: A Bayesian Approach to Radiocarbon Calibration, *The Holocene*, 18, 5, p. 729–44.

Rallu J.-L. (2007) – Pre- and Post-Contact Population in Island Polynesia, in P. V. Kirch and J.-L. Rallu (ed.), *The Growth and Collapse of Pacific Island Societies: Archaeological and Demographic Perspectives*, Honolulu, University of Hawai'i Press, p. 15–34.

Rath P., Torrence R. (2003) – Producing Value: Stemmed Tools from Garua Island, Papua New Guinea, *Australian Archaeology*, 57, p. 119–27.

Riebe I. (1967) – Anthropomorphic Stone Carvings on Unea Island, *Journal of the Polynesian Society*, 76, p. 374–78.

Riker-Coleman K. E., Gallup C. D., Wallace L. M., Webster J. M., Cheng H., Edwards R. L. (2006) – Evidence of Holocene Uplift in East New Britain, Papua New Guinea, *Geophysical Research Letters*, 33, 18, p. 1–4, DOI: 10.1029/2006GL026596 [online].

Roe D. (2000) – Maritime, Coastal and Inland Societies in Island Melanesia: the Bush-Saltwater Divide in Solomon Islands and Vanuatu, in S. O'Connor and P. M. Veth (eds.), *East of Wallace's Line: Studies in Past and Present Maritime Cultures of the Indo-Pacific Region*, Rotterdam, A. A. Balkema (Modern Quaternary Research in Southeast Asia, 16), p. 197–222.

Rohatynskyj M. A. (2001) – On Knowing the Baining and Other Minor Ethnic Groups of East New Britain, *Social Analysis*, 45, 2, p. 23–40.

Ross M. D. (1996) – *Studies in Languages of New Britain and New Ireland. 1: Austronesian Languages of the North New Guinea Cluster in Northwest New Britain*, Canberra. Department of Linguistics, Australian National University (Pacific Linguistics Series, C-135), 392 p.

Ryburn R. J. (1974) – *Pomio, New Britain: Sheet SB/56-6. International Index. 1:250,000 Geological Series – Explanatory Notes*, Canberra, Australian Government Publishing Service.

Ryburn R. J. (1975) – *Talasea-Gasmata, New Britain. Sheet SB/56-5 & SB/56-9. 1:250,000 Geological Series – Explanatory Notes*, Canberra, Australian Government Publishing Service.

Ryburn R. J. (1976) – *Cape Raoult-Arawe, Papua New Guinea. Sheet SB/55-8 & SB/55-12 International Index. 1:250,000 Geological Series – Explanatory Notes*, Canberra, Australian Government Publishing Service.

Sack P., Clark D. (1979) – *German New Guinea: The Annual Reports*, Canberra, ANU Press, 403 p.

Salisbury R. F. (1970) – *Vunamami: Economic Transformations in a Traditional Society*, Melbourne, Melbourne University Press, 389 p.

Salisbury R. F. (1972) – The Origins of the Tolai people, *Journal of the Papua and New Guinea Society*, 6, p. 79–84.

Shennan S. (2013) – Demographic Continuities and Discontinuities in Neolithic Europe: Evidence, Methods and Implications, *Journal of Archaeological Method and Theory*, 20, p. 300–11.

Sheppard P., Walter R., Nagaoka T. (2000) – The Archaeology of Headhunting in Roviana Lagoon, *Journal of the Polynesian Society*, 109, p. 9–37.

Sheppard P., Walter R., Aswani S. (2004) – Oral Tradition and the Creation of Late Prehistory in Roviana Lagoon, Solomon Islands, in V. J. Attenbrow and R. Fullagar (eds.), *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific. Papers in Honour of Jim Specht*, Sydney, Australian Museum (Records of the Australian Museum, Supplement 29), p. 123–32.

Smith A. (2001) – A Continuous Sequence? *Trochus* Shell Artefacts in Lapita and Post-Lapita Assemblages from the Arawe Islands, West New Britain Province, Papua New Guinea, in G. R. Clark, A. J. Anderson and T. Vunidilo (eds.), *The Archaeology of Lapita Dispersal in Oceania*, proceedings of the Fourth Lapita Conference (Canberra, June 2000), Canberra, Pandanus Books, Research School of Pacific and Asian Studies, Australian National University (Terra Australis, 17), p. 151–58.

Specht J. (1968) – Preliminary Report of Excavations on Watom Island, *Journal of the Polynesian Society*, 77, 2, p. 117–34.

Specht J. (1980) – Aspects of the Oral History of the Bakovi People of West New Britain Province, *Oral History*, 8, p. 23–54.

Specht J. (1981) – Obsidian Sources at Talasea, West New Britain, Papua New Guinea, *Journal of the Polynesian Society*, 90, p. 337–56.

Specht J. (2000) – Traders and Collectors: Richard Parkinson and Family in the Bismarck Archipelago, *Pacific Arts*, 21–22, p. 23–38.

Specht J. (2005) – Stone Axe Blades and Valuables in New Britain, Papua New Guinea, in C. Gross, H. D. Lyons and D. A. Counts (ed.), *A Polymath Anthropologist: Essays in Honour of Ann Chowning*, Auckland, Department of Anthropology, University of Auckland (Research in Anthropology and Linguistics Monograph, 6), p. 15–22.

Specht J. (2011) – Diversity in Lithic Raw Material Sources on New Britain, Papua New Guinea, *Archaeology in Oceania*, 46, p. 54–66.

Specht J., Gosden C. (1997) – Dating Lapita Pottery in the Bismarck Archipelago, *Asian Perspectives*, 36, p. 175–99.

Specht J., Lentfer C., Gosden C., Jacobsen G., Lindsay S. (2015) – Pre-Lapita Decorated Wood from Apalo, West New Britain, Papua New Guinea, *Archaeology in Oceania*, 50, 2, p. 105–110.

Specht J., Lilley I., Dickinson W. R. (2006) – Type X Pottery, Morobe Province, Papua New Guinea: Petrography and Possible Micronesian Relationships, *Asian Perspectives*, 45, p. 24–47.

Specht J., Torrence R. (2007a) – Pottery Sites of the Talasea Area, Papua New Guinea, in J. Specht and V. Attenbrow (eds.), *Archaeological Studies of the Middle and Late Holocene, Papua New Guinea*, Sydney, Australian Museum (Technical Reports of the Australian Museum, 20), p. 131–96.

Specht J., Torrence R. (2007b) – Lapita All Over: Land-Use on the Willaumez Peninsula, Papua New Guinea, in S. Bedford, C. Sand and S. P. Connaughton (eds.), *Oceanic Explorations: Lapita and Western Pacific Settlement*, Canberra, ANU E-Press (Terra Australis, 26), p. 71–96.

Spriggs M. (1997) – *The Island Melanesians*, Oxford, Blackwell, 326 p.

Spriggs M. (2008) – Ethnographic Parallels and the Denial of History, *World Archaeology*, 40, p. 538–52.

Summerhayes G. (2000) – *Lapita Interaction*, Canberra, Department of Archaeology and Natural History, and Centre for Archaeological Research, Australian National University (Terra Australis, 15), 244 p.

Summerhayes G., Allen J. (1993) – The Transport of Mopir Obsidian to Late Pleistocene New Ireland, *Archaeology in Oceania*, 28, p. 144–48.

Summerhayes G. R., Bird J. P., Fullagar R., Gosden C., Specht J., Torrence R. (1998) – Application of PIXE-PIGME to Archaeological Analysis of Changing Patterns of Obsidian Use in West New Britain, Papua New Guinea, in M. S. Shackley (ed.), *Archaeological Obsidian Studies: Method and Theory*, Springer, New York (Advances in Archaeology and Museum Sciences, 3), p. 129–58.

Swadling P. (1991) – Garden Boundaries as Indicators of Past Land-Use Strategies: Two Case Studies from Coastal Melanesia, in A. Pawley (ed.), *Man and a Half: Essays in Pacific Anthropology and Ethnobiology in Honor of Ralph*

Bulmer, Auckland, The Polynesian Society (Memoir, 48), p. 550–57.

Thomas T. (2009) – Communities of Practice in the Archaeological Record of New Georgia, Rendova and Tetepare, in P. J. Sheppard, T. Thomas and G. R. Summerhayes (ed.), *Lapita: Ancestors and Descendants*, proceedings of the 7th International Lapita Conference (Honiara, 4–7 July 2007), Auckland, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 28), p. 119–45.

Torrence R. (2002) – Cultural Landscapes on Garua Island, Papua New Guinea. *Antiquity*, 76, 293, p. 766–76.

Torrence R. (2016) – Social Resilience and Long-Term Adaptation to Volcanic Disasters: The Archaeology of Continuity and Innovation in the Willaumez Peninsula, Papua New Guinea, *Quaternary International*, 394, p. 6–16.

Torrence R., Doelman T. (2007) – Problems of Scale: Evaluating the Effects of Volcanic Disasters on Cultural Change in the Willaumez Peninsula, Papua New Guinea, in J. Grattan and R. Torrence (eds.), *Living under the Shadow: The Archaeological, Cultural and Environmental Impact of Volcanic Eruptions*, Walnut Creek, Left Coast Press (One World Archaeology, 53), p. 42–66.

Torrence R., Kelloway S., White P. (2013) – Stemmed Tools, Social Interaction, and Voyaging in Early-Mid Holocene Papua New Guinea, *Journal of Island and Coastal Archaeology*, 8, p. 278–310.

Torrence R., Neall V., Doelman T., Rhodes E., Mckee C., Davies H., Bonetti R., Guglielmetti A., Manzoni A., Oddone M., Parr J., Wallace C. (2004) – Pleistocene Colonisation of the Bismarck Archipelago: New Evidence from West New Britain, *Archaeology in Oceania*, 39, 3, p. 101–30.

Torrence R., Neall V., Boyd B. (2009) – Volcanism and Historical Ecology on the Willaumez Peninsula, Papua New Guinea, *Pacific Science*, 63, p. 507–35.

Torrence R., Pavlides C., Jackson P., Webb J. (2000) – Volcanic Disasters and Cultural Discontinuities in Holocene Time, in West New Britain, Papua New Guinea, in W. G. McGuire, D. R. Griffiths, P. L. Hancock and I. S. Stewart (eds.), *The Archaeology of Geological Catastrophes*, London, The Geological Society of London (Geological Society Special Publication, 171), p. 225–44.

Torrence R., Specht J., Fullagar R., Bird R. (1992) – From Pleistocene to Present: Obsidian Sources in West New Britain, Papua New Guinea, *Records of the Australian Museum*, 42, p. 83–98.

Torrence R., Stevenson C. M. (2000) – Beyond the Beach: Changing Lapita Landscapes on Garua Island, Papua New Guinea, in A. Anderson and T. Murray (eds.), *Australian Archaeologist: Collected Papers in Honour of Jim Allen*, Canberra, Coombs Academic Publishing, p. 324–45.

Welsch R. L. (1998) – *An American Anthropologist in Melanesia: A. B. Lewis and the Joseph N. Field South Pacific Expedition 1909–1913*, Honolulu, University of Hawai'i Press, 919 p.

White J. P. (1996) – Rocks in the Head: Thinking about the Distribution of Obsidian in Near Oceania, in J. Davidson, G. Irwin, F. Leach, A. Pawley and D. Brown (eds.), *Oceanic Culture History: Essays in Honour of Roger Green*, Dunedin, New Zealand Journal of Archaeology (New Zealand Journal of Archaeology Special Publication), p. 199–209.

White J. P. (2007) – Ceramic Sites on the Duke of York Islands, in J. Specht and V. Attenbrow (eds.), *Archaeological Studies of the Middle and Late Holocene, Papua New Guinea*, Sydney, Australian Museum (Technical Reports of the Australian Museum, 20), p. 3–50.

Jim Specht
Australian Museum, Sydney
and
School of Philosophical and Historical Inquiry
University of Sydney, Australia
jspecht@bigpond.com

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 205-221
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Production et échange des lames d'herminette en pierre en Polynésie centrale

Les dynamiques technoéconomiques dans l'île de Tubuai (archipel des Australes)

Aymeric Hermann

Résumé : L'usage de l'herminette est intimement lié aux sociétés austronésiennes, et ce avant même leur entrée dans le Pacifique au cours du deuxième millénaire avant notre-ère. En Océanie, l'herminette constituait un outil essentiel dans la plupart des activités artisanales impliquant le travail du bois. Au-delà de cette fonction utilitaire, certaines herminettes remplissaient une fonction ostentatoire et pouvaient ainsi être échangées lors de cérémonies intercommunautaires, notamment dans le cadre de prestations matrimoniales ou pour sceller des alliances politiques. Dans les chefferies polynésiennes, ces herminettes cérémonielles composées d'une lame en pierre généralement plus imposante que les lames « utilitaires », étaient utilisées comme objet de prestige par les élites et marquaient un statut social particulier. Les herminettes polynésiennes jouaient donc un rôle majeur tant dans l'économie de subsistance que dans l'économie politique et cérémonielle.
À travers l'analyse technologique d'une série d'assemblages archéologiques provenant de la côte nord de l'île de Tubuai (archipel des Australes, Polynésie française), nous proposons d'aborder les dynamiques technoéconomiques liées à la production et à la distribution de ces objets dans les sociétés polynésiennes. L'étude de la texture et de la composition pétrographique, minéralogique et géochimique des matières premières et des artefacts découverts dans les différents sites archéologiques permet de restituer une partie de l'approvisionnement en matières premières ainsi que la circulation des lames polies dans l'espace social, au sein de l'île ou de réseaux d'échange à longue distance. À l'issue de la description et de la comparaison des différentes chaînes opératoires en présence, nous proposons une restitution des dynamiques de production et d'entretien des lames de pierre au sein du district traditionnel de Toerauetoru, depuis les carrières d'extraction des roches et des ateliers de taille spécialisés situés à proximité des gîtes géologiques jusqu'aux habitats répartis sur la plaine littorale.

Mots-clés : Polynésie centrale, archipel des Australes, ethnohistoire, technologie lithique, façonnage d'herminette, chaîne opératoire, géochimie, réseaux d'échanges.

Stone Adze Production and Exchange in Central Polynesia: Techno-Economic Dynamics on Tubuai (Austral Islands)

Abstract: Stone adzes are common to all Austronesian societies, and this has been the case even before they reached the Pacific islands, during the second millennium BCE. In Oceania, adzes were used as utilitarian tools, in various activities involving woodworking. Beyond this value, some adzes were exchanged during inter-community meetings, as a bride price or to seal an alliance. In the Polynesian chiefdoms, elites used ceremonial adzes as prestige goods in order to expand their influence and increase their social status. Through the technological analysis of lithic assemblages from the northern coast of Tubuai (Austral Islands), this paper focuses on techno-economic dynamics related to the production and the distribution of these goods within Eastern Polynesian societies. Petrographic and geochemical analysis of exploited geological materials and finished tools from different sites yield information on raw material supply strategies and polished blades exchange networks within the island or through long-distance exchange networks. Eventually, the description and comparison of operational sequences related to adze blade production and maintenance provide a reliable

assessment of technical processes within the traditional Toerauetoru district, from quarries and specialized workshops located near the rock sources to the dwelling sites established on the coastal plain.

Keywords: Central Polynesia, Austral Islands, ethnohistory, stone tool technology, adze manufacturing, production process, geochemical characterization, exchange networks.

L'herminette est un élément central de la culture matérielle traditionnelle en Océanie. Cet outil, composé d'une lame en pierre ou en coquillage fixée sur un manche en bois par des ligatures végétales, était présent dans toutes les cultures de tradition néolithique issues des foyers asiatique et néo-guinéen. Du point de vue de l'emmanchement, l'herminette se distingue de la hache par l'orientation du tranchant : dans le cas de la hache, la lame est orientée dans le même axe que le manche, et dans le cas de l'herminette son axe est perpendiculaire au manche. Du point de vue morphologique, la lame de hache présente deux faces (ou flancs) et deux biseaux symétriques, tandis que la lame d'herminette présente généralement deux faces dissymétriques et un tranchant à biseau simple (Garanger, 1974).

L'ubiquité de cet outil dans la culture matérielle polynésienne tient au fait qu'il constituait une part importante du système technique de ces sociétés (utilisé dans les travaux de bûcheronnage, de sculpture, de menuiserie ou de charpente). Par ailleurs, certaines herminettes étaient perçues comme des réceptacles de *mana*[(1)] et ont donc fait l'objet d'une valorisation sociale qui dépassait le cadre utilitaire. Elles étaient conservées sur plusieurs générations, notamment au sein des élites politico-religieuses. En cela, les herminettes sacrées (ou « de prestige ») représentaient un attribut du pouvoir, assuraient l'efficacité de certains rituels (Hermann, 2012), légitimaient de manière idéologique la position de ces élites et constituaient un vecteur important de la circulation du *mana* au sein de la société traditionnelle. C'est donc à double titre que l'étude de ces objets permet d'appréhender le fonctionnement de la société polynésienne traditionnelle. Certes, l'intérêt que l'archéologie porte aux données matérielles tient à une nécessité, mais ces données peuvent également être un moyen privilégié d'approcher l'organisation sociale des sociétés.

Dans le cadre de cet article, nous nous intéresserons principalement aux dynamiques de production de ces outils à travers l'analyse technologique d'assemblages archéologiques provenant de différents sites étudiés sur la côte nord de l'île de Tubuai (archipel des Australes, Polynésie française). La dynamique des chaines opératoires de production depuis les carrières d'extraction jusqu'aux ateliers et aux sites d'habitat se base sur l'identification d'une signature géochimique des gîtes d'extraction qui permet de retracer la circulation des matériaux au sein de l'île. Par ailleurs, la caractérisation chimique des matériaux a également permis de mettre en évidence des provenances exogènes à Tubuai pour certains artefacts. À travers la restitution des dynamiques de production, d'entretien et d'échange des lames d'herminettes en pierre, nous proposons un nouveau regard sur l'organisation technique et économique des chefferies de Polynésie centrale.

L'ÉTUDE DES HERMINETTES POLYNÉSIENNES : HISTORIQUE DES RECHERCHES ET POSITIONNEMENT ÉPISTÉMOLOGIQUE

Historique des recherches

La littérature ethnographique fournit de nombreux témoignages évoquant la fabrication et l'usage des herminettes (voir la synthèse de Cleghorn, 1984, p. 399-402). D. Malo a mentionné le savoir-faire des artisans de Hawai'i, dans la fabrication comme dans l'utilisation des herminettes (Malo, 1951, p. 51-52 et 78). Le statut social élevé des artisans et l'usage des herminettes cérémonielles dans les alliances politiques est bien documenté à Mangaia, aux îles Cook (Gill, 1876, p. 17 ; Buck, 1934, p. 132), ainsi qu'à Hawai'i (Malo, 1951, p. 51-52). Le révérend W. Gill a décrit le travail des artisans auquel il a assisté à Mangaia (îles Cook) et a évoqué les accidents de taille relatifs à la mise en forme des lames ainsi que les rejets causés par la mise au jour de plans de diaclase ou la fracture des préformes (Gill, 1876, p. 117-119).

La dimension rituelle associée à cet objet a également été abordée par plusieurs auteurs. P. Smith a rapporté une incantation Moriori recueillie dans les îles Chatham (Rekohu), situées au large de l'île du sud de la Nouvelle-Zélande (Aotearoa). Celle-ci mentionne l'existence de créatures magiques et était chantée lors du polissage des lames (Smith, 1892, p. 81-82). Par ailleurs, plusieurs légendes polynésiennes mettent en scène l'usage de rituels liés à l'utilisation des herminettes, notamment dans celle du héros Rata (Elbert et Kirtley, 1966 ; Henry, 2000 ; Kozim, 2010 ; Luomala, 1955 ; Stimson, 1937) et dans celles du cycle de Taheta (Handy, 1930 ; Hermann, 2012 ; Lavondès, 1966 et 1975).

L'étude des collections muséographiques a donné lieu à de nombreuses descriptions formelles tout au long du xx^{e} siècle. Celles-ci ont abouti à des classifications typologiques qui ont permis d'appréhender la grande diversité des formes de lames découvertes dans les archipels polynésiens (Best, 1912 ; Skinner, 1919, 1940, 1943a et 1943b ; Stokes, 1930 ; Duff, 1945 et 1959 ; Suggs, 1961 ; Kellum, 1964 ; Figueroa et Sanchez, 1965 ; Vérin, 1969 ; Garanger, 1972 ; Kirch, 1972 ; Lavondès, 1973 et 1987). Les typologies descriptives des lames d'herminette ont également été utilisées pour tenter d'identifier des mouvements de populations et des processus de peuplement dans l'aire polynésienne, alors que les données chrono-stratigraphiques manquaient cruellement (Duff, 1960 ; Emory, 1968 ; Sinoto, 1970 ; Green, 1971).

Dans le cadre des analyses typochronologiques, les lames d'herminette ont également été utilisées en corrélation avec d'autres artefacts (notamment les hameçons), en lien avec les formes de l'architecture monumentale, afin de proposer des périodisations pour la Polynésie centrale (Suggs, 1961 ; Sinoto, 1966 ; Kirch, 1984 ; Walter, 1996), l'archipel de Hawai'i (Kirch, 1985) et la Nouvelle-Zélande (Duff, 1956 ; Green, 1968 et 1971 ; Green et Davidson, 1969).

Un tournant épistémologique s'est opéré avec les travaux de R. Green dans l'archipel des Samoa, lorsque celui-ci a mis en évidence l'influence de la nature des matériaux exploités sur les processus techniques employés pour leur transformation, et donc sur la forme finale des produits façonnés (Green, 1974, p. 144). Plus récemment, les travaux expérimentaux menés par M. Turner et D. Bonica sur les roches sédimentaires, volcaniques et métamorphiques de Nouvelle-Zélande ont permis d'améliorer la compréhension du déterminisme des matières premières lithiques en Polynésie (Turner, 2000, p. 20-24).

Avec le développement de la technologie lithique au cours des quarante dernières années, les études des assemblages lithiques polynésiens se sont étendues aux préformes, aux nucléus et aux déchets de taille (Gérard, 1975 ; McCoy, 1977 ; Leach et Leach, 1980 ; Cleghorn, 1982 et 1986 ; Leach, 1984 et 1990 ; Orliac, 1986 ; Leach et Witter, 1987). L'organisation des grandes séquences de production des lames et la dialectique entre techniques et matériaux ont été mieux comprises suite à l'adoption des premières démarches expérimentales à Tahiti (Gérard, 1975) et surtout à Hawai'i (Cleghorn, 1982).

Au cours des deux dernières décennies, les outils en pierre ont surtout fait l'objet d'analyses spectrométriques. À travers l'identification de la signature géochimique des matériaux exploités, celles-ci ont permis de retracer la circulation des lames polies entre différentes îles et différents archipels, et participent ainsi à la redécouverte d'anciens réseaux d'échange à plus ou moins longue distance. Des analyses géochimiques et des observations technologiques ont été menées de manière conjointe dans plusieurs travaux récents, notamment ceux de J. Kahn à Mo'orea et à Tahiti (Kahn, 2005 et 2009), et ceux de A. McAlister à Nuku Hiva (Allen et McAlister, 2010 ; McAlister, 2011). En établissant des correspondances entre les sites d'extraction des roches et les sites de transformation des préformes, nos travaux s'orientent également vers la description des dynamiques de production des lames d'herminette dans leur contexte géographique et social.

Positionnement épistémologique

Dans le domaine des techniques et de l'économie, les traditions de recherche anthropologiques française et anglo-saxonne se distinguent par l'importance qu'elles accordent respectivement aux techniques de production *(making)* et à la consommation ou à l'utilisation des objets *(doing)*. Traditionnellement, l'approche anglo-saxonne confère aux objets le rôle d'une interface matérielle entre les individus et le monde, d'où l'expression de culture matérielle *(material culture)*. À l'inverse, depuis les travaux de M. Mauss (Mauss, 1947 et 1948), les sciences sociales francophones se sont surtout attachées à l'étude des systèmes techniques de production et de leur relation avec l'organisation sociale des sociétés. Néanmoins, ces deux aspects de la sphère technoéconomique doivent être traités de manière complémentaire puisque le système techno-économique d'une société correspond à l'ensemble des procès matériels par lesquels des biens et des services sont produits, échangés, et consommés.

Dans le modèle développé par M. Sahlins (Sahlins, 1976), les chefferies (notamment polynésiennes) se caractérisent par une organisation socioéconomique à deux pans : d'un côté par un mode de production domestique fonctionnant au niveau de la maisonnée, et de l'autre par un mode de production communautaire géré par les élites. Or, si l'organisation de la production reflète la structure sociale au sein de laquelle se déploient les processus techniques, l'étude de ces processus devrait permettre, en retour, de mettre en lumière certains aspects de l'organisation sociale de la société polynésienne préeuropéenne. Pour ce faire, nous avons adopté l'approche technologique telle que l'envisageait M. Mauss, c'est-à-dire cherchant à mettre en évidence la manière dont la production des objets détermine les relations entre les hommes (Mauss, 1948 ; Lemonnier, 2012).

MÉTHODOLOGIE

Pétrographie et géochimie

La traçabilité des roches exploitées et découvertes en contexte archéologique se base en premier lieu sur les données géologiques disponibles pour l'île de Tubuai. Une partie de ces données a été publiée suite aux travaux effectués par les géologues dans les années 1980 (Maury *et al.*, 1994 et 2000). La partie non publiée des données nous a été transmise par R. Maury (UMR 6538, université de Bretagne occidentale). Par ailleurs, des prospections archéologiques effectuées au niveau des zones à fort potentiel d'exploitation nous ont permis de circonscrire des zones d'approvisionnement et de différencier de manière plus efficace les gîtes d'extraction (Hermann *et al.*, 2012 ; Hermann, 2013). À cette occasion, nous avons effectué une série de prélèvements sur les sites découverts.

Tous les échantillons de roche pris en compte ont été analysés à l'IUEM de Plouzané par C. Liorzou à l'aide d'un spectromètre de masse (ICP-AES), afin de déterminer leur composition en éléments majeurs et en traces. Les prélèvements ont été effectués par carottage et la préparation des échantillons a été menée selon le protocole décrit par J. Cotten et collaborateurs (Cotten *et al.* 1995). Les tests de calibration ont été réalisés selon les standards internationaux (ACE, BEN, JB-2, PM-S et WS-E). Les analyses isotopiques (ICP-MS) ont été effectuées par L. Sauzéat et C. Chauvel (université de Grenoble) sur le multicollecteur (Nu plasma) de l'ENS de Lyon.

Technologie lithique

Comme le faisait remarquer S. Ploux à propos des nucléus, les savoir-faire, l'intention et les moyens techniques mis en œuvre pour obtenir un produit donné ne peuvent être identifiés uniquement à partir de l'observation du produit ou des artefacts qui paraissent les plus significatifs du processus de production (Ploux, 1999, p. 43). De même, l'étude de la production des lames d'herminette ne peut se contenter d'une simple description des produits finis ou semi-finis (en l'occurrence les préformes façonnées). Ces produits constituent l'aboutissement d'un schéma opératoire, non seulement caractéristique de compétences techniques acquises et de schèmes techniques élaborés par l'artisan, mais également déterminé par l'organisation générale des activités techniques. L'analyse des processus techniques que nous proposons consiste à replacer chaque artefact dans un processus de production (produit, sous-produit et déchets), de manière à restituer, dans une perspective dynamique, l'agencement de la chaîne opératoire au sein de la sphère sociale, depuis le choix de la matière première jusqu'à l'abandon de l'objet fini.

La nature et la forme des blocs bruts (type de basalte, type de support : naturel ou taillé) révèlent les choix relatifs à l'approvisionnement. Les produits finis ou en cours de finition (éclats retouchés, préformes façonnées) permettent de définir les standards et les objectifs formels recherchés. Enfin, les déchets issus des processus de taille (éclats de mise en forme, nucléus, éclats de façonnage, ébauches abandonnées) documentent les choix et les modalités techniques de la production aux cours des différentes étapes logiques de la production.

TUBUAI, UNE ÎLE DE POLYNÉSIE CENTRALE

Situation géographique

Les îles Australes constituent la partie la plus méridionale de la Polynésie française, située entre 21° et 27° de latitude sud, et entre 144° et 153° de longitude ouest. L'archipel est composé de cinq îles volcaniques (Rimatara, Rurutu, Tubuai, Ra'ivavae et Rapa iti). C'est l'un des groupes d'îles les moins bien documentés par les travaux archéologiques, mais également du point de vue de la linguistique et des traditions orales. Les données disponibles sur la région sont d'autant plus difficiles à synthétiser que ces îles, bien qu'aujourd'hui regroupées dans un même ensemble administratif, ne constituaient pas autrefois un ensemble territorial et culturel homogène.

Les données de l'archéologie et de l'ethnohistoire

Les données archéologiques sur l'archipel des Australes sont très fragmentaires, et disponibles sur quelques îles seulement, dont Rimatara (Eddowes, 2004 ; Prebble, 2006), Rurutu (Bollt, 2005 ; Vérin, 1969) et Rapa iti (Anderson et Kennett, 2013 ; Prebble, 2006). Peu de travaux ont été effectués à Tubuai avant les années 1990, et ils ne concernent généralement que les structures de surface (Aitken, 1930 ; Candelot, 1980 ; Routledge et Routledge, 1921). L'île de Tubuai, située entre 22°5' et 27°5' de latitude sud et 144°5' et 153° de longitude ouest, constitue pourtant la plus grande île de l'archipel et dispose d'un fort potentiel archéologique (Hermann, 2011a).

Les données linguistiques et archéologiques (architecture cérémonielle et typologie des artefacts) suggèrent que le groupe des Australes partageait, avant la colonisation européenne, plus de traits culturels communs avec le groupe sud des îles Cook qu'avec aucun autre archipel de la région. Les traditions orales révèlent que les groupes installés dans l'ouest de l'archipel des Australes étaient engagés dans un réseau d'échange avec l'archipel des îles Cook au cours de la dernière période pré-européenne (Eddowes, 2004, p. 95-96 ; Ellis, 1969). Ce réseau impliquait notamment l'échange de plumes rouges de l'oiseau appelé *Vini 'ura (Vini kuhlii)*. Les chefs portaient ces plumes sur des parures ostentatoires qui marquaient leur sacralité – le *mana* – et permettaient de justifier d'une position sociale privilégiée. Par ailleurs, les témoignages ethnohistoriques indiquent qu'une partie des Australes a été peuplée par des populations qui partageaient les mêmes traits culturels et qui étaient probablement reliées aux Cook du sud et aux îles Sous-le-Vent.

Selon les informations recueillies par R. Aitken (Aitken, 1930, p. 30-32), la population de Tubuai était autrefois regroupée en petits villages répartis au sein de différents *mata'eina'a*, ou « districts » (fig. 1) : Toerauetoru au nord-ouest (dans la commune moderne de Mataura), Natieva et Paorani au nord-est (commune actuelle de Taahuaia), Nahitorono au sud (commune actuelle de Mahu), Tuporo à l'est (hameau actuel de Haramea), Tamatoa au sud-est (village actuel du même nom est situé à la limite entre les communes de Taahuaia et de Mahu) et Huahine au centre sans accès direct au littoral. R. Aitken (Aitken, 1930, p. 31-32) insiste sur le fait que Toerauetoru représentait, à une époque reculée, le district principal de l'île. Au sein de ce district se trouvait le *marae* Tonohae, décrit comme l'un des plus importants de l'île. Celui-ci était lié à une lignée de chefs, comme celle des Tamatoa des îles Sous-le-Vent, et au héros mythique Hiro, qui serait venu jusque dans l'archipel des Australes pour établir un *marae* dans chaque île, d'abord à Ra'ivavae puis à Tubuai, Rurutu et Rimatara (Aitken, 1930, p. 123). La maisonnée du chef du district était située à proximité de ce *marae*, à l'embouchure de la rivière Vaiohuru qui marquait la limite avec le district de Tuporo. La construction de l'église par les missionnaires a poussé la population de Toerauetoru à s'installer plus à l'est (au centre du village actuel de Mataura), abandonnant ainsi le village lié à l'ancien pouvoir politicoreligieux[(2)].

Le choix du corpus

Après avoir effectué un échantillonnage au sein des assemblages archéologiques et des formations géolo-

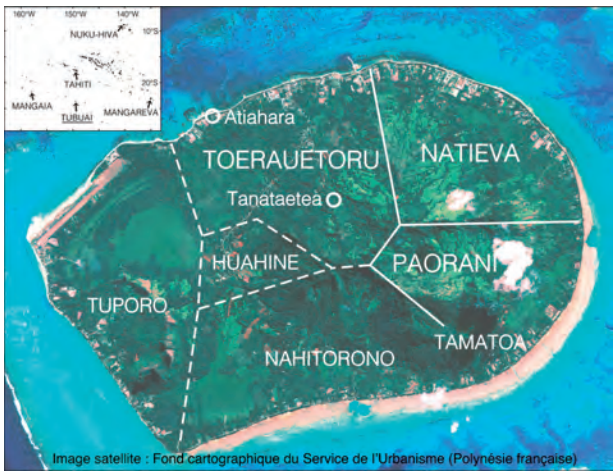


Fig. 1 – Carte de Tubuai.
Fig. 1 *– Map of Tubuai.*

giques de l'île (Hermann, 2011a, 2011b, et 2013, p. 151-157), nous avons mis en place une traçabilité des matériaux lithiques à l'aide des techniques de caractérisation géochimique par spectromètre de masse (Hermann, 2013, p. 166-185). Il a ainsi été possible de restituer des réseaux d'approvisionnement en matières premières entre les différentes localités de l'île. Ces réseaux constituaient une sorte de « fil rouge » qu'il a fallu suivre pour comprendre l'enchaînement des actions techniques entreprises dans les différents sites. Parmi les sites pris en compte, nous avons sélectionné des assemblages archéologiques au sein du district de Toerauetoru mentionné plus haut.

Nous avons d'abord choisi de focaliser notre attention sur le site d'Atiahara découvert au nord-ouest sur la terre Atiahara (fig. 1) et fouillé successivement sous la direction de plusieurs archéologues au cours des années 1990-2000 (R. Shutler, M. Eddowes, É. Conte, et dernièrement R. Bollt). Ce site constitue la seule occupation domestique en place connue dans l'île. À l'aide des documents de terrain issus des fouilles successives, nous avons pu restituer une organisation spatiale des structures d'habitat pour les différents niveaux d'occupation du site. Les niveaux d'occupation ont été datés entre le début du XIII^e^ siècle et la fin du XIV^e^ siècle de notre ère (Hermann, 2013, p. 210-214 ; Hermann *et al.*, 2015 ; ici : fig. 2).

Les matériaux lithiques utilisés sur le site d'Atiahara proviennent majoritairement d'une carrière d'extraction de basanites découverte plus à l'intérieur de l'île, mais au sein du même territoire traditionnel de Toerauetoru, sur la terre Tanataetea (Hermann, 2013, p. 166-178). Nous avons choisi d'étudier les dynamiques de production présentes dans ces deux sites car ils nous donnaient l'opportunité de suivre des chaînes opératoires dans un même espace social. Les niveaux archéologiques d'amas d'éclats découverts au niveau des ateliers de taille situés à proximité de la carrière ont été fouillés et datés (Hermann, 2011b). L'analyse stratigraphique et les datations radiocarbone ont permis de mettre en évidence une occupation de ces ateliers sur une durée relativement longue, à partir du XIV^e^ siècle (Hermann, 2013, p. 191-199 ; ici : fig. 2).

LES CHAÎNES OPÉRATOIRES DE PRODUCTION

L'approvisionnement

À Atiahara, l'approvisionnement en matières premières est très variable. Dans chaque niveau d'occupation ce sont les basanites de Tanataetea qui ont été majoritairement exploitées. Néanmoins plusieurs lames polies ont été produites à partir de basanites provenant d'un autre district de l'île. Ces lames de bonne facture ont semble-t-il été importées déjà finies au sein du site d'Atiahara. En ce qui concerne les lames d'herminette polies confectionnées à partir des basanites de Tanataetea, elles sont minoritaires dans les niveaux inférieurs, mais largement majoritaires dans le niveau le plus récent, dont l'occupation a été datée de la fin du XIV^e^ siècle (Hermann, 2013, p. 210-214).

Entre le milieu du XIII^e^ siècle et le milieu du XIV^e^ siècle, les blocs de basanite extraits à Tanataetea ont été importés bruts à Atiahara afin de confectionner de petites préformes sur éclats. Ce n'est que dans un deuxième temps, au cours du XIV^e^ siècle, que des lames polies de meilleure facture produites à partir de ces mêmes roches ont été introduites au sein des habitats d'Atiahara, alors que des ateliers de taille sont justement mis en place directement au niveau du gîte de matière première à Tanataetea. Tout porte donc à croire que les lames d'herminette polies de bonne facture qui sont importées à Atiahara au cours de cette deuxième période sont le fruit du travail des artisans installés à Tananaetea.

Les processus de transformation

L'analyse technologique menée sur les assemblages des sites de Tanataetea et Atiahara nous a permis de mettre en évidence différentes chaînes opératoires de taille de la pierre (débitage et façonnage) qui révèlent l'existence de processus technoéconomiques particuliers, ainsi que des individus, des savoir-faire, et des contextes de production très différents.

Dans les ateliers de taille à ciel ouvert situés au niveau de la carrière de Tanataetea, les lames d'herminette ont été produites de manière très standardisée et la sélection de la matière première exploitée a été d'autant plus rigoureuse que les objectifs de production semblaient strictement définis (fig. 3). Grâce à une grande maîtrise des techniques de percussion, les tailleurs ont mis en œuvre différentes stratégies de débitage afin de détacher des éclats massifs qui ont constitué les supports adaptés à la confection de lames d'herminette de grandes dimensions. Grâce à une préparation importante des surfaces de plan de frappe et à une gestion rigoureuse des volumes façonnés, les méthodes de façonnage bifaciales ou trifaciales ont permis d'obtenir de grandes lames d'herminette de forme régulière et standardisée à partir des éclats-supports massifs (fig. 4).

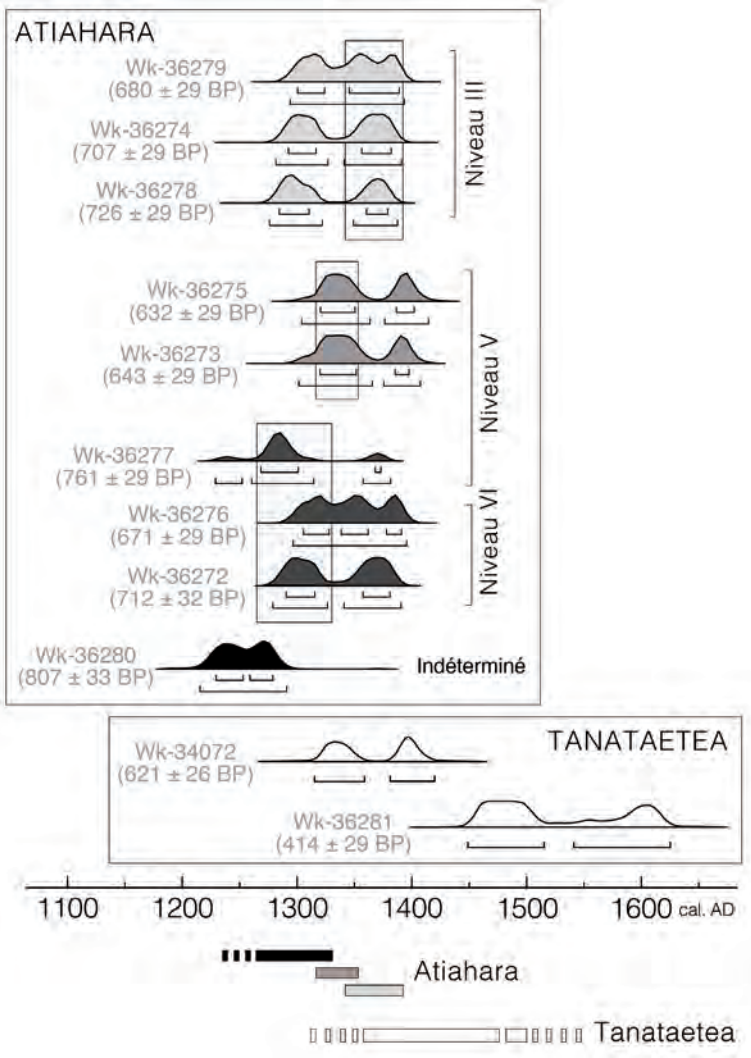


Fig. 2 – Datations radiocarbone des sites de Tanataetea et d'Atiahara.
Fig. 2 *– Radiocarbon dating results from the sites of Tanataetea and Atiahara.*

Dans le contexte domestique du site d'Atiahara, les artefacts découverts témoignent au contraire de la production de petites lames d'herminette réalisées à l'aide de savoir-faire plus limités. Les activités de taille mises en œuvre (débitage et façonnage) sont effectivement plus simples et la gamme peu variée des produits confectionnés est marquée par une certaine irrégularité dans les formes (fig. 6a). Le matériel recueilli au niveau de ces structures d'habitat ne montre pas une spécialisation particulière dans les activités de production lithique (pas de préparation des surfaces de plan de frappe, mauvaise gestion des volumes et des techniques de percussion, etc.). Par ailleurs, nous avons différencié deux grandes catégories de chaînes opératoires de production lithique à Atiahara (fig. 5).

La première catégorie correspond à un processus que nous avons qualifié de « primaire », dans le sens où il inclut toutes les séquences opératoires, depuis l'extraction des matériaux bruts jusqu'au polissage des lames. C'est un processus de production linéaire, comparable à celui observé à Tanataetea, impliquant une certaine sélection des blocs de matière première, le débitage d'éclats-supports (de dimensions beaucoup plus modestes qu'à Tanataetea) et finalement le façonnage des préformes, effectué de manière relativement expéditive (fig. 6a).

La deuxième catégorie de chaîne opératoire comprend deux processus de transformation des lames polies utilisées. D'un côté, on observe un processus d'entretien des lames dont le tranchant a été émoussé par l'utilisation (fig. 6b), et de l'autre la réutilisation des lames cassées comme support afin de produire de nouvelles lames, ce que l'on a appelé « un processus de production secondaire » (fig. 6c). Ce recyclage des lames devenues inutilisables semble indiquer que les occupants du site d'Atiahara ont eu un accès limité aux matériaux bruts de bonne qualité.

De manière générale, les savoir-faire des artisans à Atiahara sont très différents de ceux maîtrisés et mis en œuvre à Tanataetea. Néanmoins, le mode de production est comparable dans les deux contextes, car il correspond à une combinaison des chaînes opératoires de débitage et de façonnage, réalisées successivement de manière à produire des lames d'herminette sur éclat. L'utilisation de prismes naturels comme supports au façonnage est certes

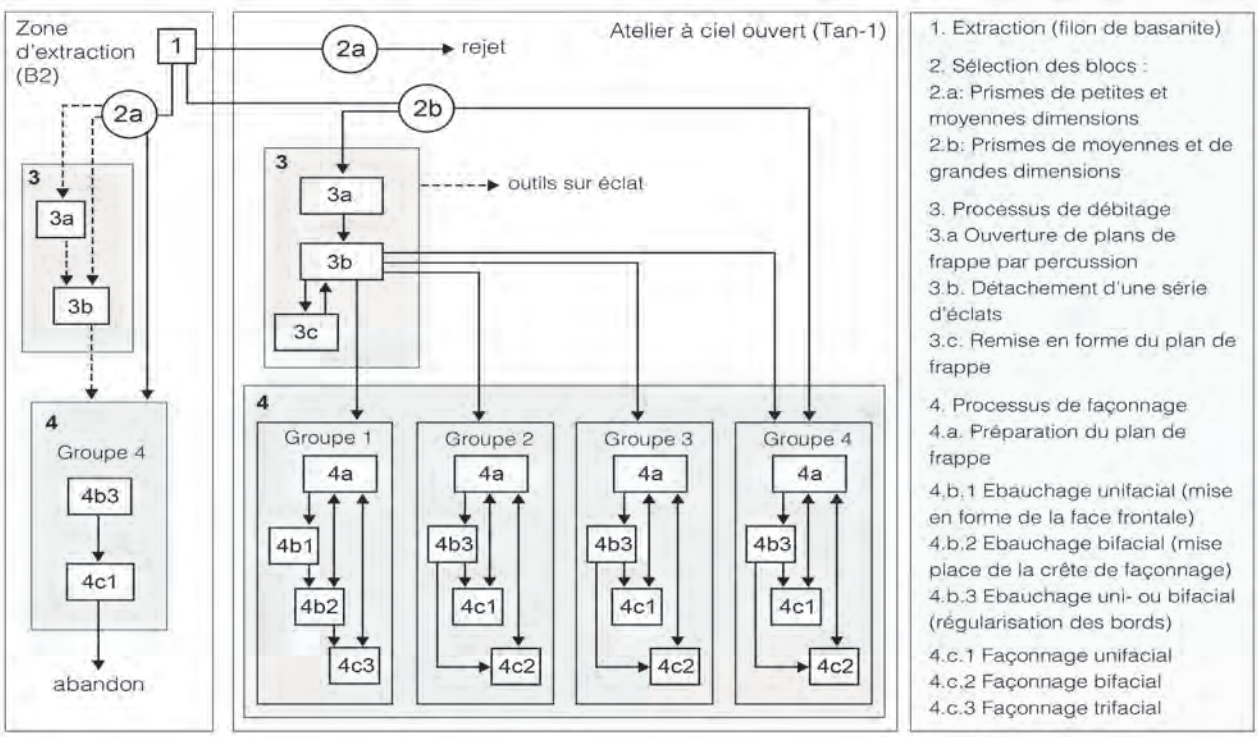


Fig. 3 – Chaînes opératoires de production standardisée des lames en pierre dans les ateliers de Tanataetea.
Fig. 3 *– Operational sequences of the standardized production of stone blades in the Tanataetea workshops.*

plus courante en contexte non spécialisé, mais la réalisation du débitage, aussi modeste soit-il, atteste d'une conception particulière de la production lithique qui est partagée par tous : spécialistes et non-spécialistes. Cette organisation de la production correspond à un choix particulier parmi un éventail d'autres choix possibles. D'ailleurs, lorsque les prismes naturels extraits présentaient des caractéristiques morphologiques proches de celles du produit fini envisagé par le tailleur, les lames d'herminette ont été produites uniquement par façonnage, comme dans les ateliers du Mauna Kea (île d'Hawai') où les tailleurs spécialistes ont utilisé des prismes de section quadrangulaire (Cleghorn, 1982 et 1986), ou aux Marquises avec les lames de type *Koma* façonnées sur des prismes de section triangulaire (Anderson *et al.*, 1994; Suggs, 1961, p. 112-113).

La combinaison des processus de débitage et de façonnage avait également été décrite par H. Leach et D. Witter (Leach et Witter, 1987 et 1990) dans leur étude des ateliers de Tataga-matau à Tutuila (Samoa Américaines). Par ailleurs, l'examen des planches photographiques représentant des préformes de lame dans la littérature nous a permis d'identifier l'utilisation d'éclats-supports plus ou moins longs et massifs partout en Polynésie (voir synthèse de Hermann, 2013, p. 367-368). Il semble donc que la production de lames d'herminette sur éclat corresponde à une tradition technique propre à l'ensemble des sociétés Polynésiennes, différente de celle des sociétés installées dans l'ouest du Pacifique, où l'utilisation de roches sédimentaires ou métamorphiques a donné lieu à d'autres techniques et d'autres types de support.

LA DISTRIBUTION DES PRODUITS FAÇONNÉS

La traçabilité des matières premières lithiques en Polynésie centrale : éléments de méthodologie

Depuis plus de vingt ans, la caractérisation pétrographique et géochimique des basaltes permet de restituer des sphères d'échange à longue distance en Polynésie qui étaient jusque-là insoupçonnées, faute de preuve matérielle et d'information correspondante dans les traditions orales.

Pour permettre une traçabilité fiable, les correspondances entre les artefacts et les gîtes de matière première doivent être établies à partir d'un modèle de différenciation qui corresponde à la variabilité pétrochimique des roches issues de la région prise en compte. Le modèle que nous présentons (fig. 7) permet non seulement d'orienter les choix des analyses à effectuer pour chaque échantillon, mais également de hiérarchiser les données acquises puisque les critères employés pour identifier les signatures pétrochimiques et différencier les provenances n'ont de valeur que par rapport au contexte géologique considéré.

M. Weisler (Weisler, 1993) avait déjà proposé de hiérarchiser les informations relativement aux différents critères d'analyse des roches en associant les analyses chimiques aux observations pétrographiques des minéraux et des oxydes. Il mettait ainsi en évidence l'intérêt de quantifier les éléments majeurs pour différencier des

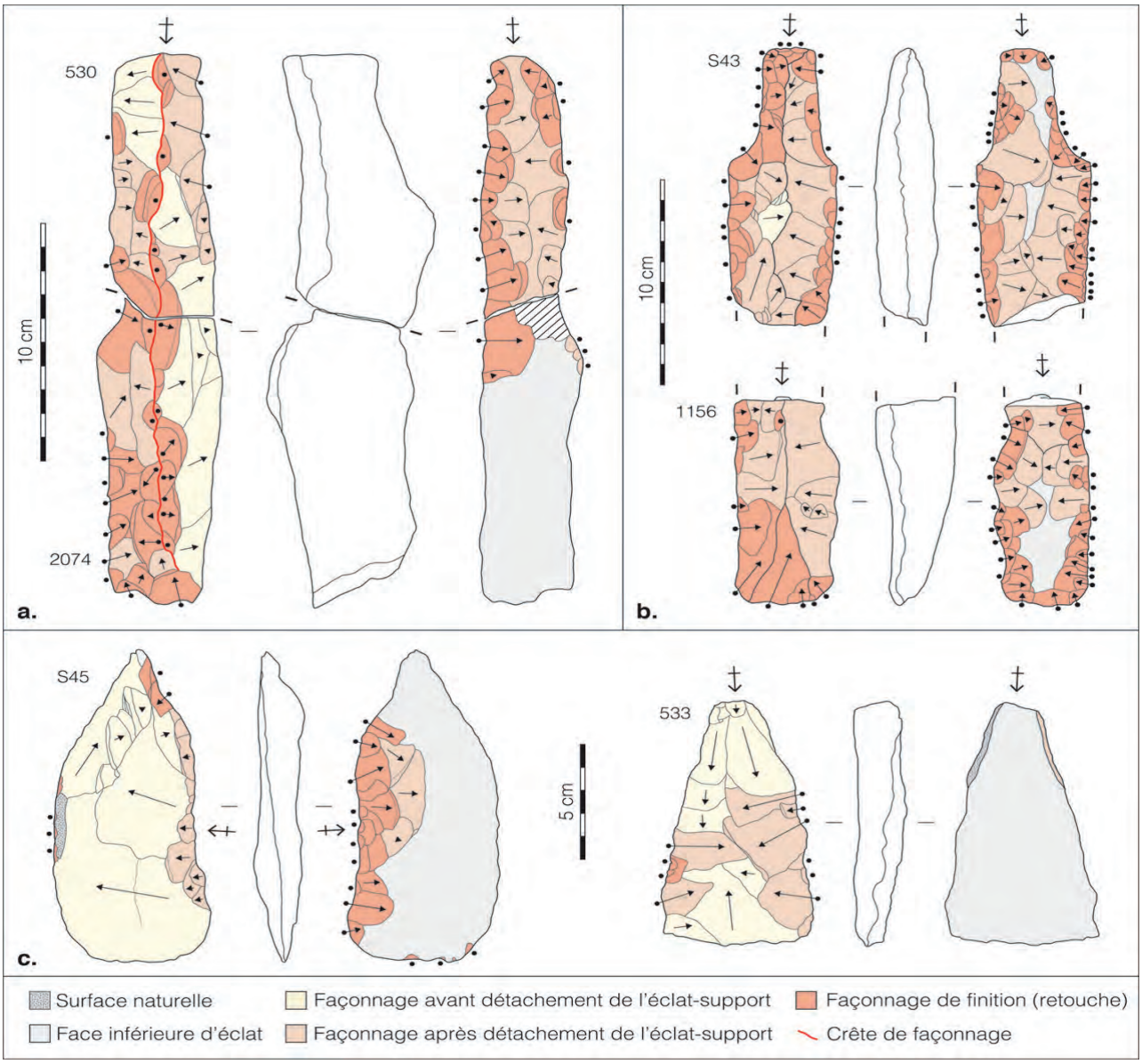


Fig. 4 – Préformes de lames produites sur le site de Tanataetea.
***Fig. 4** – Blade preforms produced at the Tanataetea site.*

types de roches et les éléments en trace pour prendre en compte variabilité géochimique au sein d'un ensemble de coulées de lave de même nature (Weisler, 1993, p. 62-63). Néanmoins, la question de l'échelle d'interprétation reste aujourd'hui problématique si l'interprétation des résultats ne considère pas un niveau plus général de différenciation des roches volcaniques : celui des domaines mantelliques sources et des pôles isotopiques. En effet, les roches volcaniques peuvent être issues de différents domaines géologiques : les dorsales sous-marines, les zones de subduction (comme dans les arcs insulaires de l'ouest du Pacifique) et le domaine intra-plaque au niveau des points chauds (comme toutes les îles polynésiennes situées à l'est de la ligne d'Andésite, et notamment les archipels de Polynésie centrale). Au sein de ce domaine intra-plaque, chaque point chaud a produit une suite d'îles caractérisées par des compositions isotopiques particulières qui varient entre les différents alignements d'îles, mais également d'une île à l'autre puisque la composition des laves issues du réservoir magmatique a évolué au fil du temps. En Polynésie centrale, les points chauds se caractérisent par des compositions très différentes (Chauvel *et al.*, 1992) :

– le pôle HIMU (pour *high-μ*, μ désignant le rapport U/Pb), qui caractérise la plupart des laves de l'alignement des Australes-Cook (Ra'ivavae, Rurutu, Tubuai et Mangaia), présente des rapports $^{238}U/^{204}Pb$ élevés, aboutissant au fil du temps à des rapports $^{206}Pb/^{204}Pb$ particulièrement élevés (> 20) ;

– le pôle EM-1 *(enriched mantle type 1)*, au sein duquel sont comprises les laves de Rarotonga, des Gambier et de Pitcairn, qui se caractérisent notamment par des rapports $^{87}Sr/^{86}Sr$ plus élevés (> 0,704) et des rapports $^{206}Pb/^{204}Pb$ particulièrement faibles (< 19) ;

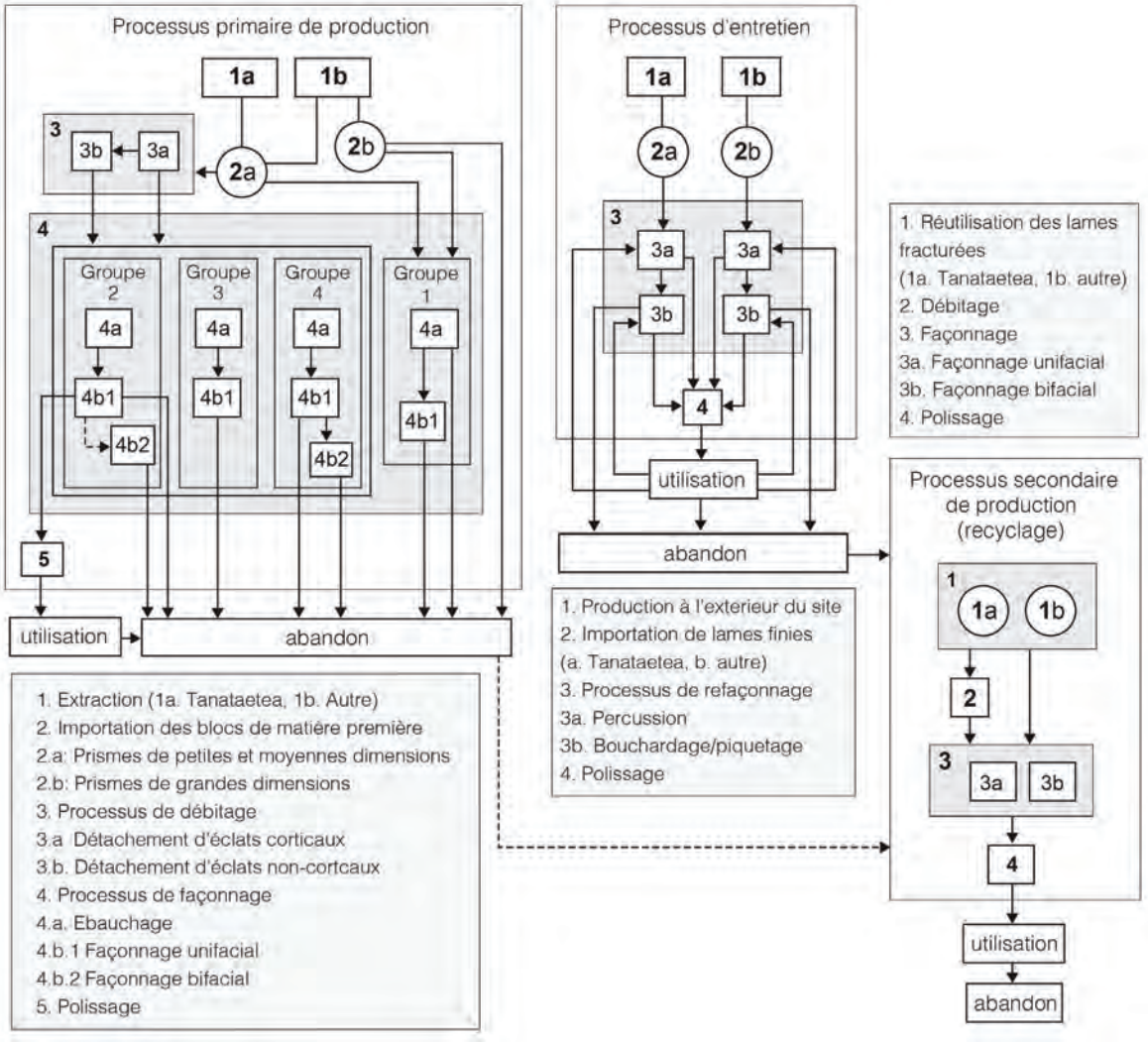


Fig. 5 – Chaînes opératoires de production et d'entretien des lames en pierre dans les habitats du site d'Atiahara.
***Fig. 5** – Operational sequences of production and maintainance of stone blades in the houses of the Atiahara site.*

– le pôle EM-2 *(enriched mantle type 2)*, qui correspond aux laves des archipels de la Société et des Marquises, celles-ci étant enrichies en matériaux sédimentaires, et caractérisées par des rapports $^{87}Sr/^{86}Sr$ plus élevés (> 0,703) et des valeurs faibles pour Nb/Th et Ta/La (Kalfoun, 2001, p. 128).

La prise en compte des données isotopiques permet ainsi d'identifier l'origine de chaque échantillon de manière plus efficace puisqu'elle permet de restreindre le nombre de sources potentielles à des régions bien définies.

L'identification des transferts interinsulaires en Polynésie centrale

L'utilisation de ce modèle de différenciation nous a permis de réinterpréter les résultats des analyses géochimiques menées au cours des vingt dernières années. La synthèse présentée en figure 8 restitue l'ensemble des transferts inter-îles mis en évidence pour la Polynésie centrale, tout en mettant en évidence la partialité de certaines identifications. Nous avons considéré que les analyses étaient complètes lorsque la mesure des éléments majeurs et des éléments en traces a été associée à celle des rapports d'isotopes radiogéniques permettant l'identification des domaines mantelliques sources. Les analyses comprenant seulement l'une ou l'autre de ces mesures ont été qualifiées de partielles car elles permettent certes d'identifier une provenance exogène mais pas l'emplacement du gîte source de manière certaine [(3)]. Enfin, les analyses prenant en compte uniquement le type pétrographique (à travers la quantification des éléments majeurs) ont été qualifiées de « très partielles », puisque ce type de caractérisation seul ne permet généralement pas de discriminer de manière assez précise une île ou un archipel par rapport à d'autres (pas plus que l'analyse pétrographique en lame mince). L'amélioration de la précision dans les analyses spectrométriques permet certes une meilleure quantification des éléments en traces (Charleux *et al.*, 2014), mais le problème de la discrimination des sources est toujours relatif à l'identification d'un domaine géologique spécifique, donc à la détermination d'une signature isotopique.

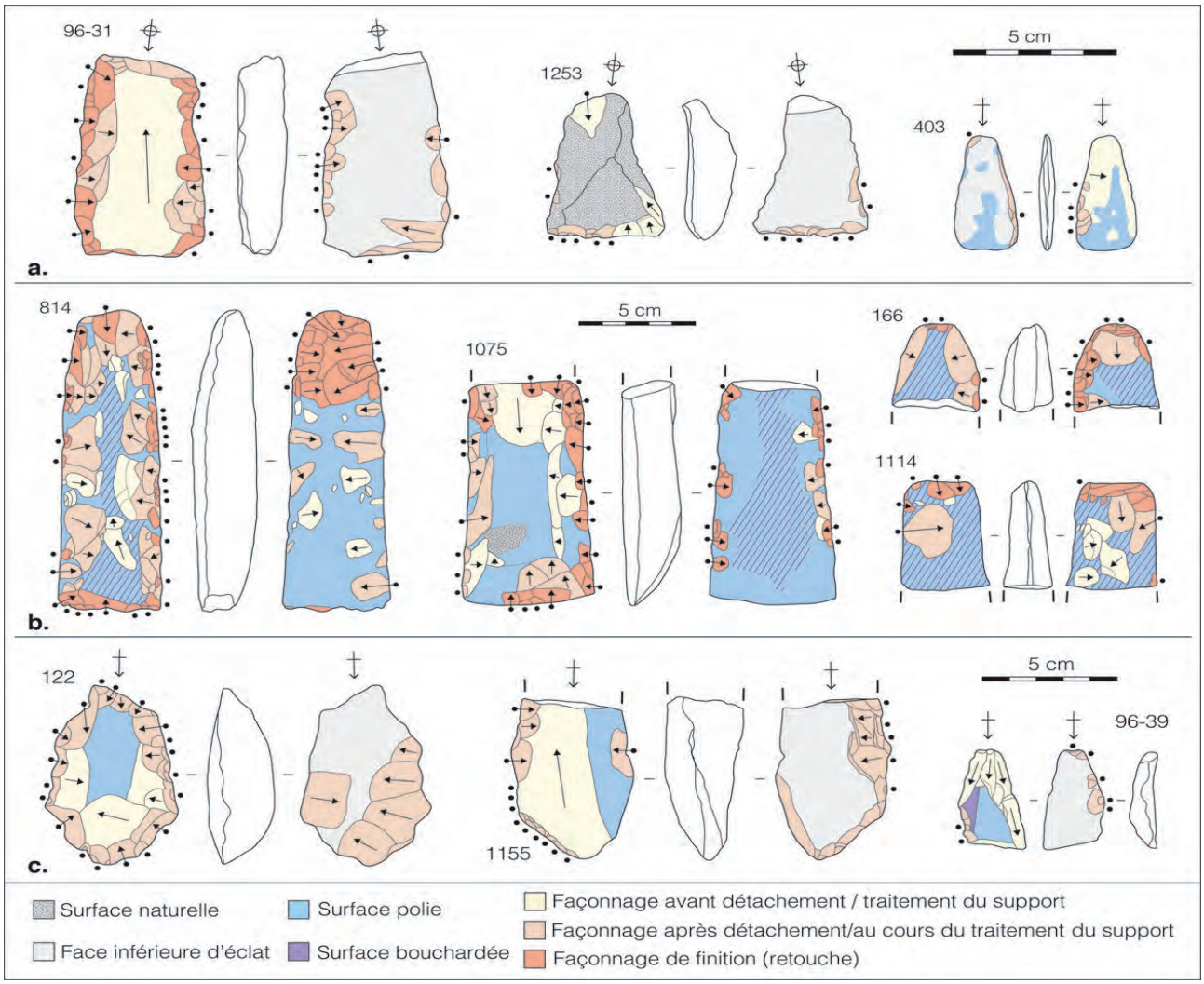


Fig. 6 – Préformes de lames produites et entretenues sur le site d'Atiahara ; a : production primaire ; b : production secondaire.
***Fig. 6** – Preforms produced and maintained at the Atiahara site; a: primary production; b: secondary production.*

Tubuai au sein des réseaux d'échange de Polynésie centrale

Tous les artefacts analysés à Atiahara provenaient de niveaux archéologiques datés de la fin du XII^e^ à la fin du XIV^e^ siècle. Dans cet assemblage, trois éléments apparaissent exogènes à l'île :

– Une lame d'herminette façonnée dans un basalte alcalin présente une composition isotopique clairement différente de celle qui caractérise le pôle HIMU (Hermann, 2013, p. 179-182). Celle-ci correspond bien au pôle isotopique EM-2, qui englobe les archipels de la Société, des Marquises et des Gambier. Les analyses des éléments majeurs et en trace ont permis d'identifier une signature géochimique très proche de celle des échantillons provenant de l'île d'Eiao, une « île-carrière » du groupe nord des Marquises devenue célèbre pour ses basaltes à grains fins et ses nombreux ateliers de façonnage (Weisler, 1998 et 2002 ; Charleux *et al*., 2014).

– Deux éclats de verre volcanique découverts lors des fouilles effectuées par R. Bollt en 2007 ont été analysés par le professeur John Sinton (université de Hawai'i). Il n'est certes pas possible de déterminer la provenance exacte de ces deux éclats de verre volcanique à partir des seuls éléments majeurs, cependant ces données indiquent un contexte magmatique bien différent de celui de Tubuai. En effet, il s'agit de deux types de roches (benmoréite et mugéarite) issus de suites magmatiques modérément alcalines, alors que les laves de Tubuai sont issues d'une suite magmatique très alcaline (Maury *et al.*, 2000). Dans l'archipel des Australes, seules deux îles présentent des roches évoluées (SiO_2 > 50%) et modérément alcalines (Na_2O+K_2O > 6 %) : Ra'ivavae et Rapa iti. Cependant, aucune des roches prélevées dans ces îles ne présente de structure vitreuse. À près de 2000 km à l'est de Tubuai, l'île de Pitcairn est connue pour ses gisements de verres volcaniques (Weisler et Woodhead, 1995), dont plusieurs benmoréites et mugéarites. Il n'a malheureusement pas encore été possible de mener des analyses complémentaires sur ces deux artefacts, mais une caractérisation isotopique devrait permettre de déterminer leur provenance avec plus de certitude, car Pitcairn et Rapa iti sont issus de pôles isotopiques différents : EM-1 et HIMU, respectivement.

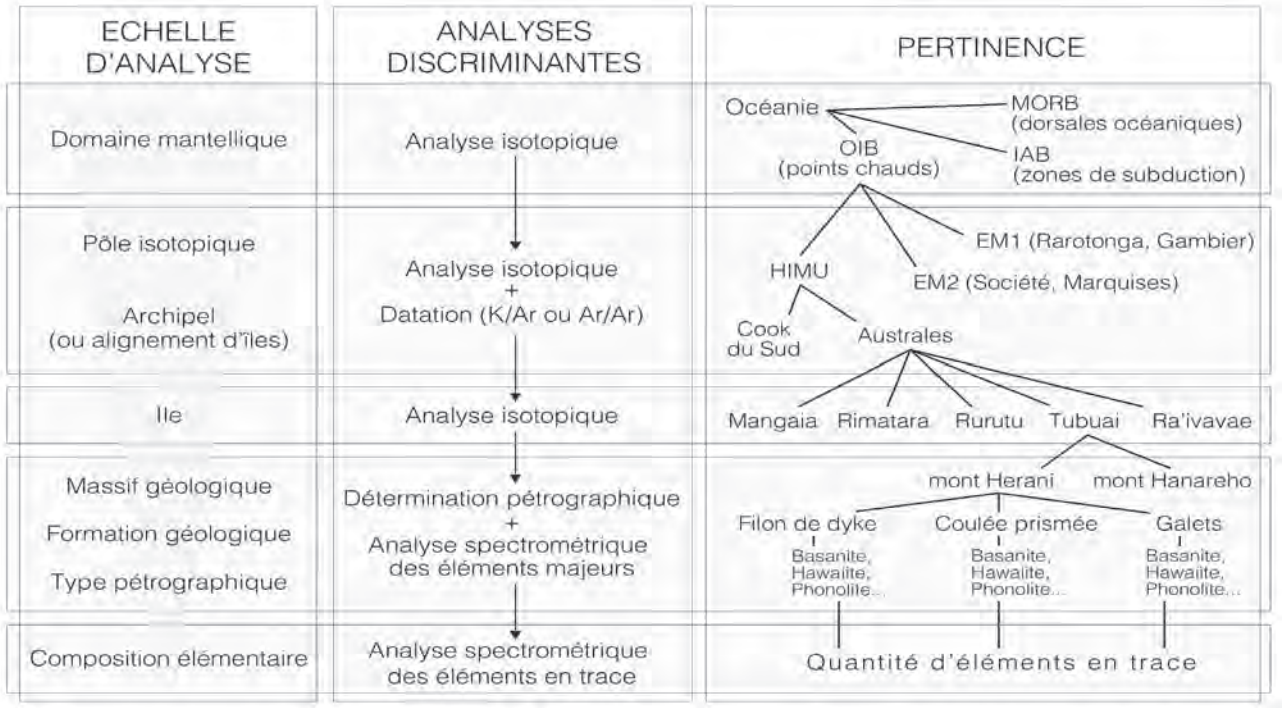


Fig. 7 – Hiérarchisation des caractéristiques géologiques et des analyses associées dans les études de provenance.
***Fig. 7** – Hierarchical relationships of geological characteristics and associate sourcing analyses.*

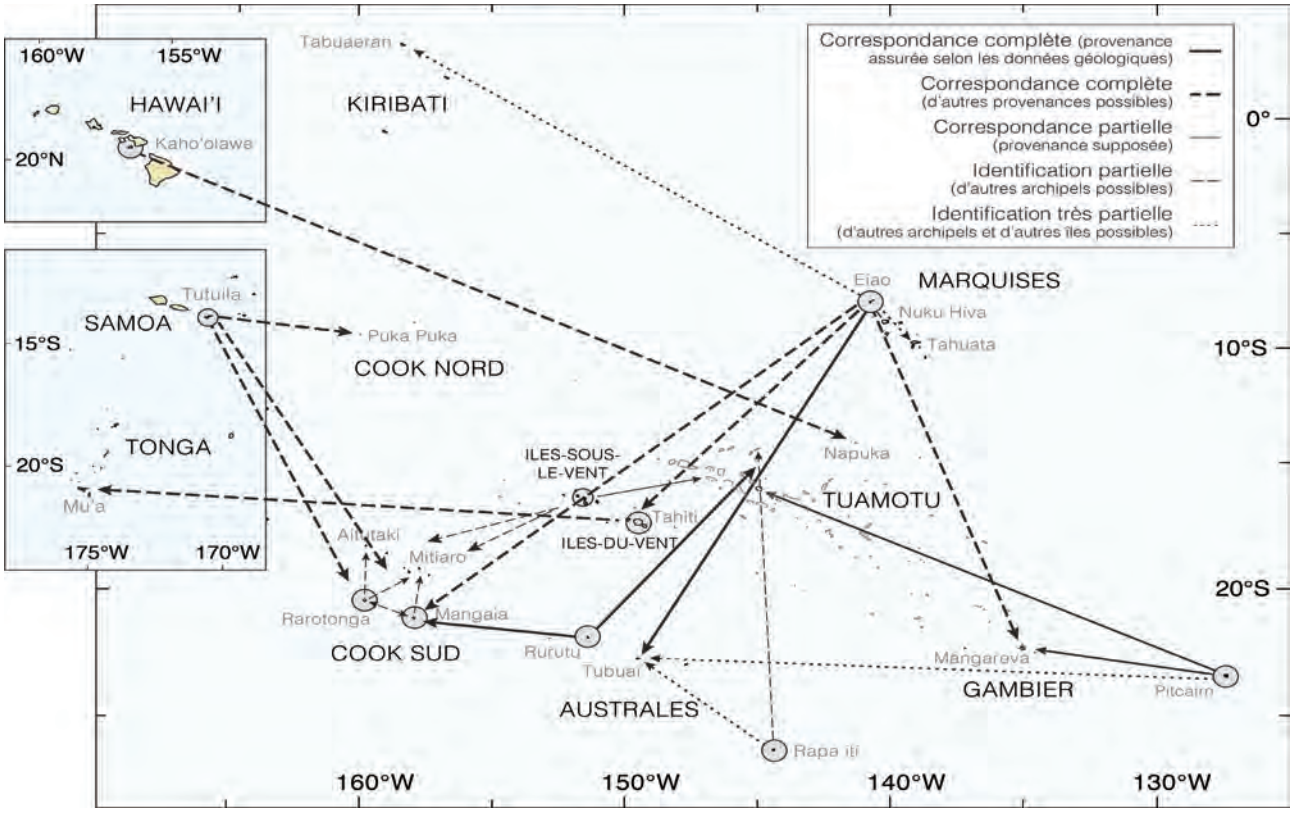


Fig. 8 – Carte de la Polynésie centrale et synthèse critique des transferts inter-îles d'artefacts lithiques (d'après Best *et al.*, 1992 ; Clark *et al.*, 2014 ; Collerson et Weisler, 2007 ; Di Piazza et Pearthree, 2001 ; Hermann, 2012 et 2013 ; Kahn e*t al.*, 2013 ; McAlister *et al.*, 2013 ; Rolett, 1998 ; Weisler, 1997, 1998 et 2002 ; Weisler et Kirch, 1996 ; Weisler et Woodhead, 1995).
***Fig. 8** – Map of Central Polynesia and critical synthesis of the inter-island transfers of lithic artifacts (after Best et al., 1992; Clark et al., 2014; Collerson and Weisler, 2007; Di Piazza and Pearthree, 2001; Hermann, 2012 and 2013; Kahn et al., 2013; McAlister et al., 2013; Rolett, 1998; Weisler, 1997, 1998 and 2002; Weisler and Kirch, 1996; Weisler and Woodhead, 1995).*

DISCUSSION

Les dynamiques de la production lithique à Tubuai

À travers l'analyse technologique des assemblages issus des sites de Tanataetea et d'Atiahara, nous avons tenté de définir les savoir-faire pratiques mis en œuvre et les choix concrets opérés à des moments précis par plusieurs artisans évoluant au sein de la même unité territoriale. Les niveaux de technicité observés sont clairement différenciés dans les deux sites et cette hétérogénéité des savoir-faire paraît bien représentative de l'organisation spécialisée des sociétés polynésiennes. Néanmoins, la production de lame sur éclat dans les deux contextes (spécialisé et non-spécialisé) montrent qu'une même tradition technique est largement partagée au sein de la société traditionnelle de Tubuai.

Par ailleurs, il semble que la production de lames d'herminette soit fortement contrainte par la disponibilité des matériaux lithiques de qualité qui permettent notamment de produire des lames de grandes dimensions. La répartition différentielle des matières premières de bonne qualité indique que celles-ci font l'objet d'une gestion particulière : elles sont accessibles aux artisans spécialistes dont les ateliers de taille sont installés à proximité de la carrière d'extraction mais leur utilisation dans les maisonnées d'Atiahara est très limitée.

Enfin, contrairement à ce que l'on aurait pu s'imaginer *a priori*, la succession des séquences de production depuis les carrières d'extraction jusqu'aux sites d'habitats n'est pas toujours linéaire. En effet, les lames d'herminettes produites au niveau des ateliers situés à proximité des carrières n'ont pas été distribuées de manière homogène dans tous les sites d'habitat (Hermann, 2013, p. 186-187).

À Atiahara, le mode d'approvisionnement en matière première ainsi que la production et la distribution des lames d'herminette évoluent significativement au cours des XIII^e^ et XIV^e^ siècles. Dans un premier temps, les basanites de Tanataetea ont été importées brutes dans le site d'Atiahara, et ont été transformées dans le cadre de la production de petites préformes sur éclats dans les occupations datées entre 1250 et 1350 AD. Dans un deuxième temps, des lames polies de meilleure facture (beaucoup plus massives et élégantes) sont apportées finies sur le site alors que des ateliers spécialisés sont constitués à Tanataetea au cours du XIV^e^ siècle. Leur traitement post-utilisation a donné lieu à la constitution de processus d'entretien et de recyclage, constitués en parallèle du processus de production domestique, qui perdure malgré l'importation des produits finis depuis le complexe de carrière-ateliers.

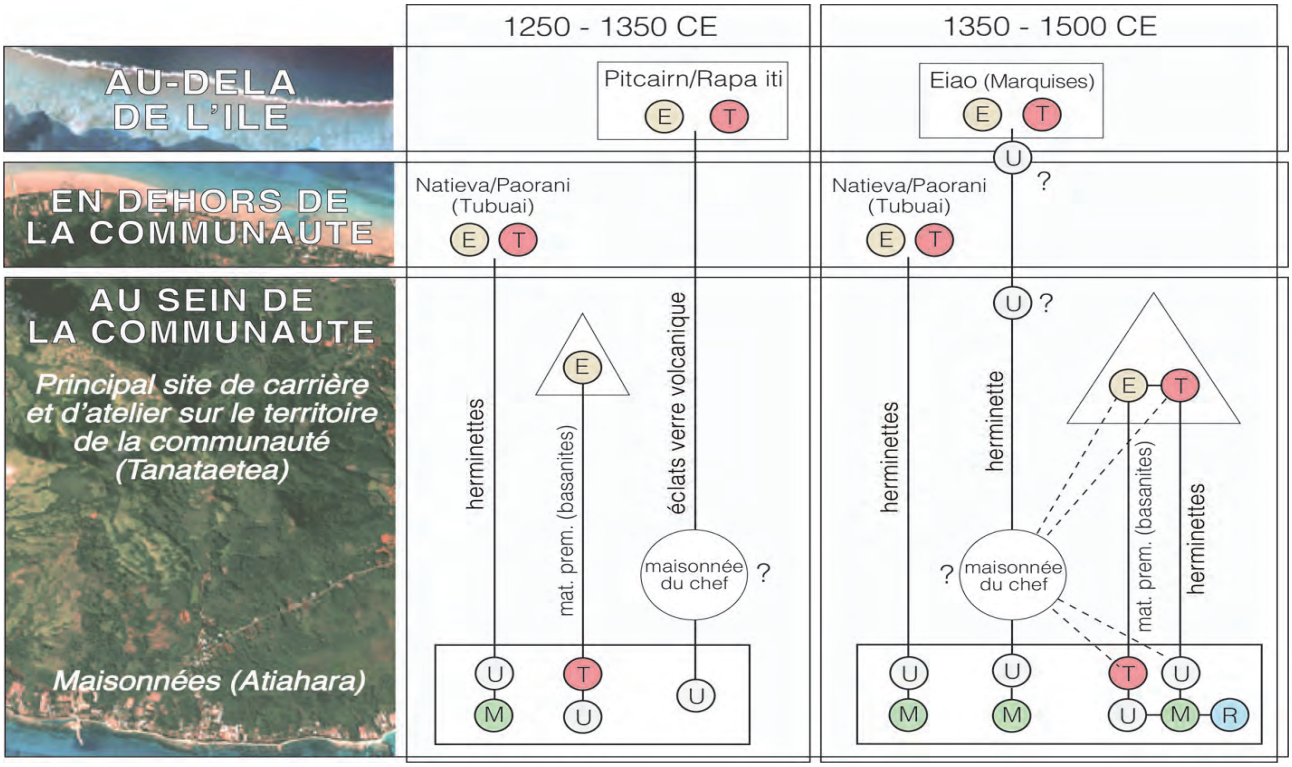


Fig. 9 – Dynamiques techno-économiques de la production et de l'échange d'artefacts lithiques à Tubuai (E = extraction de la matière première ; T = transformation des supports ; U = utilisation de la lame finie ; M = maintenance de la lame émoussée ; R = réutilisation de la lame comme support au débitage).

***Fig. 9** – Technical and economical dynamics related to the production and exchange of lithic artefacts on Tubuai (E = extraction of raw material; T = transformation of the blanks; U = use of the finished blade; M = maintaining of the blunted blade; R: re-use of the blade as a debitage blank).*

Les réseaux d'échange interinsulaires en Polynésie centrale

Malgré des résultats parfois approximatifs, la géochimie appliquée à l'archéologie a permis de mettre en évidence de nombreux transferts d'objets lithiques entre des îles éloignées. Plusieurs auteurs ont évoqué des « sphères d'interactions » (centrale, périphérique et marginale) qui correspondraient à l'extension maximale de différentes sphères d'échange régionales (Rolett, 2002 ; Weisler, 2002). Ce concept de « sphère d'interaction » permet de concevoir la complexité des relations intercommunautaires représentées par les transferts de biens entre les îles, car ceux-ci n'étaient surement pas effectués à sens unique. Cependant, il est désormais difficile d'identifier plusieurs sphères indépendantes et des régions réellement « marginalisées » car il semble que des transferts d'objets ont été exécutés d'une extrémité à l'autre de la région centrale, depuis les Cook à l'ouest jusqu'aux Marquises et Pitcairn à l'est (fig. 8). De ce point de vue, l'identification d'une lame d'herminette provenant de l'île d'Eiao dans le site d'Atiahara (c'est-à-dire à plus de 1500 km au sud-ouest des Marquises) est révélatrice de la dimension spatiale des réseaux d'échange. D'autres exemplaires de lames d'Eiao été découvertes à Mo'orea, à Mangareva (Weisler, 1998), à Makatea (Collerson et Weisler, 2007) et plus récemment à Rarotonga (McAlister *et al.*, 2013).

CONCLUSION

Grâce aux reconstructions linguistiques (Kirch et Green, 2001), nous savons que la société Polynésienne ancestrale était déjà composée de chefs et d'artisans spécialistes. Les changements observés dans l'organisation du système technique de production des lames d'herminette à Tubuai ne sont donc pas directement liés à la constitution d'un groupe de spécialistes au début du II^e^ millénaire car les artisans spécialisés dans la taille de la pierre ont probablement toujours existé en Polynésie. Ces changements, qui concernent également les dynamiques d'échange intra- et intercommunautaires, semblent plutôt liés à une évolution significative dans la gestion et l'exploitation des ressources lithiques, ainsi que dans la distribution des biens socialement valorisés (fig. 9). Il serait tentant d'y voir la marque d'un contrôle grandissant des élites politiques locales sur les différentes maisonnées qui composent le principal *mata'eina'a* de Tubuai.

Utilisé comme outil du quotidien mais également comme objet de prestige, l'herminette à lame de pierre était un objet nécessaire aux sociétés polynésiennes dans le contexte technique, mais également dans le domaine politique et cérémoniel. Son statut et sa fonction dépendaient des conditions dans lesquelles il était confectionné et mis en circulation. Ainsi, la production et la distribution des herminettes pouvait correspondre à deux dimensions de l'économie dans les sociétés polynésiennes : une économie « de subsistance » *(staple economy)* et une économie « politique » *(wealth economy)*, basée sur l'accumulation de richesse et de prestige (Kirch, 2010 ; Kirch *et al.*, 2011). Au-delà de cette constatation, il est nécessaire de mieux définir la mise en place et l'agencement de ces deux dimensions économiques au sein de la sphère sociale. De ce point de vue, l'analyse conjointe des modalités de production et d'échange des lames d'herminette à partir de contextes archéologiques bien contrôlés devrait permettre d'apporter de nouveaux éléments pour une meilleure compréhension de l'évolution des chefferies polynésiennes.

NOTES

(1) Le concept de *mana* n'a pas d'équivalent dans les langues occidentales. Il a longtemps été traduit par l'idée de « force » ou de « pouvoir », mais il serait peut-être plus juste de parler d'« efficacité », tant au sens pratique que symbolique. Pour reprendre les termes de M. Mauss et H. Hubert, « le *mana* n'est pas simplement une force, un être, c'est encore une action, une qualité et un état » (Mauss et Hubert, 1902-1903, p. 101).

(2) La même configuration est observée pour plusieurs villages en Polynésie centrale. À Maupiti par exemple, C. Handy décrit le centre politico-religieux constitué par le *marae* ancestral et la maisonnée du chef devant la passe principale, dans le district bien nommé de *Te fare ari'i* (Handy, 1931, p. 106).

(3) Les analyses isotopiques seules permettent d'identifier un archipel ou une série d'îles issues du même pôle isotopique, mais pas le gîte et rarement l'île de provenance. À l'inverse, les analyses des éléments majeurs et en traces permettent d'émettre des hypothèses solides sur la provenance des matériaux, mais sans analyse isotopique la restriction de la source à un archipel est discutable.

RÉFÉRENCES BIBLIOGRAPHIQUES

Aitken R. T. (1930) – *Ethnology of Tubuai*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 70 ; Bayard Dominick Expedition, 19), 169 p.

Allen M. S., Mcalister A. J. (2010) – The Hakaea Beach Site, Marquesan Colonisation, and Models of East Polynesian Settlement, *Archaeology in Oceania*, 45, 2, p. 54-65.

Anderson A., Leach H. M., Smith I., Walter R. (1994) – Reconsideration of the Marquesan Sequence in East Polynesian Prehistory, with Particular Reference to Hane (MUH1), *Archaeology in Oceania*, 29, p. 29-52.

Anderson A., Kennett D. J. (2013) – *Taking the High Ground: The Archaeology of Rapa, a Fortified Island in Remote East Polynesia*, Canberra, ANU E Press (Terra Australis, 37), 288 p.

Best E. (1912) – *The Stone Implements of the Maori*, Wellington, A. R. Shearer (Dominion Museum Bulletin, 4), 445 p.

Best S., Sheppard P. J., Green R. C., Parker R. (1992) – Necromancing the Stone: Archaeologists and Adzes in Samoa, *Journal of the Polynesian Society*, 101, 1, p. 45-85.

Bollt R. (2005) – *Peva: The Archaeology of a Valley on Rurutu, Austral Islands, East Polynesia*, thèse de doctorat, université de Hawai'i at Manoa, Honolulu, 427 p.

Brousse R., Barsczus H. G., Bellon H., Cantagrel J. M., Diraison C., Guillou H., Leotot C. (1990) – Les Marquises (Polynésie française) : volcanologie, géochronologie, discussion d'un modèle de point chaud, *Bulletin de la Société géologique de France*, 6, 6, p, 933-949.

Buck P. H. [Te Rangi Hīroa] (1934) – *Mangaian Society*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 122), 207 p.

Candelot J.-L. (1980) – Note préliminaire sur les pierres gravées de Tubuai, *Journal de la Société des océanistes*, 36, 66-67, p. 137-138.

Charleux M., Mcalister A., Mills P. R., Lundblad S. P. (2014) – Non-destructive XRF Analyses of Fine-Grained Basalts from Eiao, Marquesas Islands, *Journal of Pacific Archaeology*, 5, 1, p. 75-89.

Chauvel C., Hofmann A. W., Vidal P. (1992) – HIMU-EM: The French Polynesian connection, *Earth and Planetary Science Letters*, 110, 1-4, p. 99-119.

Clark G. R., Reepmayer C., Melekiola N., Woodhead J., Dickinson W. R., Martinsson-Wallin H. (2014) – Stone Tools from the Ancient Tongan State Reveal Prehistoric Interaction Centers in the Central Pacific, *Proceedings of the National Academy of Sciences*, 111, 29, p. 10491-10496.

Cleghorn P. L. (1982) – *The Mauna Kea Adze Quarry: Technological Analyses and Experimental Tests*, thèse de doctorat, université de Hawai'i at Manoa, Honolulu, 371 p.

Cleghorn P. L. (1984) – An Historical Review of Polynesian Stone Adze Studies, *Journal of the Polynesian Society*, 93, 4, p. 399-422.

Cleghorn P. L. (1986) – Organizational Structure at the Mauna Kea Adze Quarry Complex, Hawaii, *Journal of Archaeological Science*, 13, 4, p. 375-387.

Collerson K. D., Weisler M. I. (2007) – Stone Adze Compositions and the Extent of Ancient Polynesian Voyaging and Trade, *Science*, 317, p. 1907-1911.

Cotten J., Le Dez A., Bau M., Caroff M., Maury R. C., Dulski P., Fourcade S., Bohn M., Brousse R. (1995) – Origin of Anomalous Rare-Earth Element and Yttrium Enrichments in Subaerially Exposed Basalts: Evidence from French Polynesia, *Chemical Geology*, 119, p. 115- 138.

Di Piazza A., Pearthree E. (2001) – Voyaging and basalt exchange in the Phoenix and Line archipelagoes: the viewpoint from three mystery islands, *Archaeology in Oceania*, 36, p. 146- 152.

Diraison C. (1991) – *Le volcanisme aérien des archipels polynésiens de la Société, des Marquises et des Australes-Cook. Téphrostratigraphie, datation isotopique et géochimie comparées. Contribution à l'étude des origines du volcanisme intraplaque du Pacifique central*, thèse de doctorat, université de Bretagne occidentale, Brest, 413 p.

Duff R. (1945) – A Revised Typology of (Southern) New Zealand Adzes, *Journal of the Polynesian Society*, 54, p. 147-159.

Duff R. (1956) – *The Moa-Hunter Period of Maori Culture*, Wellington, Govt. Printer, 433 p.

Duff R. (1959) – Neolithic Adzes of Eastern Polynesia, *in* J. D. Freeman et W. R. Geddes (dir.), *Anthropology in the South Seas, Essays Presented to H. D. Skinner*, New Plymouth, Thomas Avery & Sons, p. 121-147.

Duff R. (1960) – Pacific Adzes and Migrations, *Journal of the Polynesian Society*, 69, 1, p. 276-282.

Eddowes M. (2004) – *Étude archéologique de l'île de Rimatara (archipel des Australes)*, Papeete, ministère de la Culture de Polynésie française (Dossiers d'archéologie polynésienne, 3), 112 p.

Elbert S. H., Kirtley B. F. (1966) – Seven Pileni Tales, *Journal of the Polynesian Society*, 75, 3, p. 348-372.

Ellis W. (1829a) – *Polynesian Researches, during a Residence of Nearly Six Years in the South Sea Islands: Including Descriptions of the Natural History and Scenery of the Islands, with Remarks on the History, Mythology, Traditions, Government, Arts, Manners, and Customs of the Inhabitants*, 1, Londres, Fischer, Son & Jackson, 536 p.

Ellis W. (1829b) – *Polynesian Researches, during a Residence of Nearly Six Years in the South Sea Islands: Including Descriptions of the Natural History and Scenery of the Islands, with Remarks on the History, Mythology, Traditions, Government, Arts, Manners, and Customs of the Inhabitants*, 2, Londres, Fischer, Son & Jackson, 576 p.

Ellis W. (1831) – *Polynesian Researches, during a Residence of Nearly Eight Years in the Society and Sandwich Islands*, 3, Londres, Fischer, Son & Jackson, 407 p.

Ellis W. (1969) – *Polynesian Researches*, Rutland (Vt.), Charles E. Tuttle, 3 vol.

Emory K. P. (1968) – East Polynesian Relationships as Revealed Through Adzes, *in* I. Yawata et Y. H. Sinoto (dir.), *Prehistoric Culture in Oceania: A Symposium*, Honolulu, Bishop Museum Press, p. 151-169.

Figueroa G., Sanchez E. (1965) – Adzes from Certain Islands of Eastern Polynesia, *in* T. Heyerdahl et E. N. Ferdon (éd.), *Miscellaneous Papers, Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific*, 2, Londres, George Allen and Unwin (Monographs of the School of American Research and the Kon-Tiki Museum, Oslo, Norway, 24, 2), p. 169-254.

Garanger J. (1972) – Herminettes lithiques océaniennes: éléments de typologie, *Journal de la Société des océanistes*, 28, p. 253-274.

Gérard B. (1975) – *Outillage, première partie*, Papeete, ORSTOM.

Gill W. N. (1876) – *Life in the Southern Isles. Or, Scenes and Incidents in the South Pacific and New Guinea*, Londres, The Religious Tract Society, 360 p.

Green R. C. (1968) – West Polynesian Prehistory, *in* I. Yawata et Y. H. Sinoto (dir.), *Prehistoric Culture in Oceania: A Symposium*, Honolulu, Bishop Museum Press, p. 99-109.

Green R. C. (1971) – Evidence for the Development of the Early Polynesian Adze Kit, *New Zealand Archaeological Association Newsletter*, 14, p. 12-44.

Green R. C. (1974) – Excavation of the Prehistoric Occupations of SU-SA-3, *in* R. C. Green et J. M. Davidson (dir.), *Archaeology in Western Samoa*, II, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 7), p. 108-154.

Green R. C., Davidson J. M. (1969) – Description and Classification of Samoan Adzes, *in* R. C. Green et J. M. Davidson (dir.), *Archaeology in Western Samoa*, I, Auckland, Auckland Institute and Museum (Bulletin of the Auckland Institute and Museum, 6), p. 21-33.

Handy C. E. S. (1930) – *Marquesan Legends*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 69), 138 p.

Handy C. E. S. (1931) – *History and Culture in the Society Islands*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 79), 110 p.

Henry T. (2000) – *Tahiti aux temps anciens*, Paris, musée de l'Homme (Publications de la Société des océanistes, 1), 722 p.

Hermann A. (2010) – *Prospections archéologiques dans l'île de Tubuai (archipel des Australes, Polynésie Française)*, rapport de missions non publié, service de la Culture et du Patrimoine, UPF, Tahiti, , 60 p.

Hermann A. (2011a) – *Dynamique de production des industries lithiques en Polynésie centrale : travaux entrepris dans l'île de Tubuai (archipel des Australes, Polynésie française), Programme 2010-2011*, rapport final non publié, CIRAP, UPF, Tahiti, 104 p.

Hermann A. (2011b) – *Site archéologique de Tanataetea, commune de Mata'ura, île de Tubuai (Archipel des Australes, Polynésie française*), rapport de fouille, service de la Culture et du Patrimoine, UPF, Tahiti, 23 p.

Hermann A. (2012) – La vengeance légendaire de 'Apeku'a : Structure et sémantique de la version marquisienne de la légende d'Apakura, *Bulletin de la Société des études océaniennes*, 325, p. 23-37.

Hermann A. (2013) – *Les industries lithiques pré-européennes de Polynésie centrale : savoir-faire et dynamiques technoéconomiques*, thèse de doctorat, université de la Polynésie française, Tahiti, 420 p.

Hermann A., Maury M., Liorzou C. (2012) – Traçabilité des matières premières lithiques dans les assemblages archéologiques polynésiens : le cas de Tubuai (archipel des Australes, Polynésie française), *Géologue*, 172, p. 80-83.

Hermann A., Bollt R., Conte É. (2015) – The Atiahara Site Revisited: An Early Coastal Settlement in Tubuai (Austral Islands, French Polynesia), *Archaeology in Oceania*, DOI: 10.1002-arco.5070 [en ligne].

Kahn J. G. (2005) – *Household and Community Organization in the Late Prehistoric Society Island Chiefdoms (French Polynesia)*, thèse de doctorat, University of California, Berkeley, 573 p.

Kahn J. G. (2009) – Adze Production in the Papeno'o Valley, Tahiti, Society Islands: Technological Analysis of the Putoura (TPP-035) Workshop Assemblage, *New Zealand Journal of Archaeology*, 30, p. 55-87.

Kahn J. G., Sinton J., Mills P. R., Lundblad S. P. (2013) – X-Ray Fluorescence Analysis and Intra-Island Exchange in the Society Island Archipelago (Central Eastern Polynesia), *Journal of Archaeological Science*, 40, p. 1194-1202.

Kalfoun F. (2001) – *Géochimie du niobium et du tantale : distribution et fractionnement de ces deux éléments dans les différents réservoirs terrestres*, thèse de doctorat, université Montpellier 2, 273 p.

Kellum M. (1964) – Les pièces archéologiques découvertes à Rurutu (îles Australes, Polynésie française), *Journal de la Société des océanistes*, 15, p. 32-38.

Kirch P. V. (1972) – Five Triangular Adzes from Haiku, Maui, Hawaiian Islands, *New Zealand Archaeological Association Newsletter*, 15, 4, p. 140-143.

Kirch P. V. (1984) – *The Evolution of the Polynesian Chiefdoms*, Cambridge, Cambridge University Press, 314 p.

Kirch P. V. (1985) – *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*, Honolulu, University of Hawaii Press, 360 p.

Kirch P. V. (2010) – *How Chiefs Became Kings: Divine Kingship and the Rise of Archaic States in Ancient Hawai'i*, Berkeley and Los Angeles, University of California Press, 288 p.

Kirch P. V., Green R. C. (2001) – *Hawaiki, Ancestral Polynesia: An Essay in Historical Anthropology*, Cambridge, Cambridge University Press, 375 p.

Kirch P. V., Mills P. R., Lundblad S. P., Sinton J., Kahn J. G. (2011) – Interpolity Exchange of Basalt Tools Facilitated via Elite Control in Hawaiian Archaic States, *Proceedings of the National Academy of Sciences*, 109, 4, p. 1056-1061.

Lavondès H. (1966) – *Récits Marquisiens*, 2, Papeete, ORSTOM, 266 p.

Lavondès A. (1973) – *La culture matérielle en Polynésie*, thèse de doctorat, université Paris V, 1 046 p.

Lavondès H. (1975) – *Terre et Mer, pour une lecture de quelques mythes polynésiens*, thèse de doctorat, université Paris V, 480 p. et 290 p.

Lavondès A. (1987) – *La culture matérielle en Polynésie et les collections du musée de Tahiti et des îles*, Paris, ORSTOM (Travaux et documents microédités, 25), 963 p.

Leach H. M. (1984) – Jigsaw: Reconstructive Lithic Technology, *in* J. E. Ericson et B. A. Purdy (dir.), *Prehistoric Quarries and Lithic Production*, Cambridge, Cambridge University Press (New Directions in Archaeology), p. 107-118.

Leach H. M. (1990) – Archaic Adze Quarries and Working Floors, an Historical Review, *Journal of the Polynesian Society*, 99, 4, p. 373-394.

Leach H. M., Leach B. F. (1980) – The Riverton Site: An Archaic Adze Manufactory in Western Southland, New Zealand, *New Zealand Journal of Archaeology*, 2, p. 99-140.

Leach H. M., Witter D. C. (1987) – Tataga-Matau 'Rediscovered', *New Zealand Journal of Archaeology*, 9, p. 33-54.

Leach H. M., Witter D. C. (1990) – Further Investigations at the Tataga-Matau Site, American Samoa, *New Zealand Journal of Archaeology*, 12, p. 51-83.

Lemonnier P. (2012) – Des objets pour penser l'indicible: la nécessaire convergence des théories de la culture matérielle, *in N.* Schlanger et A.-C. Taylor (dir.), *La Préhistoire des autres : perspectives archéologiques et anthropologiques*, actes du colloque international (Paris, 18-19 janvier 2011), Paris, INRAP et La découverte, p. 277-289.

Luomala K. (1955) – *Voices on the Wind: Polynesian Myths and Chants*, Honolulu, Bishop Museum Press, 191 p.

Malo D. (1951) – *Hawaiian Antiquities*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publication, 2), 278 p.

Maury R. C., El Azzouzi M., Bellon H., Liotard J. M., Guille G., Barsczus H. G., Chauvel C., Diraison C., Dupuy C., Vidal P., Brousse R. (1994) – Géologie et pétrologie de l'île de Tubuai (Australes, Polynésie française), *Comptes rendus de l'Académie des sciences*, 318, 10, p. 1341-1347.

Maury R. C., Guille G., Guillou H., Brousse R. (2000) – *Carte géologique de France (1/50 000), feuille Rurutu et Tubuai, Polynésie française (1154)*, notice explicative, Orléans, BRGM, 81 p.

Maury R. C., Legendre C., Chauvel C., Guille G., Blais S., Guillou H., Rossi Ph. (2015) – An Atypical Hotspot Chain, *in* J.-Y. Meyer et E. M. Claridge (dir.), *Terrestrial Biodiversity of the Austral Islands, French Polynesia*, Paris, Muséum national d'histoire naturelle (Patrimoines naturels, 72), p. 21-37.

Mauss M., Hubert H. (1902-1903) – Esquisse d'une théorie générale de la magie, *Année sociologique*, 7, p. 1-146.

Mauss M. (1947) – *Manuel d'ethnographie*, Paris, Payot (Bibliothèque scientifique), 211 p.

Mauss M. (1948) – Les techniques et la technologie, *in* I. Meyerson (dir.), *Le travail et les techniques*, actes de la journée de psychologie et d'histoire du travail et des techniques (Toulouse, 23 juin 1941), Paris, Presses universitaires de France *(Journal de psychologie normale et pathologique)*, p. 71-78.

Mccoy P. C. (1977) – The Mauna Kea Adze Quarry Project: A Summary of the 1975 Field Investigations, *Journal of the Polynesian Society*, 86, p. 223-244.

Mcalister A. J. (2011) – *Methodological Issues in the Geochemical Characterisation and Morphological Analysis of Stone Tools: A Case Study from Nuku Hiva, Marquesas Islands, East Polynesia*, thèse de doctorat, université d'Auckland, 495 p.

Mcalister A. J., Sheppard P. J., Allen M. S. (2013) – The Identification of a Marquesan Adze in the Cook Islands, *Journal of the Polynesian Society*, 122, 3, p. 257-273.

Orliac M. (1986) – Outils et techniques avant l'arrivée du métal, *in* A. Lavondès (dir.), *Encyclopédie de la Polynésie*, 5. *La vie quotidienne dans la Polynésie d'autrefois*, Papeete, C. Gleizal, p. 9-24.

Ploux S. (1999) – La question des savoir-faire, une histoire de processus, *in* F. Briois et V. Darras (dir.), *La pierre taillée : ressources, technologies, diffusion*, Toulouse, AEP, EHESS (Séminaires du Centre d'anthropologie de Toulouse), p. 43-47.

Prebble M. (2006) – *Islands, Floras and History: An Environmental History of Plant Introduction and Extinction on the Austral Islands, French Polynesia*, thèse de doctorat, Australian National University, 405 p.

Rolett B. V. (1998) – *Hanamiai: Prehistoric Colonization and Cultural Change in the Marquesas Islands (East Polynesia)*, New Haven, Yale University Press (Yale University Publications in Anthropology, 81), 262 p.

Rolett B. V. (2002) – Voyaging and Interaction in Ancient East Polynesia, *Asian Perspectives*, 41, 2, p. 182-194.

Routledge S., Routledge K. (1921) – Notes on Some Archaeological Remains in the Society and Austral Islands, *Journal of the Royal Anthropological Institute of Great Britain and Ireland*, 51, p. 438-455.

Sahlins M. (1976) – *Âge de pierre, âge d'abondance : l'économie des sociétés primitives*, Paris, Gallimard (Bibliothèque des Sciences humaines), 409 p.

Sinoto Y. H. (1966) – A Tentative Prehistoric Cultural Sequence in the Northern Marquesas Islands, French Polynesia, *Journal of Polynesian Society*, 75, 3, p. 286-303.

Sinoto Y. H. (1970) – An Archaeologically Based Assessment of the Marquesas Islands as a Dispersal Center in East Polynesia, *in* R. C. Green et M. Kelly (dir.), *Studies in Oceanic Culture History*, Honolulu, Bishop Museum Press (Pacific Anthropological Records, 11), p. 105-132.

Skinner H. D. (1919) – A Maori Stone Axe, *Journal of the Polynesian Society*, 28, p. 240-241.

Skinner H. D. (1940) – Maori Adzes, Axes, Chisels and Gouges from the Murihiku Region, New Zealand, *in* F. N. Chasen et M. W. F. Tweedie (dir.), *Proceedings of the Third Congress of Prehistorians of the Far East*, actes du colloque (Singapour, 24-30 janvier 1938), Singapour, Government Printing Office, p. 142-172.

Skinner H. D. (1943a) – The Classification of Graywacke and Nephrite Adzes from Murihiku, New Zealand, *Journal of the Polynesian Society*, 52, p. 65-85.

Skinner H. D. (1943b) – The Classification of Graywacke and Nephrite Adzes from Murihiku, New Zealand, part 2: Nephrite Adzes, *Journal of the Polynesian Society*, 52, p. 157-190.

Smith P. (1892) – Stone Implements from the Chatham Islands, *Journal of the Polynesian Society*, 1, p. 80-82.

Stimson J. F. (1937) – *Tuamotuan Legends*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 148), 147 p.

Stokes J. F. G. (1930) – Stone Implements, *in* R. T. Aitken (dir.), *Ethnology of Tubuai*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin, 70), p. 130-164.

Suggs R. C. (1961) – *The Archaeology of Nuku Hiva, Marquesas Islands, French Polynesia*, New York, The American Museum of Natural History (Anthropological Papers of the American Museum of Natural History, 49, 1), 205 p.

Turner M. T. (2000) – *The Function, Design and Distribution of New Zealand Adzes*, thèse de doctorat, université d'Auckland, 506 p.

Vérin P. (1969) – *L'ancienne civilisation de Rurutu, îles Australes, Polynésie française : la période classique*, Paris, ORSTOM (Mémoires ORSTOM, 33), 318 p.

Walter R. K. (1996) – What is the East Polynesian 'Archaic'? A View from the Cook Islands, *in* J. M. Davidson, G. Irwin, B. F. Leach, A. Pawley et D. Brown (dir.), *Oceanic Culture History: Essays in Honour of Roger Green*, Dunedin, New Zealand Archaeological Association (*New Zealand Journal of Archaeology* Special Publication), p. 513-530.

Weisler M. I. (1993) – Provenance Studies of Polynesian Basalt Adze Material: A Review and Suggestions for Improving Regional Databases, *Asian Perspectives*, 32, p. 61-83.

Weisler M. I. (1997) – *Prehistoric Long-Distance Interaction in Oceania: An Interdisciplinary Approach*, Dunedin, New Zealand Archaeological Association (New Zealand Archaeological Association Monograph, 21), 237 p.

Weisler M. I. (1998) – Hard Evidence for Prehistoric Interaction in Polynesia, *Current Anthropology*, 39, 4, p. 521-532.

Weisler M. I. (2002) – Centrality and the Collapse of Long-Distance Voyaging in East Polynesia, *in* M. D. Glascock (dir.), *Geochemical Evidence for Long-Distance Exchange*, Westport, Bergin and Garvey (Scientific Archaeology for the Third Millennium), p. 257–273.

Weisler M. I., Kirch P. V. (1996) – Interisland and Interarchipelago Transfer of Stone Tools in Prehistoric Polynesia, *Proceedings of the National Academy of Sciences*, 93, p. 1381-1385.

Weisler M. I., Woodhead J. D. (1995) – Basalt Pb Isotope Analysis and the Prehistoric Settlement of Polynesia, *Proceedings of the National Academy of Sciences*, 92, p. 1881-1885.

Aymeric Hermann
Centre international de recherche archéologique en Polynésie (CIRAP), université de la Polynésie française, B.P.6570-98702 FAA'A, Tahiti, Polynésie française
aymeric.hermann@upf.pf

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 223-230
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

Canoes of Atchin (Vanuatu) Based on John Willoughby Layard's Work

Anne Di Piazza

Abstract: This paper draws heavily on John Willoughby Layard's important typescript entitled "Canoes" stored at the University of California, San Diego, dedicated to coastal and sea-going canoes, their manufacture, usage and consecration. It consists of drafts for a chapter of a monograph John Willoughby Layard was working on about the people and culture of Atchin, a small island off the northeast coast of Malakula (Vanuatu). The current author notes that these canoes were rigged with an Oceanic spritsail and had the particularity of tacking through the wind when they were of small size (coastal) and of shunting when they were larger (sea-going). The author hypothesizes that the Oceanic spritsail and its associated tacking maneuver were borrowed from the Polynesian maritime tradition, likely via one of the Solomon outliers, while its balance platform likely came from Micronesia.

Keywords: Vanuatu, canoes, Oceanic spritsail, traditional navigation.

Les pirogues d'Atchin (Vanuatu) d'après les enquêtes de John Willoughby Layard

Résumé : Cet article repose très largement sur un important tapuscrit intitulé « Canoes » écrit par John Willoughby Layard conservé à l'université de Californie, San Diego, et consacré aux pirogues côtières et de pleine mer, à leurs techniques de construction, à leurs usages et à leurs rituels. Il s'agit de différentes versions d'un chapitre devant être intégré à la monographie que John Willoughby Layard prévoyait d'écrire sur les habitants et la culture d'Atchin, une petite île de la côte nord-est de Malakula (Vanuatu). Le présent auteur souligne le fait que ces pirogues gréées avec une voile à livarde océanienne ont la particularité de remonter au vent de manière amphidrome lorsqu'elles sont de petite taille et de manière monodrome lorsqu'elles sont de grande taille. L'auteur poursuit en faisant l'hypothèse que cette voile à livarde et sa manœuvre monodrome sont un emprunt au monde maritime polynésien, fait peut-être via les « outliers » de l'archipel des Salomon, tandis que la plateforme à balancier serait d'origine micronésienne.

Mots-clés : Vanuatu, Pirogue, voile à livarde océanienne, navigation traditionnelle.

Presented herein are observations taken from an unpublished typescript conserved at the University of California, San Diego, written by John Willoughby Layard, entitled "Canoes". This document of 169 pages (including various versions of certain parts), is remarkable for the information it contains on traditional naval architecture of central Vanuatu, Malakula[1] and its offshore Small Islands,[2] notably Atchin (fig. 1). Before examining this document in detail, I will briefly contextualize its author, a British anthropologist and psychoanalyst, and his work, then review his description of canoes and lastly discuss the singularity of these vessels from central and northern Vanuatu within the Pacific maritime traditions. I will conclude that its rig, the Oceanic spritsail and its manner of coming about was borrowed from Polynesia, perhaps from one of the Solomon outliers while its balance platform is more likely to have come from Micronesia.

JOHN WILLOUGHBY LAYARD: BIBLIOGRAPHICAL ELEMENTS

John Willoughby Layard's (1891–1974) biography has been recently compiled by H. Geismar and A. Herle (Geismar and Herle, 2010) in a masterful book entitled *Moving Images. John Layard, fieldwork and photography on Malakula since 1914*. The following section is largely drawn from this work. J. W. Layard studied at King's College, Cambridge where he completed a degree in modern

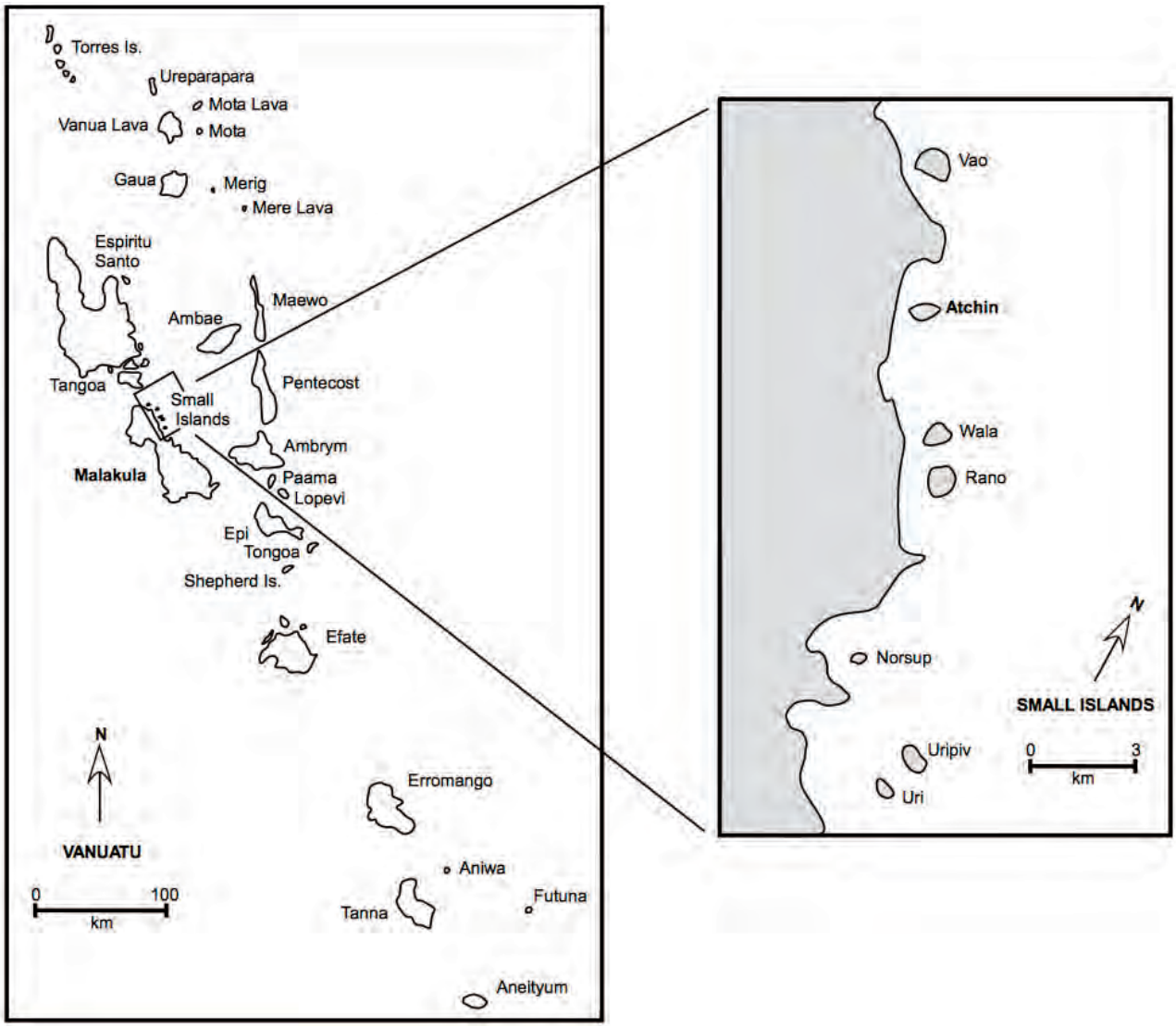


Fig. 1 – Vanuatu archipelago with the small islands off the northeast coast of Malakula (after www.worldatlas.com).
***Fig. 1** – L'archipel de Vanuatu avec les petites îles au large de la côte nord-est de Malakula (d'après www.worldatlas.com).*

languages and while still an undergraduate, he joined an anthropological discussion group where he encountered W. H. R. Rivers and A. C. Haddon, two important figures in the foundation of modern ethnology who encouraged him to pursue a fourth year in anthropology.

In 1914, John Willoughby Layard, with W. H. R. Rivers, A. C. Haddon, B. Malinowski and others journeyed to Australia to attend the BAAS (British Association for the Advancement of Science) meeting. Originally, A. C. Haddon—assisted by J. W. Layard—had planned to continue on to New Guinea to conduct an ethnographic survey, but the outbreak of war and the unavailability of the expected naval transport cancelled their plans. W. H. R. Rivers then decided to carry out an anthropological investigation in Vanuatu, accompanied by J. W. Layard. The New Hebrides Resident Commissioner suggested that they work along the north coast of Malekula. "The native culture was there to be found in its purest state" (Langham, 1975, p. 237). As noted by H. Geismar (Geismar, 2006, p. 528), J. W. Layard and W. H. R. Rivers were also "attracted to Malakula after their encounter with the monumental collections made by Swiss ethnologist Felix Speiser, who [had] travelled through the archipelago in 1910–1912". J. W. Layard himself wrote:

> The natives' memories are also kept green by the numerous megalithic monuments which form their most striking memorial. It was the then barely known existence of such monuments, first published by Speiser (1913) that attracted the late Dr. W. H. R. Rivers and myself to Malekula. These monuments, which include dolmens, monoliths, stone-platforms, cairns, and circles, primarily and to this day still associated with mortuary ritual, reach their highest development in connection with the great sacrificial rite called Maki, the name given in these islands to a socio-religious hierarchy corresponding to the Mangke of the Big Nambas, based on identification with the ancestors and with a mythical hawk (Layard, 1936).

Upon disembarking on Atchin, the ambiance was tense. H. Geismar (Geismar, 2009, p. 208) noted that "the Atchin community had recently had a violent altercation with a despotic Irish trader" (see Layard, 2008;[3] Monnier, 1991; Geismar, 2009). Previous violence between locals and foreign traders had resulted in punitive visits by the navy, to devastating effect. In his auto-biography, J. W. Layard describes how the two anthropologists based themselves upon their arrival in an abandoned Roman Catholic Mission and how they were, at first, scrupulously avoided by local people (Layard, 2010). After a few days, W. H. R. Rivers left for Tangoa, a small island south of Santo, while J. W. Layard remained on Atchin for the best part of a year, traveling briefly to the neighboring islands of Vao, Oba (now Ambae), and to South-West Bay on Malekula (Langham, 1975, p. 237). J. W. Layard (along with B. Malinowski working in the Trobriand Islands at the same time), thus became a pioneer of long term fieldwork, collected detailed and accurate early ethnological data about customary life in Vanuatu as attested by his important *Stone men of Malekula*, a monograph on Vao based on only a few weeks of fieldwork. Originally this volume should have been followed by three others on Atchin, Wala and Rano, as well as the remaining 'Small Islands' of Uripiv, Uri and Norsup (Huffman, 2010, p. 211).

John Willoughby Layard's fieldnotes and unpublished manuscripts are held in the Mandeville Special Collections Library, University of California at San Diego (MSS 84; see http://libraries.ucsd.edu/speccoll/testing/html/mss0084.html#abstract for more details). He donated his collection of artifacts and photographs [4] to the Cambridge Museum of Archaeology and Anthropology.

Among these documents, the one entitled "Canoes" contains a list of the names of the winds, a tale of a disastrous sailing expedition to Pentecost, a technical description of two types of canoes (coastal and sea-going), an ethnographic analysis of rites accompanying the manufacture of a long distance-canoe, as well as two drawings of canoes. These documents [5] are not field notes, but a chapter for a monograph on Atchin in preparation. He noted in *Stone men of Malekula* (Layard, 1942) that his brief descriptions of canoes would be much more detailed in his forthcoming Atchin volume.

DESCRIPTION AND USAGE OF SEA-GOING AND COASTAL CANOES AFTER J. W. LAYARD

Shortly after J. W. Layard's arrival on Atchin, the "inauguration rite for a canoe" occasioned by the purchase of a European whale boat by the village of Emil Parav, incited him "to enquire into the making of a real canoe" (UCSD, MSS 84, Box 48, folder 13). It is reasonable to hypothesize that he took such an interest in canoes because he was a student of A. C. Haddon, who would become the grand specialist on Pacific canoes. But since the construction of the large sea-going canoes had ceased, J. W. Layard had a "trustworthy native who had often sailed in them" build a model of one (UCSD, MSS 84, Box 48, folder 13; Geismar and Herle, 2010, p. 84, photo no. 98790). This finely made model sea-going canoe possesses all features characteristic of the type: sewn on wash-strakes, fore and aft symmetry with a 'bow' piece and figure-head at each end, outrigger booms placed together amidships, platforms on the outrigger booms on both sides of the hull (fig. 2). A departure from the original is the material of the sail, made from the fibrous bases of coconut petioles rather than woven pandanus mats. This model appears to

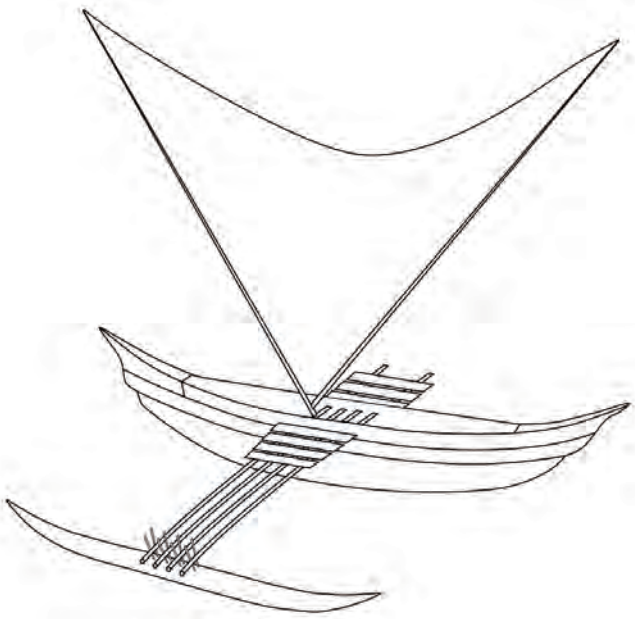


Fig. 2 – Sketch of a model sea-going canoe from Atchin based on a photograph by J. Layard.
Fig. 2 *– Dessin d'une maquette de pirogue de haute mer d'après une photographie de J. Layard.*

have been decorated for the consecration ritual presumably connected with its manufacture, presentation or offering. It is decorated with pandanus leaf pennants tied to the spars, and with *Cycas* fronds at their tips and on the figure heads at both bows.

According to J. W. Layard:

> …There are two kinds of canoes in the small islands: (i) The ordinary coastal canoe in everyday use, for crossing over to the mainland [Malekula], and short journeys up and down the coast, and (ii) the large sea-going canoes for use in trading and ceremonial expeditions to Santo, Oba, Ambrim and other islands within a radius of about eighty miles. These have now gone out of use, and white man's whale boats are used instead. The main function of long-distance canoes is trade in pigs, the sacrificial animals without which no rite can be performed. This takes them chiefly to the islands of Pentecost and Ambrim, though other islands may of course be visited. They are also war canoes in this sense only that the fighting is occasioned almost exclusively by the trade in pigs. The fighting tendency is well brought out by the sham marauding scenes enacted on the maiden trip.
>
> The outstanding difference in construction between the two kinds of canoe lies not so much in their size, as in the arrangement of the outrigger booms.
>
> i) The coastal canoe has three booms, the two after booms being close together and at some distance from the fore boom.
>
> ii) The sea-going canoe is double ended and has four booms equi-distant and close together amidships. The sea-going canoe also has two tiers of wash-strakes as opposed to the coastal canoe which has at most one but usually none at all…The sail is symmetrical in plan and V-shaped (the angle of the V being rather less than a right angle) with concave upper side… (UCSD, MSS 84, Box 48, folder 13). Whereas the coastal canoes have only one bow and can therefore be paddled or sailed in only one direction, these sea-going canoes have bows at either end, so that they can sail either way (MSS 84, box 31, folder 6).

As can be seen, J. W. Layard's data is descriptive. He does not use these canoes as evidence for tracing migration patterns, evolution or diffusion; notions that he had probably been taught at Cambridge; A. C. Haddon and W. H. R. Rivers being both advocates of cultural diffusion. At the time, the anthropological discipline was understood as an evolutionary and/or historical reconstruction of the migrations of people based on a comparative analysis and distribution of physical types, languages, material culture and customs (Geismar and Herle, 2010, p. 76–77). For Haddon,[6] the distribution and evolution of canoe and rig types throughout Oceania was to be correlated to historical movements of people. A. C. Haddon, in collaboration with James Hornell, a fisheries specialist, published the classic work *Canoes of Oceania* in three volumes between 1936 and 1938. It is still the basic reference today. In volume II, in the "New Hebrides" chapter, the data on Atchin come from the catalog prepared by J. W. Layard for the Cambridge Museum "to describe the models he gave to the museum and supplemented by numerous photographs" (Haddon, 1937, p. 27–32). The catalogue was apparently extracted from his unpublished monograph for the building and inauguration rites of sea-going canoes.

Haddon stated that "The [Atchin] sail is a simple kind of Oceanic spritsail similar to that which was formerly used in New Zealand" (Haddon, 1937, p. 30), and in their conclusion that "…there can be no doubt that when the proto-Polynesians entered the Polynesian area from Micronesia, probably soon after the beginning of the Christian era, their vessels were rigged with simple triangular spritsails" (Haddon and Hornell, 1938, p. 55). Haddon and Hornell appear thus to consider the Atchin sail as a relic of a proto-Polynesian Oceanic spritsail.

BUILDING A SEA-GOING CANOE

Following John Willoughby Layard's description, the procedure of building a canoe may conveniently be divided into four parts:[7]

– Work done on mainland Malakula: whence suitable trees are found upon the mainland, the ground is cleared, communion rites and calling upon the ancestors of the village and in particular of the owners of the ground on which the tree is felled are held. Bark and branches are removed, the preliminary hollowing of the log begins, the ends of the dug-out both fore and aft are undercut. These works are done by the five Atchin villages in rotation.

– Transporting the rough dug-out to the small island: a communion rite is held, the owners praying to their ancestors that the removal may prove easy and successful. A feast of pudding, coconuts and bananas preceded the beginning of the work, each visiting party hauling at the rope in turn, singing specific songs. On arrival at the shore of Atchin, a prized pig is killed by the chief canoe owner as well as other pigs. These are presented to the workers. Dances are accomplished, yams are aligned for all half-villages who have labored and mats are presented to each individual worker.

– Assembling the parts of the canoe: the dug-out is left for about a month to dry, while the outside then the inside are further trimmed. Pigs are killed and sacrificial signals are sounded on slit gongs. The bow and stern along with the lower wash-strakes are made, tested and attached. They are followed by the outrigger booms and float. The half-finished canoe is buried in the sand to half its height in order to insure its immobility. All villages assist. The completed outrigger is attached to the canoe, the wings of a sea-gull [8] are attached to the boom insuring that "the canoe may fly like a gull before the wind" (UCSD, MSS 84, Box 48, folder 13). A leaf is also tied, "… leaves of this kind being seen to float upon the water and said to be the resting-places of these fish when on their flights" (UCSD, MSS 84, Box 48, folder 13). Yams are aligned for each of the half-villages. Each worker is presented

with a mat. Pigs are killed and sacrificial signals sounded on the gongs. The remaining work on the canoe is presumably done by men of the home village and includes the assemblage of the thwarts, the main upper wash-strakes, the fore and after upper wash-strakes, the outrigger platforms, the main figure-heads, the fore and after platforms, the bow and stern strakes with their subsidiary figure-heads. Yams, mats, sacrificial signals and pigs accompany all occasions.

– The inauguration rite after the purchase of a whale boat: the day before the inauguration rite the strips of matting plaited by the women are sewn together by the old men to complete and set up the sail in the dancing ground. Yams are aligned for each half-village, two pigs are killed and puddings of pounded breadfruit and banana are cooked. To make the ceremony more magnificent than ever, a scraggy bullock, taking the place of a full circle-tusker, was sacrificed. Dances and killing of pigs and the bullock are executed on appointed nights following the rotation of the villages. On each of these appointed nights, yams and mats are presented to the guests and two more pigs are killed in honor of the two halves of the dancing village.

As stressed already by Nancy Munn, in her paper on Gawan canoes of the Massim, building canoes is not simply a technological procedure, but involves "developmental symbolic processes that transform both socially significant properties or operational capacities of objects, and significant aspects of the relation between persons and objects, between the human and the material worlds" (Munn, 1977, p. 39). Canoes are given a "soul through identification with the chief sacrificial tusker whose title is assumes. Since the owner, i.e. the sacrifice, himself takes the same title, it is clear that this rite is in fact another form of Maki [grade taking ceremony], in which not only the man, but also the canoe, takes on the rank of the sacrificed boar, and the two are, in this respect, identical" (Layard, 1942, p. 469).

ATCHIN CANOES IN A LARGER PERSPECTIVE

Let us now consider the data collected by John Willoughby Layard in a larger perspective, that of the distribution of canoe types and rigs in the Pacific. To understand just how unusual are the canoes of central and northern Vanuatu,[9] sometimes monodrome (tacking),[10] sometimes amphidrome (shunting),[11] one needs to review the major types of sail rigs that existed in Oceania and their geographical distribution (Di Piazza, 2014a and 2014b).

In the west, in island Melanesia, Western Polynesia (although see discussion about Samoa and Tonga below) and Micronesia, the prevailing canoe type is the shunting single outrigger with an Oceanic lateen sail. This rig is characterized by a triangular sail with its apex stepped at the bow of the hull. It uses three spars, a yard, a boom and a movable mast raked towards the bow. The entire rig will be shifted to the other end of the hull during each shunt. In the East, in Eastern Polynesia (as well as in Samoa and maybe Tonga) [12] tacking canoes carry Oceanic spritsails. This rig also uses a triangular sail, but attached between two spars, a sprit and a functional mast positioned at the forward end of the canoe but well back from the bow. Samoa lies at the frontier between these two traditions. It is the only archipelago where the eastern and western rig co-existed with their respective maneuvers. Indeed this archipelago appears to be where the tacking Oceanic spritsail was innovated and from where it spread to East Polynesia, as argued elsewhere (Di Piazza, 2014).

There are a few exceptions to the distribution of these eastern and western traditions. On the Polynesian outliers of Tikopia and Anuta within Melanesia tacking canoes use Oceanic spritsails (Feinberg and George, 2008), that is a sail and a maneuver from the East. On the east coast of New Caledonia, Ouvea in the Loyalties and on the Belep islands to the north, there are shunting canoes with Oceanic spritsails (Haddon and Hornell, 1975) that is a sail from the East and a maneuver from the West. On Tonga and the Niua group, there was a type of large double canoe, the *tongiaki*, rigged with an Oceanic lateen that came about by tacking (Haddon and Hornell, 1975). Thus it used a western sail and an eastern maneuver. As in Samoa, they probably also had small tacking outriggers with Oceanic spritsails.

Atchin canoes have the particularity of using a Polynesian sail rig such that it can use maneuvers, shunting and tacking. To the knowledge of the author, this rig is the only one that allows such freedom of utilization, incorporating the advantages of both methods. The Atchin rig seems to have simplified the shunting maneuver. Rather than carry the tack from one end to the other, the boom swings around the mast and the mast foot is shifted forward slightly along a longitudinal bar or moved from closely spaced crossbeam to another. In some cases, the rig may simply be inclined forward, leaving the position of the mast foot unchanged. In the case of small (often one-man) canoes, in gentle conditions, even this simplified shunting procedure may be dispensed with and they come about by tacking. Sailing with the outrigger float to leeward where it may be forced under water by an unexpected gust of wind is always risky. If this risk is acceptable in good weather when conditions are conducive to re-righting the small canoes, it would not be the case with the much heavier sea-going canoes.

THE ATCHIN CANOE: A POLYNESIAN/MICRONESIAN HYBRID IN A MELANESIAN WORLD

Stuart Bedford and Matthew Spriggs (Bedford and Spriggs, 2008) discussed Northern Vanuatu as a Pacific crossroads. They reviewed inter-archipelagic

interactions between northern Vanuatu and the southern Solomon Islands, northern New Caledonia, Fiji and western Polynesia from the initial human colonization some 3000 years ago up to the present. About Polynesia, they concluded that:

> Northern Vanuatu is thus currently rather a void in the story of Polynesian influence on island Melanesian societies. It may be that Polynesian influences have been masked or replaced by recent sociopolitical developments and cultural practices associated with the spread of the grade-taking political system throughout northern Vanuatu (Bonnemaison, 1996, p. 200–216)… Investigation of the history of the grade-taking system and its associated material culture will help to shed light on this issue (Bedford and Spriggs, 2008, p. 100–101).

As discussed above, Atchin canoes carry a strong Polynesian signature. The geographical distribution of this canoe type suggests that the central and northern Vanuatu region may have been a node in a network including Polynesian islands, most probably the nearby Polynesian outliers, such as Tikopia or Anuta whose canoes tack through the eye of the wind and carry Oceanic spritsails.

J. W. Layard also told us that Atchin sea-going canoes are associated to the grade taking ritual (Maki) as well as gong-raising (Layard, 1928). He noted that:

> The close connection both with the Maki and with the rite of gong-raising is clear from the similarity of ceremonial pattern in all three rites [the third being the inauguration of a sea-going canoe or a whale boat]… (UCSD, MSS 84, Box 48, folder 13).

With Atchin canoes, the 'polynesianisation' of an artefact has neither been 'masked', nor 'replaced' but integrated into a grade taking socio-political system, integrated into a maritime tradition. The Atchin people have certainly borrowed a sail rig and its maneuver from the East but they also have innovated upon it. The butterfly sail is a variety of the Oceanic spritsail but the deeply hollow head and the two highly raked spars make it a unique example.[13] Atchin canoes are the sole craft designed to incorporate technological traits that render both the tacking and shunting maneuvers possible. The vocabulary related to this artefact is also particular. The Atchin terms for the spars *(a-tsem* or *tsorta)*, the stays *(nav* or *rev-rev)*, the steering paddle *(no-wosh na'ak)*, or the maneuver *(ra-tseme)*, are not shared with other Oceanic languages, which use reflexes of **fana* or * *jila*, **tuku*, **foe uli*, **sua* or **siki* or **li-iaki*.

Another architectural trait that makes the Atchin canoe a cosmopolitan vessel, binding different traditions, is the presence of two platforms, one on the outrigger (to windward) and one to leeward. The leeward platform, acting as a lever to counterbalance the weight and therefore drag of the outrigger float, is found throughout Micronesia (except Kiribati). The Atchin platform strongly resembles Micronesian platforms in that it extends far to leeward. Platforms are also present in parts of Melanesia (Fiji, Santa Cruz, Isle of Pines and the Loyalties) although they do not extend far from outboard (Haddon and Hornell, 1975; Neyret, 1974). It may be that in Melanesia the platform is mainly used as a walkway to aid carrying the tack of the lateen sail aft when shunting. While this type of balance platform is associated with the Oceanic lateen and the shunting maneuver, an analogous feature (a balance plank or narrow platform opposite the outrigger) is known from three cases of tacking canoes in Polynesia: the *tipairua* from Tahiti, the *iatolima* and *soatau* from Samoa (Haddon and Hornell, 1975). It differs from the Oceanic lateen rigged balance platform in that it supports the starboard shroud(s). It also allows crew members to counterbalance the wind forces and prevent the outrigger from being submerged. The canoes from central and northern Vanuatu appear to have incorporated borrowings from more than one region, adding complex external influences into the development of Melanesian naval architecture.

CONCLUSION

This review of J. W. Layard's typescript was intended to present unpublished documents and a type of high seas canoe that disappeared just before the arrival of J. W. Layard on Atchin in 1914, but not forgotten. In 1980, an Atchin canoe sailed nearly 1,300 miles in ten days to Papua New Guinea to participate to the Third Festival of Pacific Arts held in Port Moresby. This canoe, named Vanuatu, was 45 feet long and 15 feet across the outrigger and hull (Huffman, 2010, p. 237). In 1995, Tilley assisted to the building and launching of coastal canoes specially made for the visit of the heads of the 'Melanesian Spearhead Group' for the ninth annual meeting of the presidents of the different Melanesian countries on Wala.

> The six traditionally designed and crafted canoes were being built to carry the politicians over to Wala Island from the mainland. The canoes had to be 'correct' in every detail and conform to the dictates of kastom. The fame of Wala was at stake (Tilley, 2002, p. 22).

More than 80 years after the 'claimed' disappearance of large Atchin canoes, the master canoe builders have successfully kept part of their ancient art alive, by continuing to build and use their smaller coastal sailing canoes. This highlights the fact that more humble craft, which serve for daily routine voyages of cabotage, are now the sole vehicles for the conservation and transmission of this endangered maritime *savoir-faire*. Endangered in the sense that J. W. Layard, did indeed record the last first-hand knowledge of the great sacred canoes that were at the heart of an intricate and spiritually charged cosmos.

NOTES

(1) Since Independence, in 1979, the official spelling of 'Malekula' has become 'Malakula'. 'New Hebrides' is used when quoting or paraphrasing pre-Independence texts.
(2) Off the northeastern side of Malakula is a group of islands called the Small Islands, amongst them Vao, Atchin, Wala, Rano, Norsup, Uripiv and Uri.
(3) Layard, 2008 should read Layard, 2010.
(4) The original glass-plate negatives were donated by his son, Richard Layard to the Museum in 2003.
(5) This document is cataloged under the title "Unpublished Atchin Book : notes and drafts, 'Canoes' (includes comparative vocabulary, drawings and vocabulary for winds)" at UCSD.
(6) In 1900, A. C. Haddon originally trained as an evolutionary biologist, had been appointed the first lecturer in Ethnology at Cambridge, following his participation in the 1898 Cambridge Anthropological Expedition to the Torres Strait (Haddon 1901–1936).
(7) Whether sacrifices and feasting (killing of pigs, offering yams and mats, eating special puddings, sounding gongs) are practiced after each major event is not explicit in the text.
(8) This may be a tern (*Sterna* spp.) as there are no gulls (subfamily *Larinae*) in the Pacific.
(9) This canoe type was used on Mota in the Banks islands (Codrington, 1891), on Malekula (Somerville, 1894), on Vao (Speiser, 1996), on Tangoa, an islet off Espiritu Santo (Edge-Partington, 1898 cited by Haddon and Hornell, 1975, vol. II, p. 37), presumably on Efate (Somerville, 1894), Pentecost (Hardacre, cited by Haddon and Hornell, 1972, vol II, p. 34) and Santo (Neyret, 1974).
(10) Tacking canoes have dedicated bows and sterns and their outriggers will thus be alternatively on the windward and leeward side. Their hulls are symmetrical port and starboard. When sailing to windward, the sail swings from one side of the mast to the other as in European craft.
(11) Shunting canoes always keep the outrigger, and thus one side of the hull, to windward. When changing direction to windward, the sail is shifted from one end of the canoe to the other by pivoting the mast from forward to aft. The bow becomes the stern and vice versa. Their hulls are symmetrical fore and aft, and sometimes asymmetrical windward to leeward with fuller forms to windward.
(12) Sources are rare on Tonga. There tacking canoes rigged with an Oceanic spritsail are known only from a sketch and two aquatints based on it by John Webber from Cook's third voyage (Dodd, 1972, p. 21 and 134).
(13) The butterfly sail resembles the Hawaiian crab claw rig in regards to its hollow head but the latter has its forward spar (or mast) vertical.

BIBLIOGRAPHICAL REFERENCES

Bedford S., Spriggs M. (2008) – Northern Vanuatu as a Pacific Crossroads: The Archaeology of Discovery, Interaction, and the Emergence of the 'Ethnographic Present', *Asian Perspectives*, 47, 1, p. 95–120.

Bonnemaison J. (1996) – Graded Societies and Societies Based on Title: Forms and Rites of Traditional Political Power in Vanuatu, in J. Bonnemaison, K. Huffman, C. Kaufmann, and D. Tryon (eds.), *Arts of Vanuatu*, Honolulu, University of Hawai'i Press, p. 200–3.

Codrington R. H. (1891) – *The Melanesians: Studies in Their Anthropology and Folklore*, Oxford, Clarendon Press, 419 p.

Di Piazza A. (2014) – La pirogue monodrome à voile à livarde : l'outil de peuplement de la Polynésie orientale, in L. Dousset, B. Glowczewski and M. Salaün (eds.), *Les sciences humaines et sociales dans le Pacifique sud : terrains, questions et méthodes*, Marseille, Pacific-credo Publications (Cahiers du Credo), p. 33–47.

Di Piazza A. (2014) – The Vanuatu 'Butterfly Sail': A Polynesian Oceanic Spritsail in Melanesia, *Asian Perspectives*, 53, 2, p. 150–61.

Dodd E. (1972) – *Polynesian Seafaring*, New York, Dodd, Mead (The Ring of Fire, 2), 192 p.

Edge-Partington J. (1898) – *An Album of the Weapons, Tools, Ornaments, Articles of Dress etc. of the Natives of the Pacific Islands: Drawn and Described from Examples in Public and Private Collections in England*, Manchester, P. Hove, 225 p.

Feinberg R., George M. (2008) – Seafaring in the Polynesian Outliers, in H. Selin (ed.), *Encyclopaedia of the History of Science, Technology and Medicine in Non-Western Cultures*, New York, Springer, p. 1983–89.

Geismar H. (2006) – Malakula: A Photographic Collection, *Comparative Studies of Society and History*, 48, 3, p. 520–63.

Geismar H. (2009) – Stone Men of Malekula on Malakula: An Ethnography of an Ethnography, *Ethnos*, 74, 2, p. 199–228.

Geismar H., Herle A. (2010) – *Moving Images: John Layard, Fieldwork and Photography on Malakula since 1914*, Honolulu, University of Hawai'i Press, 308 p.

Haddon A. C. (1935) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, I. *General Ethnography*, Cambridge, Cambridge University Press, 421 p.

Haddon A. C., Rivers W. H. R., Seligmann C. G. (1901) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, II. *Physiology and Psychology*, part I. *Introduction and Vision*, Cambridge, Cambridge University Press, 140 p.

Haddon A. C., Myers C. S., Mcdougall W. (1903) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, II. *Physiology and Psychology*, part II. *Hearing, Smell, Taste, Cutaneous Sensations, Muscular Sense, Variations of Blood-Pressure, Reaction-Times*, Cambridge, Cambridge University Press, 223 p.

Haddon A. C., Ray S. H., Seligmann C. G., Wilkin A. (1907) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, III. *Linguistics*, Cambridge, Cambridge University Press, 528 p.

Haddon A. C., Hingston Quiggin A., Wilkin A., Rivers W. H. R., Ray S. H., Myers C. S., Bruce J. (1912) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, IV. *Arts and Crafts*, Cambridge, Cambridge University Press, 393 p.

Haddon A. C., Rivers W. H. R., Seligmann C. G., Wilkin A. (1904) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, V. *Sociology, Magic and Religion of the Western Islanders*, Cambridge, Cambridge University Press, 378 p.

Haddon A. C., Rivers W. H. R., Myers C. S., Wilkin A. (1908) – *Reports of the Cambridge Anthropological Expedition to Torres Straits*, VI. *Sociology, Magic and Religion of the Eastern Islanders*, Cambridge, Cambridge University Press, 316 p.

Haddon A. C. (1937) –*Canoes of Oceania: The Canoes of Melanesia, Queensland, and New Guinea*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publications, 28), 342 p.

Haddon A. C., Hornell J. (1938) –*Canoes of Oceania: Definition of Terms, General Survey, and Conclusions*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publications, 29), 88 p.

Hardacre M. (n. d., c. 1910) – *Raga Vocabulary*, unpublished manuscript.

Hornell J. (1936) –*Canoes of Oceania: The Canoes of Polynesia, Fiji, and Micronesia*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Special Publications, 27), 454 p.

Huffman K. (2010) – *Tsoni, yu save resis* (Johnny, you can run fast). Memories of John Layard: Travelling photos, voices, songs, men, pigs and spirits amongst the 'Sea People' of Northeast Malakula, in H. Geismar and A. Herle (eds.), *Moving Images: John Layard, Fieldwork and Photography on Malakula since 1914*, Honolulu, University of Hawai'i Press, p. 205–44.

Langham I. (1975) – Obituary: John Willoughby Layard, *Oceania*, 45, 3, p. 237–39.

Layard J. (1928) – Degree-Taking Rites in South West Bay, Malekula, *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, 58, p. 139–224.

Layard J. (1936) – Atchin Twenty Years Ago, *The Geographical Journal*, 88, 4, p. 342–51.

Layard J. (1942) – *Stone Men of Malekula: The Small Island of Vao*, London, Chatto & Windus, 816 p.

Layard J. (n. d.) – "Canoes", unpublished manuscript, John W. Layard Papers, MSS 84, Mandeville Special Collections Library, University of California, San Diego.

Layard J. (2010) – The Coming of the White Man on Atchin, in H. Geismar and A. Herle (eds.), *Moving Images: John Layard, Fieldwork and Photography in Malakula since 1914*, Hawaii, University of Hawai'i Press, University of Cambridge Museum of Archaeology and Anthropology, p. 143–68.

Monnier P. (1991) – *L'Église catholique au Vanuatu : Atchin*, Port Vila, Maison Mariste.

Munn N. (1977) – The Spatiotemporal Transformation of Gawa Canoes, *Journal de la Société des océanistes*, 33, p. 39–53.

Neyret J. (1974a) – *Pirogues océaniennes*, I. *Mélanésie*, Paris, Association des amis des musées de la Marine, 186 p.

Neyret J. (1974b) – *Pirogues océaniennes*, II. *Polynésie, Micronésie, Indonésie, Inde, Autres Continents*, Paris, Association des amis des musées de la Marine, 314 p.

Somerville B. T. (1894) – Ethnological Notes on the New Hebrides, *Royal Anthropological Institute Journal*, 23, p. 393.

Speiser F. (1913) – *Two Years with the Natives in the Western Pacific*, London, Mills & Boon, 190 p.

Speiser F. (1996) – *Ethnology of Vanuatu: An Early Twentieth Century Study*, Honolulu, University of Hawai'i Press, 643 p.

Speiser F. (1923) – *Ethnographische Materialien aus den Neuen Hebriden und den Banks-Inseln*, Berlin, C. W. Kreidel, 457 p.

Tilley C. (2002) – The Metaphorical Transformations of Wala Canoes, in V. Buchli (ed.), *The Material Culture Reader*, Oxford, Berg Publishers, p. 27–56.

Anne Di Piazza
CNRS, UMR 7308 « CREDO »
Aix-Marseille Université
13003 Marseille, France

La pratique de l'espace en Océanie :
découverte, appropriation et émergence des systèmes sociaux traditionnels
Spatial dynamics in Oceania: Discovery,
Appropriation and the Emergence of Traditional Societies
Actes de la séance de la Société préhistorique française
de Paris, 30 janvier-1er février 2014
Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle
Paris, Société préhistorique française, 2016
(Séances de la Société préhistorique française, 7), p. 231-243
www.prehistoire.org
ISSN : 2263-3847 – ISBN : 2-913745-2-913745-66-0

**Banua, *panua, fenua*: a Austronesian Conception of the Socio-Cosmic World

Sophie Chave-Dartoen

Abstract: This paper aims to understand the major and long-lasting impact of mobility and transplantation on societies in the Austronesian area, in terms of both former and recent practices and representations. Underlining the local conceptions about land, country and landscape, this article shows the socio-cosmic character of local societies and discusses the relevance of archaeological and anthropological approaches to the landscape. It also offers a sociological insight into the dispersal of populations and migration phenomena in the South Pacific. This discussion centers on the meaning of the terms *(banua, fenua, fonua,* and *'enua)* derived from the (reconstructed) Proto-Malayo-Polynesian term **banua,* and on the study of its fundamental character in Wallis Island (Western Polynesia). The social, cultural, experiential, practical and cognitive dimensions of the original term are also explored, as are its reflexes and the complex categories to which it refers. The way it functions is also analyzed, particularly in the context of migration and resettlement (i.e. phenomena of segmentation, projection, duplication of social groups and their socio-cosmic world). This study sheds light on the past and clarifies certain contemporary phenomena still perceptible in many Oceanian diasporas.

Keywords: socio-cosmic societies, landscape, South-Pacific peopling and migrations, cultural evolution, Austronesian languages speaking societies.

Banua, *panua, fenua : une conception austronésienne du monde sociocosmique

Résumé : Cet article vise à comprendre le poids important et durable des phénomènes de mobilité et de transplantation, tant dans les pratiques – anciennes et récentes – que dans les représentations pour les sociétés de l'aire austronésienne. Dégageant les conceptions locales qui ont été développées au sujet de la terre, du pays, du paysage, il montre le caractère socio-cosmique des sociétés locales, discute du bienfondé des approches archéologiques et anthropologiques centrées sur la question du « paysage » et propose un éclairage plus proprement sociologique concernant la dispersion des populations et les phénomènes de migration dans le Pacifique Sud. La réflexion s'arrime sur la signification des termes *(banua, fenua, fonua, 'enua)* dérivés du terme (reconstruit) Proto-Malayo-Polynesien **banua* et sur l'étude de son caractère fondamental à Wallis, en Polynésie occidentale. Les dimensions sociales, culturelles, expérientielles, pratiques et cognitives du terme originel, de ses réflexes et des catégories complexes auxquelles ils réfèrent sont explorées ici, ainsi que leur caractère opératoire, notamment en contexte de migration et de réimplantation (phénomènes de segmentation, de projection, de duplication des groupes sociaux et de leur monde socio-cosmique). Cette étude permet donc d'éclairer le passé, elle permet aussi de saisir certains phénomènes contemporains toujours perceptibles dans de nombreuses diasporas océaniennes.

Mots-clés : sociétés socio-cosmiques, paysage, peuplement et migration dans le Pacifique Sud, évolution culturelle, sociétés de langues austronésiennes.

In an overview of the relationship between the populations of the Austronesian area[1] and their environment, T. Reuter (Reuter, 2006a, p. 11) stressed that "a struggle with the experiences of displacement and re-emplacement has been central to the historical experience of Austronesian societies for millennia". Mobility is indeed an integral part of these societies' experience, at least for those speaking the Malayo-Polynesian languages in Eastern Indonesia and Oceania. However, it should be emphasised that although they are not nomadic people, these societies originated and were perpetuated thanks to mobility. Their movements were probably curtailed due to constraints such as demographic growth, food production and access to necessary lagoon and land resources, but this does not explain their structured and structuring characteristics. Archaeological and ethnological studies have evidenced some regularity in their movements, which—for the near past and the present days

at least—clearly stem from social factors such as the spreading of 'houses' and 'canoes' (Carsten and Hugh-Jones, 1995; Fox, 2006b), alliance and exchange networks (Kaeppler, 1978; Bonnemaison, 1987; Monnerie, 1996; Bedford and Spriggs, 2008), conquest (as was the case in Tonga, Tahiti and Hawai'i), exile and the integration of foreigners (Sahlins, 1985 and 2012; D'Arcy, 2006; Fox, 2008 and 2012). In the case of precarious settlements, the earlier bases they maintained also obeyed structural, social and ceremonial principles (D'Arcy, 2006; Petersen, 2000). P. Bellwood (Bellwood, 1996 and 2006) stressed the weight of social logic in the face of strictly natural and material determinism. He emphasized the segmental nature of the Austronesian descent groups and their splitting and spreading, comparing this process to 'colonizing propagules' (Bellwood, 2006, p. 108).[2]

The human colonization of Oceania matched the rapid development, a little less than four millennia ago, of a cultural complex called Lapita that was associated, by linguists and archaeologists, to speakers of Malayo-Polynesian languages (Bellwood, 2006; Kirch, 2000; Noury and Galipaud, 2011). This seems to have been the outcome of some Asian populations meeting with previous inhabitants[3] in island Melanesia. From there, they sailed eastward to progressively reach most of the remote Polynesian islands. They developed a rather unique civilization that somehow remained very close to the social life, ideas and values found elsewhere in island Melanesia, Eastern Indonesia, Madagascar and Micronesia. In this paper, 'Oceania' and 'Pacific' will refer to the southern part of this cultural area, including the south-east of Indonesia. Following on from the work of M. Sahlins (Sahlins, 1957), J. Fox (Fox, 1995a and 1995b) pointed out the branching and segmentation phenomena that occurred in this area, which combined generational structuring and relative seniority from a spatial and genealogical point of origin. This pattern established a status distinction between groups and individuals according to their closeness to a reference ancestor. This distinction governs the distribution of rank, responsibilities and authority and structures internal relationships and interrelationships between groups. The control of land rights, the ritual management of land fertility (Wessing, 1999; Wessing and Barendregt, 2005; McRae, 2006; Reuter, 2006a, 2006b and 2006c; Fitzpatrick and Barnes, 2010), and the monopoly of violence—sometimes delegated to juniors or strangers (Gunson, 1979)—are often associated with it. Status adjustments are made possible by competition and/or usurpation. Bellwood (Bellwood, 1996) added a 'founder-focused ideology' to these social features, i.e. a 'frontier ideology' focused on the opportunity for ambitious juniors to gain autonomy by secession and the starting of their own dynasty. A. Pawley (Pawley, 2007, p. 12) took up this idea, defending "a culturally sanctioned desire to found new settlements in order to become a revered (or even deified) ancestor in the genealogies of future generations". This hypothesis shields the issue of population dispersion from the exclusive influence of biological or material determinism. However, this is a simplistic vision because it attributes these phenomena to the effects of individual ambitions and to the juniors' quest for autonomy as a response to their elders' authority and power. It seems to overlook some essential aspects of precedence and authority in the Malayo-Polynesian speaking societies, where authority is mainly established on ritual mediation and the benefits it provides. In Wallis Island, for instance, the success of a man does not show his strength or skills as much as it demonstrates the joint investment of the deities, the ancestors, the allies and the dependents in his actions (Chave-Dartoen, n. d.). P. Bellwood and A. Pawley's hypothesis also overlooks the large, dense, social and ritual networks that constitute the social space, and which defined these societies and facilitated and organized their expansion over time (e.g. Terrell et al., 2003; Terrell, 2004; Fox, 2006a).

It is both difficult and hazardous to reduce facts of a different nature, scattered in time and space, to a single explanatory model, and, indeed, this is not the aim of the paper although it proposes an anthropological point of view on Pacific migration. It incorporates the material constraints and the weight of events—which can ensure from individual aspiration and actions—in an history with its own deep logic and enduring values. For this paper, I studied the characteristics and values of Eastern Indonesian, Melanesian and Micronesian and mostly Polynesian societies. In this paper, 'ideology' is not to be understood, as Bellwood defined it, as culturally shared ideas based on the individual interests of juniors searching for power, and the posthumous status of a founding-ancestor, but as a system of joint ideas and values which durably organize a social world, its practices, its representations (Dumont, 1978 and 1983) and its perceptions and experiences.

Some ethnological works (e.g. Firth, 1967; Mahina, 1992) and historical anthropology (e.g. Sahlins, 1985; Babadzan, 1993; Gell, 1995) show the 'socio-cosmic' character (De Coppet, 1990 and 1995) of Oceanic societies: living people, ancestors, and deities are interdependent, and the social world is coextensive with its cosmos. Here, social institutions, particularly rites, jointly adjust the order of the world and the relationships between its various entities. This characteristic is certainly common and long standing, but it is frequently overlooked in attempts at historical reconstruction. It is, however, an essential parameter in understanding the way the social domain and its transformations are locally conceptualized and experienced. I will reconsider here some theories about Oceanic population and migration by taking into account these ideological implications. The Wallisian concept of *fenua* provides a helpful point of comparison. It also provides the opportunity to question certain epistemological foundations directly linked to the modern Western ideology underlying them.

An ethnographic project carried out over more than twenty years in Wallis Island convinced me about the centrality of what is called *fenua* in the Polynesian conceptions of society. According to historical linguistics,[4] this word is derived from the Proto-Malayo-Polynesian term

**banua*, whose reflexes are found in Eastern Indonesia and most of Island Oceania except in Australia and Papua New Guinea languages (Blust, 1987; Fox, 2006d; Reuter, 2006b; Ross et al., 2007). The link between the reconstructed semantics of this term, the known population facts and local contemporary conceptions of the socio-cosmic world shed light on the movement and the settlement of these populations in the regional space. It also facilitates the understanding of certain principles which seem to define these conceptions in the long term.

This paper starts with a review of the concept of landscape, which is widely used in theories about the Lapita and Polynesian expansions. According to J. Fox (Fox, 2006a, p. 2), the anthropological use of this concept follows three perspectives: "a topographic vista, an intimate emplacement of local experiences, or […] an 'interanimation' of sense, speech and memory." In the theories presented below, this corresponds mainly to an ecological unit submitted to human action. I shall confront this specific—archaeologically-oriented—meaning of the word with proposals from other archaeologists, linguists and anthropologists. It should clarify some aspects of the societies for whose analysis this concept has been used. T. Ingold's proposals (Ingold, 2000) have a dual interest: they address archaeologists by giving specific orientations to their discipline, while facilitating the approach of the relationship between man and his environment. I will show that, for Western Polynesia at least, the local category of *fenua* challenges certain points of this debate by deepening our understanding of the complex phenomena at work.

My hypothesis is that of a conceptual proximity between the term **banua* (and its reflexes) and a concept of landscape with a specific idea of the socio-cosmic world, in which the efficient action of humans, ancestors and deities are all essential to its renewal, according to various modalities and responsibilities.

THE ISSUE OF LANDSCAPE

In the scientific literature regarding the populations of the Pacific Islands (e.g. cultural evolutionary anthropology, human ecology), the word 'landscape' refers to two kinds of phenomena: first, the natural milieu with its potentialities and its constraints; and second, the partly artificial heterogeneous environment resulting from the conjunction of ecological (i.e. geophysical, biological, climatic) factors and direct or indirect human action.

Landscape and differential evolution of Polynesian societies

Concerning Polynesia, M. Sahlins (Sahlins, 1957) made essential proposals that combine living conditions and the availability of the 'resources across the landscape' among the factors of 'cultural adaptation to distinctive environments'. M. Sahlins hypothesized that ecological and technical constraints had led to the adaptation of migrant populations and the differentiation of their social organization. These small, more or less autonomous, social groups would have developed in environments allowing autarkic production units, according to the pattern of 'truncated descent lines'. Meanwhile, vast 'ramifications' would have developed where resources were more scattered. In this case, the principle of seniority would have organized production and distribution within the social group. M. Spriggs (Spriggs, 2008, p. 215–16) stresses that this idea of secondary adaptation to the conditions in high islands and those found in atolls was the founding stone of the 'cultural drift' theory (Vayda and Rappaport, 1963). The resources of the environment, and more particularly their distribution in the 'landscape', became a major concern. In this perspective, which heralded behavioral ecology (Anderson, 2009), the concept of landscape focused on the climatic, geophysical and biological determinisms shaping it (i.e. landscape history). It also questioned the environmental constraints on the development of human societies and their cultural and technical adaptation. These deterministic factors are still important in some theories but they often constitute only part of the causal explanation. M. Sahlins (Sahlins, 1976, p. 209) stated: "nature is to culture as the constituted is to the constituting." He went on to say:

> [the] action of nature is mediated by a conceptual scheme, a cognitive 'map' of how the world—or an island—was to be ordered. [...] Thus, having arrived in a particular island group, Polynesians did not simply adapt passively to its constraints and limitations. They actively modified and molded their insular world, with [...] often dramatic consequences for their own mode of existence (Sahlins, 1976, p. 210).

Landscape and preferential settlements

It should be noted that the issue and the meaning of 'landscape' differs according to theories and perspectives. The measure of human impact on 'landscape', and the determination of 'cultural landscapes' resulting from it (i.e. paleoecological records), is measurable far back in the past (Head, 2000). When talking about well-established populations, it is "widely acknowledged nowadays that our species has domesticated not only particular species of plants and animals, but also landscapes—a term that we take to mean not only certain places, or types of places such as estuaries, coastal plains, and tropical forests, but also the 'species pool', or range of species inhabiting such places" (Terrell et al. 2003, p. 325). By domesticated, J. Terrell means an intimately known 'landscape' that is used as a garden to provide a wide range of food thanks to different techniques, ranging from collecting to cultivating. It therefore differs from the 'natural' or 'wild landscapes' encountered by colonizers moving eastward. However, it is still quite consistent with the idea of a 'transported landscape' presented below.

Most of the theories concerning human settlements in the South Pacific, especially M. Sahlins', do not rely on simplistic forms of determinism between man and his environment. G. Clark and S. Bedford (Clark and Bedford, 2008), for example, proposed the ecological concept of the 'colonization friction zone' or 'friction landscape'. Their definition combines environmental, demographic and cultural factors:

> Landscape can be conceived of as composed of aggregates of factors that either impede or facilitate the movement of living organisms (Clark and Bedford, 2008, p. 59).

During the Lapita expansion, some unfavourable zones, either unfamiliar or difficult to reach —such as the Solomon Islands, Samoa and the north of Tonga—would have temporarily hindered the process of migration. However, cultural factors, such as demography and the accessibility of an island, would have partially facilitated the movement. Numerous authors [(5)] have emphasized the relationship between population and resources by associating demographic and techno-cultural constraints with more strictly environmental, or landscape-related, ones. As A. Pawley put it:

> [Lapita settlements] were situated facing passages in the reef through which canoes could come and go. Most were in areas where there is either a broad fringing reef, or a lagoon and a barrier reef, or both. They were also adjacent to identifiable fresh water sources and every site has arable land nearby. Small islands generally offered the further advantage that they were only lightly wooded so that gardens could be planted without first cleaning primary forest (Pawley, 2007, p. 6).

In other words, Austronesian language speakers (at least those associated with the Lapita cultural complex) were under external constraints, yet they chose where to settle and from where to radiate outwards. Here again we find the conjunction of culturally defined needs and expectations of migrant groups organized in social and ecological units gaining access to a variety of resources. Like P. Bellwood (Bellwood, 2006, p. 101-103), A. Pawley also insists on "the inherent transportability of the agricultural economy to support colonizing propagules" (Pawley, 2007, p. 12). This cultural dimension, embedded in the initial choice of suitable places for settlements, provides an operational aspect to the concept of 'landscape'. Through their activities (e.g. from food collecting to shifting horticulture, from irrigated taro plantations to monumental settlements), migrants modified their environment according to their needs, practices and the ideas that guided their development. Such a modified environment is nowadays termed 'landscape', and it became an operational concept as soon as the cultural dimension of settlement location was taken into account: exploratory research of Lapita settlements usually starts at sites that may have formerly fulfilled such criteria.

Transported landscapes

The concept of 'landscape' has had a huge theoretical impact amongst historians, anthropologists and archaeologists. E. Anderson (Anderson, 1952, p. 9) noted that: "unconsciously as well as deliberately man carries whole floras about the globe with him... he now lives surrounded by transported landscapes." Later, P. Kirch[(6)] continued:

> In Oceanic islands, the introduction of highly competitive weeds and predators had drastic effects on the vulnerable endemic biota.[(7)] In the colonization of new land, however, humans […] carry with them a cultural concept of landscape which causes them to actively shape a new environment in that mold. For Polynesians, this cultural concept of landscape, transferred from previously settled archipelagos in the south and southwest Pacific, included such notions as the suitability of the valley bottom for irrigated terracing and the efficacy of fire in converting forest into shifting cultivation (Kirch, 1982, p. 2-3).

The colonization of the Pacific Islands consequently initiated a "process of conversion of a natural ecosystem into an actively manipulated cultural landscape" (Kirch, 1982, p. 4). For A. Anderson (Anderson, 2009, p. 748), this process started a "serial replication of agricultural landscapes" from the southern Solomon Islands to Eastern Samoa 3,000 years ago. It was based upon "an integrated package of root and tree crops, plus domestic scavengers, that was re-created, island by island, through frequent long-distance voyaging."

These practices were probably less homogeneous than this model suggests. For A. Anderson and S. O'Connor (Anderson and O'Connor, 2008, p. 7), seafaring migration was probably associated with 'colonizing behaviors' that changed over time. They acknowledge that the model of a 'transported landscape' explains how and why "[the] landscapes of so many Pacific islands have been modified by human influence". This model also implies "a sense of deliberate and repetitive re-creation, especially of agro-arboreal production" (Anderson and O'Connor, 2008, p. 7). However, the authors highlighted that the first colonization of Remote Oceania mostly depended on the intensive gathering of available resources (e.g. sea shells, flightless birds, nesting turtles) prior to horticulture and animal breeding, although archaeologists have shown that the ancient degradation of the forests was probably caused by early shifting agriculture. Moreover, population settlements were probably the outcome of multiple intraregional movements, apart from the most isolated islands. "It follows that migration was not restricted to the founding events of island settlement; rather, it continued as a significant component of the formation and reformation of island cultures up to the historical era and, of course, within the present day" (Anderson and O'Connor, 2008, p. 7). In summary, archaeological data and ethnology show the cultural unity in the south Pacific and the pervasiveness of some populating processes, but they do not prove the extreme antiquity of a unique,

complex pattern of a 'transported landscape' (Anderson, 2009, p. 748). Oceanic landscapes, therefore, probably result from a process of interactions lasting many centuries.

While the colonists did not immediately create the landscapes or the contemporary settlement patterns, they did gradually contribute to them. The cultural unity of insular Pacific societies is probably not solely attributable to the common origin of the population or current societies, but rather results from a long tradition of contacts, exchanges, migratory movements and the dissemination of common processes and/or structural aspects, such as the organization of groups according to the environment and the temporality of their activities. T. Ingold's proposals, centered on the complexity of the perceptions and the practices of the landscape, shed light on the importance of these connections, and the 'landscapes' encapsulating features.

Landscape and experience

T. Ingold (Ingold, 2000, p. 189) promotes "a 'dwelling perspective', according to which the landscape is constituted as an enduring record of—and testimony to—the lives and works of past generations who have dwelt within it, and, in so doing, have left there something of themselves". The 'landscape' cannot, therefore, be reduced to features: it encapsulates tasks and temporalities. The link between cultural practices and the necessity of dwelling is anchored in it. T. Ingold (Ingold, 2000, p. 198), quoting F. Inglis (Inglis, 1977), considers that "a landscape is the most solid appearance in which a history can declare itself." To paraphrase G. Mead, "if every object is to be regarded as a 'collapsed act', then the landscape as a whole must likewise be understood as the taskscape in its embodied form: a pattern of activities 'collapsed' into an array of features" (Mead, 1938). However, "to perceive a landscape is therefore to carry out an act of remembrance, and remembering is not so much a matter of calling up an internal image, stored in the mind, as of engaging perceptually with an environment that is itself pregnant with the past" (Ingold, 2000, p. 189). I would add that the pervasiveness of actual activities should not be overlooked. T. Ingold also discusses (Ingold, 2000, p. 149) the relational conceptions of the hunter-gatherers regarding their world: "To exist [...]) is already to be positioned in a certain environment and committed to the relationship it entails. Reality, then, is relational through and through... The relational field is [...] the very ground from which things grow, and take on the forms they do. Another word for this ground is land". Consequently, a "relational approach" is necessary in order to grasp "the generation of knowledge and substance" which is "embedded in life-historical narratives of the deeds of predecessors, of their movements and emplacements, and of their interventions—oftentimes from beyond the grave—in the lives of successors" (Ingold, 2000, p. 133).

Another point made by T. Ingold is that the inhabitants of a landscape use it and therefore perceive the conditions of their existence, both whilst alive and dead, and their own relationship with the environment and the non-human entities that populate it. In this perspective, "a skill well remembered is one that is flexibly responsive to ever-variable environmental conditions" (Ingold, 2000, p. 147), whereas people are understood as "centres of progenerative activity variously positioned within an all-encompassing field of relationships." They all circulate, leaving their trace behind them and creating a mobile space where the relationships which constitute them come to mingle.

For T. Ingold, the meaning of 'landscape', therefore, associates the environment and practices with experiences based on perception and memorization. This proposal brings out the independent complexity of the natural, cultural and cognitive phenomena as well as their interweaving. The people, their private and collective experiences and their worldview are at the heart of mobility issues. In this perspective, a 'transported landscape' could not result from the mere transportation of techniques, material culture, animals and plants.

T. Ingold's challenging proposals pertain to an essentially perceptual and cognitive register. Moreover, they cast light on the epistemological biases stemming from our modern Western ideology—which he calls the 'genealogical model'. T. Ingold promotes a conception of sociality based on the primacy of relationships and shared experience. He invites us to take a closer look at unnoticed or often underestimated ways of perceiving, thinking and acting.

These proposals converge with those of anthropologists such as J. Fox and N. Munn. Their theories are also relational, but they are more focused on the culturally based dimensions of subjectivity. Underlining the intimate relations existing between language, culture and perception, J. Fox asserts (Fox, 2006c): "The ordering of space is fundamental to the creation of locative identities and to some extent reflects patterns of *deixis* that are a key feature of Austronesian languages". His conclusions (Fox, 2006a, p. 4) stress that—as with any other human language—perception and expression of space constitute, in Austronesian languages, a category in which powerful cultural and social determinisms are profoundly anchored.

For N. Munn (Munn, 1996, p. 458), conceptions of space include eminently cultural phenomena of perception. The Australian Warlpiri even acknowledge the active presence of ancestors whose "corporeal boundary [is transposed] onto the land […], giving it fixed, relatively enduring markers". In these cases, their presence is perceptible through signs, warnings, and misfortunes seized in the interaction: "This combination of communication and force characterizes the Aboriginal sense of country." N. Munn wrote (Munn, 1996, p. 460). Although Warlpiri Aborigines are not linked with the Malayo-Polynesian cultural complex, this assertion is true for most of the other regional societies.

The uses of the concept of 'landscape' reflect the complexity of the issues it raises concerning the peopling and cultural evolution of the Pacific societies, explanations based on material and environmental determinisms, individual aims and initiatives, psycho-cognitive functions or

more specific cultural and social aspects, all of which are diversely favored according to the theories.

**BANUA/FENUA*: CONCEPTIONS OF THE SOCIO-COSMIC WORLD AND COMPLEX OPERATING CATEGORIES

The theories concerning 'landscape' provide an insight into the complexity of the vernacular concept of *fenua (*banua)*. Three aspects will be examined here: firstly, the intimate and culturally mediatized relationship that people maintain with their environment in the Pacific area; secondly, the ecological and social unity of the socio-cosmic world designated by the term *fenua*; and thirdly, the operational dimension of this concept, which corresponds to a concrete, empirical category of social space. Some aspects of this, both structured and structuring, abstract concept are constant in many Malayo-Polynesian-speaking societies[8]. This concept refers to cultural patterns and a set of principles that organize time and space in a given society, thus organizing its experiences, practices and representations. In other words, beyond the experience and immediate dimensions stressed by Ingold, I suggest considering the cultural—and culturally transmitted and shared—cognitive dimensions of the emic concept of *fenua*.

The opposition between land and sea: an anthropocentric semantic field

Linguists have proposed the reconstructed form **banua* as the Proto-Malayo-Polynesian original term of later reflexes. In the sub-section of the lexicon dedicated to the Proto-Oceanic landscape-related terms *(*panua)*, M. Ross and coworkers (Ross et al., 2007, p. 36-91) point out that while **tanoq* refers to the 'ground' or the 'soil', the meaning of **panua* is more abstract (Ross et al., 2007, p. 395): "1. inhabited area or territory, 2. community together with its land and things on it, 3. land, not sea, 4. (with reference to weather and the day/night cycle) the visible world, land and sky". The term corresponds to the idea of an overwater land or a large island, as opposed to islets and reefs. Contrary to the sea, the 'land'—Proto-Malayo-Polynesian **banua*, Proto-Oceanic **panua*, and East-Uvean/Wallisian[9] *fenua*—is essentially defined as being populated by a human community.

The binary opposition 'land/sea' is a frequent form of relative spatialization in the Austronesian area (Fox, 2006a; Fox, 2006c; Ross et al., 2007, p. 229–230). My own fieldwork in Wallis Island (Chave-Dartoen, 2000) has demonstrated that the 'land/sea' *(fenua/tai)* opposition overlaps another more abstract one: *'uta/tai*, which distinguishes a 'land side' from a 'sea side' in any given position. In both oppositions, the 'land' corresponds to a center, an 'inside' *(loto)*, the damp and cool core where the local society develops and renews itself, with generative responsibilities being incumbent upon men (e.g. horticulture) and women (e.g. maternity). This contrast with the sea—an open, dry, hot and dangerous realm from where deities and foreigners arrive—highlights the characteristics of the *fenua*: a secure and fertile island, and the only place suitable for the development of human and social life. However, it should be remembered, as M. Sahlins (Sahlins, 2008 and 2012) and J. Fox (Fox, 2008) noted again recently, that Austronesian societies do value what comes from the outside: it is generally incorporated into the social world and helps consolidate the social order and establish social distinctions. This is particularly true in Fiji and Western Polynesia (Sahlins, 1985 and 2012), where status hierarchy is founded on external (divine or foreign) references. Thus, the outside does not correspond to an absolute otherness, left at the margins of the social world, but is structurally internalized and made a constituent of the locality. In other words, the social world *(fenua)* is defined in terms of its difference from the outside, while concurrently using structural and ritual means to incorporate it into the cosmos and the mechanisms operating its own renewal.[10]

H. Guiot (Guiot, 2000) defined the *fenua* (in Futuna) as a welcoming and fertile land. She pointed out—as A. Babadzan (Babadzan, 1983) and B. Saura (Saura, 2000) previously did for Eastern Polynesia—the matrix character of the land. On Futuna—as in Wallis (Guiot, 1998)—the inland forest is "a generator of fertility for the soil of the island and, consequently, of well being for the people" because it is the "place of the vitality of the land",[11] "le ma'uli'aga o le fenua" (Guiot, 2000, p. 22). The *'ulufenua*—"all the animated entities produced by the land"—originated here: "domesticated or wild plants, animals, rocks, spring and river water as well as human natives of the *fenua*", but only those who were born there (Guiot, 2000, p. 22).

Such representations are ancient and common in the area where the Malayo-Polynesian languages are spoken. The radial organization of the socio-cosmic space has been pointed out in Madagascar (Thomas, 2006), Melanesia (Spriggs, 1997) and Polynesia (Sahlins, 1957; Gérard, 1974). In Indonesia, for the Baduy people of West Java (Berthe, 1965; Wessing, 2005; Wessing and Barendregt, 2005), as in the mountains of Bali (McRae, 2006; Reuter, 2006a and 2006b), social and ritual organizations overlap. The genealogy of local groups, the fertility of the land and the social world are considered to have originated in the deep and wooded valleys of the center.[12] This relational and spatial organization conjugates the upward orientation of the ancestral genealogical references—and their increasing gradation in value—with the downward orientation of the beneficial flows giving life to the land and the people. This pattern is frequent in the high islands of Oceania, and is consistent with M. Sahlins' observations (Sahlins, 1957) about the radial organization of the autarkic social units which extend from the center of the island to the sea.

The importance of the opposition between land and sea is also striking in Polynesian myths. The land *(*banua/*panua/fenua)* is particularly significant there: it constitutes a whole, defined solely by the development

of social life. This opposition may be original, as in the Tongan origin myth (Herda, 1988, p. 20-21): emerging from the primitive sea—the 'home of the spirits'—land appeared (a trembling rock), from which a pair of primitive twins rose. However, the land can also be raised from the bottom of the sea by a fishing deity. In both cases, of primitive opposition (between the world of spirits and the social world) or more incidental distinction (between the sea roamed by deities and the land allocated to human beings), the 'land/sea' opposition is a founding factor. In this conception of the world, the land is not a matter of natural reality: it is a social space, shaped by the gods, the civilizing heroes, the ancestors and the living humans who, by performing rituals, ensure its permanence and its renewal (Gell, 1995; Douaire-Marsaudon, 1998).

Another aspect of this opposition is apparent in the uncountable mythical and ritual transactions associated with the rise of new societies and communities where places are transferred with the relationships they encapsulate. A process similar to plant reproduction by cutting and cloning: baskets of earth, sand, wood chips or ashes are transported and spread to create new islands;[13] water springs are stolen by deities;[14] stones are moved[15] and taken from their former sites to create new settlements (Gérard, 1974). This process is the same for human communities or social groups, which are split, re-implanted and even duplicated.[16] Such facts can probably be linked to the transfer of place names,[17] widely attested in Wallis and Tuvalu,[18] like the names of islands and archipelagoes such as Savai'i/Hawai'i, 'Uvea/Ouvea, or Futuna. These phenomena deserve specific study, but it should be noted that place names, like personal names, form multi-dimensional cognitive entities to which processes of memorization, condensation and valuation are bound (Chave-Dartoen, 2012). Their use and transfer refer to places as much as to mental and social spaces (Lefebvre, 1974) organized by myths and narratives. In certain cases, they form spatio-temporal routes that J. Fox called topogenies: "a landscape of [named] places forms a complex structure of social memory" (Fox, 2006a, p. 7; for a case study: Fox, 2006e). Therefore, a transfer of place names indicates the likely migration of a social group, as well as the transfer of its specific cultural and cognitive references and the system organizing these references.

I would add that some contemporary reflexes of **banua* also refer to the placenta (Chave-Dartoen, 2000; Saura, 2000), the person's original alter ego, immediately buried after birth. In Wallis, the grave is like a mooring bollard for dead people *(mate)* wandering at night. It therefore becomes a genealogical reference as the physical fluids, flowing from the decomposing body, penetrate the ground *(fenua)* which is then fertilized by the beneficial action of the ancestors and the deceased who are buried there (Chave-Dartoen, 2000).

The opposition between the original marine environment and the land defines the latter as being occupied by both living and dead people and their fertility rituals. This opposition is undoubtedly more significant for Polynesians than for other societies speaking Austronesian languages (e.g. in Bali or Java), who withdrew inland after the rise of Hindu or Muslim coastal states. On the other hand, totally foreign 'spirits of the place' are hardly ever found in Polynesia: dead people, ancestors and deities are all incorporated at some level of the socio-cosmic world.[19]

In any case, the concept of 'land' *(*banua/*panua/fenua)* roots its definition in the cultural and social dimensions of the relationship between the local society, the ground where it settled and the environment in which it evolves. This 'land', coextensive with the society (i.e. humans, ancestors, deities) and its cosmos, is the foundation for its practices, representations and experiences. It extends as far as the limits of the social, visible and invisible world, and sometimes includes the surrounding marine world.

Wallisian *fenua* is translated as *pays* in local French as it would be for an english translation as counttry, this translation matches the socio-cultural dimension of a space inhabited by a human community, but ignores the encompassing and relational character of the Polynesian term. This excludes any substantial definition of the 'land' as a 'country' commonly defined by limits or fixed attributes, as is the case for nation-states or a territory.

In Wallis, social units are not defined on a territorial basis, but according to the mutual bonds and duties ceremonially maintained between a chief and his dependents (Chave-Dartoen, n.d.). Gathering the villagers who maintain a ceremonial relationship with him, the chief shapes the village boundaries, which encompass the lands on which people 'make their living' *(ma'uli'i ai)*. The same principle underpins the position and the function of the king, whose figure aggregates what is considered as the 'land' *(fenua)* at the level of the whole society (Chave-Dartoen, 2000 ant 2010).

This principle can be found elsewhere in the region, as far as Indonesia. Most of the time, the existence of the 'land' *(*banua/*panua/fenua)* is essentially established on the ritual and ceremonial relationships which define the socio-cultural group inhabiting it. This relational definition of the 'land' and its community implies the coherence of its social whole, not its closure and the exclusion of other similar entities. In this respect, the concept not only admits creations *ex nihilo*, but also displacements, duplications, as well as, for migrants, the progressive disappearance of its original founding relationships behind new reconfigured relationships. Finally, the concept admits that different *fenua* can coexist in the same place. They may be juxtaposed, somehow superimposed or interlocked, according to how local groups define themselves and others, and how they integrate their environment and their neighbors.

The social definition of an ecological unit

This definition of the *fenua* converges with that of R. Blust:

> "[Proto-Malayo-Polynesian]**banua* tells us that the territorial unit which contributed to the life support of the human community was terminologically distinguished from territories external to it (the latter probably being

> represented by PMP **alas* 'forest'). This inhabited territory included the village, its fields and fruit groves, its domesticated animals, its sources of drinking water and its places for the disposal of the dead (the goodwill of the deceased being indispensable to the prosperity of the living) (Blust, 1987, p. 101).

This lexical reconstruction partially relies on examples from the Solomon Islands.

Concerning Polynesia, Tonga can also be added to the Wallisian example. Before the reorganization of the chieftainship operated in the 19th century, the term *fonua* used to designate "the people of/and place", i.e. "a local territorial entity that incorporated the land and natural surrounds associated with a chiefly title-holding, and the people residing on that land" (Francis, 2006, p. 345). Within this entity under the authority of a title-holder "human agency is integral to a physical landscape that includes the land, the ocean and the sky" (Francis, 2006, p. 345).

Once again, we should note the relational definition of *fonua*. As in **banua/*penua/fenua*, this territorial reference is subordinated to that of the people, including ancestors and deities. R. Blust's proposals were discussed by M. Ross and co-workers (Ross et al., 2007), J. Fox (Fox, 2006d) and T. Reuter (Reuter, 2006b), and all insisted on the polysemy of the term. J. Fox and others showed that ritual practices were essential to the constitution and the territorial setting-up the societies of the islands of Southeast Asia and Melanesia speaking Malayo-Polynesian languages. This is a fundamental point. The importance of the ritual foundation of local societies has also been highlighted by French ethnologists following on from M. Leenhardt's work (Leenhardt, 1971) in New Caledonia. Later, D. De Coppet (De Coppet, 1990 and 1995) suggested that they should be characterized as socio-cosmic or cosmomorph. Therefore, the various definitions of the term **banua* refer to the cosmomorphic dimension of these societies and their holist character.

In this respect, it corresponds particularly to what C. Friedberg (Friedberg, 2005, p. 28) termed a 'complex category' when analyzing vernacular classifications and associated practices.

She explained that such categories are "organizers of the space" and "can play the role of encompassing categories for certain plants at the same time". They originate in use and experience. The Wallisian language contains other categories of this type such as *vao* (forest), *toafa* (barren zone) or *to'oga* (taro irrigated plantations). Because of its general characteristics, the category **banua* is clearly on a higher level. The term corresponds to a social and ecological unit that includes a human community with its invisible counterpart (i.e. dead people, ancestors and deities), the lands on which it subsists and the different ecosystems that provide resources and activities. Usually, these ecosystems are aligned along the radial axis of the island and structure the ordinary and extraordinary activities of the people (Ross et al., 2007): dense forest, fallow lands and coconut plantations (which offer additional food resources and plant materials) where the shifting gardens are open; dry or wet coastal zones (villages/taro irrigated plantations and mangrove swamps), beaches, lagoon and reefs. Whether it refers to an island, a community or a social unit such as a household, the **banua/*panua/fenua* category refers to a complex whole. It constitutes a human group and the social, cultural and technical appropriation of the environment it lives in, subsists on and 'embodies' (Ingold, 2000, p. 63). From an emic point of view, this close relationship not only means that the people are dependent on their environment, but that their investment acts directly on the environment and defines it as coextensive to the social world in development. Such complex categories are operational. They refer to experiences, representations and technical practices. By doing so, they organize actions according to very complex cultural schemes (Friedberg, 1997, p. 47).

For C. Friedberg (Friedberg, 2005, p. 30) "a society and the real or imagined environment in which it lives must be considered as a whole." Such a proposal corresponds exactly to the conceptions that Pacific societies have about the social world and life, as stressed by the Tongan ethnologist O. Mahina concerning his own society. The myths and the representations transmitted by the "oral tradition" *(talatupu'a)* "may be regarded as a cosmic representation of the social arrangement, where the environment is seen as merely an extension of human society. It follows that, as far as the *talatupu'a* is concerned, the origin of the universe is socially connected. [...] Literally, the universe is thus made social—and environmental—specific to the Tongan social world, and the universe, at least for the Tongans, is symbolically Tongan society" (in Francis, 2006, p. 345).

The complex nature of the category **banua/*panua/fenua* is clear. It corresponds to the ritual, ecological and social unit constituted by cosmomorphic groups or societies. The terms 'land' and 'landscape' only translate part of the meaning of this complex category. One should keep in mind that, as pointed out by T. Ingold, J. Fox and N. Munn, its meaning is not substantive but relational and based on the experiential, cognitive and social dimensions of space. The point of view here has to be emic: the category **banua/*panua/fenua* refers to the cultural model, to the social and ritual organization as well as to the forms of sensitivity of the society developing here. Bearing the imprint of these sensitivities, values, representations, actions and techniques, the 'land', 'landscape' and 'environment' have no other existence than that defined by their inhabitants.

We can therefore suppose that, when moving or migrating, speakers of Malayo-Polynesian languages looked for settlement sites that allowed the organization of a socio-cultural space corresponding to the **banua/*panua/fenua* category. A place offering propitious conditions for the development of social life and for the technical and ritual unfolding of a new (re-)created cosmos. In this perspective, a successful and long-lasting settlement implies a culturally defined choice of place and, more importantly, a place shaped by the technical and ritual, direct and indirect actions of men.

SYNTHESIS

Several fundamental aspects of the South Pacific societies deserve to be recalled in this synthesis. The reflexes of **banua* refer, above all, to socio-cosmic worlds (or to coherent units within it) based on the inseparable relationship between the living and the dead, ancestors, deities and the 'land'—extended to what we call 'landscape'—from which life flourishes. Together, they shape and renew it. In these worlds, all socio-cosmic relationships are organized around the 'elders', with all social entities, including deities and ancestors, finding a place in the gradation of status and authority determined by relative seniority. Rank and authority originate in the relationships maintained with ancestors and deities—nowadays the Christian God—providing fertility to the land and prosperity to the society that inhabits it. Rituals and respect for social values ensure the stability of these beneficial relationships and the renewal of society.

Concerning Wallis and Futuna, H. Guiot (Guiot, 1998 and 2000) showed that the *fenua* is seen as a well-nourished land where everything grows. In Wallis Island, the 'king' is made responsible for it by God's will (Chave-Dartoen, 2000). The same is true in Tonga, where the 'land' is not understood as an entity standing outside the social world, as would be the natural domain, opposed to the culture subsisting on it. In spite of the deep social changes at work, many local societies still devalue strictly individual ambitions and ignore a transcending order, such as natural laws or fate. In such socio-cosmic societies, values, institutional organization and the efficiency of technical and ritual practices shape the environment and the order of the whole cosmos. It was certainly the same in the distant past, as shown in comparative studies in linguistics and social analysis at a regional scale (e.g. Carsten and Hugh-Jones, 1995; Bellwood et al., 2006; Reuter, 2006c).

The reflexes of **banua* correspond to what C. Friedberg termed a 'complex category'. It designates a complex whole (a socio-cosmic world) including technical and ritual practices, as well as the experiences and representations ensuring its life and renewal. This whole, however, is not so much composed of material substances but rather of socio-cosmic relationships. It can be displaced and transposed when one of its segments moves to re-establish a world where the living and the dead will cohabit, under the responsibility of an elder chief. The term **banua* and its contemporary reflexes therefore correspond to what appears to be an operational, performative category: any social unit corresponding to a socio-cosmic world perceived, identified and experienced as such by the people participating in its renewal, is **banua/*panua/fenua*.

Although societies where Austronesian languages are spoken are numerous and diverse, and may be impacted differently by environmental constraints and historical events, they have at least partially maintained institutions, practices and representations from their common origin and history. For instance, most of these societies still recognize the coherence of the cosmos, whose renewal is jointly ensured by both the living and the dead.

These socio-cosmic worlds and the institutions that create them are not unchangeable but they are condensed in the **banua* category and its reflexes. All the relationships constituting the socio-cosmic world are condensed within it. The environment is internalized on two levels of these socio-cosmic worlds: experience and rituals. The term **banua* designates the cosmos in its very order, submitted to the rituals and the beneficial interactions of humans, ancestors and deities. Human society, coextensive with its cosmos, depends on it just as much as it deploys it, shapes it, renews it and, if necessary, re-configures it.

NOTES

(1) This category is a conceptual construction based on linguistic features (Bellwood et al., 2006). This paper focuses on the speakers of Malayo-Polynesian languages, a branch of the Austronesian languages coming from Southern China and Taiwan, and ranging southward and eastward through the Indo-Pacific ocean. This linguistic family encompasses a cultural area stretching from Malaysia through Indonesia and Micronesia down to Eastern Polynesia, excluding Australia, most of inland New-Guinea and some isolates. It does not mean that an 'Austronesian people' or an 'Austronesian society' ever existed.

(2) French word meaning "a small natural cutting formed by some bryophytes" (Larousse dictionary, personal translation).

(3) Whether the inhabitants came all the way down from Southern China and Taiwan with their cultural baggage (e.g. see Kirch, 2000) or were already settled, having developed a truly original culture at the contact of nearer Asian influences (Terrell, 2002), is a matter of debate (see Anderson and O'Connor, 2008 for a synthesis). Later arrivals from Northern Micronesia are also reported. Genetic analysis on introduced animal bones found in archaeological excavations (e.g. pigs, rats, poultry) show different routes and origins. Human displacements are therefore shown to be complex and diversified (Anderson, 2009). Most of the interesting theories about migration are based on the need to exchange. See J. Terrell (Terrell, 2002) concerning what he termed Greater Near Oceania; e.g. see also P. Bellwood (Bellwood, 1996) and P. Kirch (Kirch, 2000), concerning the expansion of Lapita.

(4) One method of historic (phylogenetic) linguistics—its semantic approach—consists in lexical comparison and the reconstruction of ancient vocabularies by studying morphologic and semantic mutations.

(5) D. Frimigacci (Frimigacci, 1980) for New Caledonia, for example; see P. Kirch (Kirch, 2000) or A. Noury and J.-C. Galipaud (Noury and Galipaud, 2011) for synthesis on the matter.

(6) See also Kirch, 1984, p. 135.

(7) Polynesian people transported three species of mammals, two species of lizard, snails and weeds. Their settlement deeply modified the local ecosystem and, in some cases (as in Hawai'i), destroyed it (Kirch, 1982).

(8) T. Ingold rejects the idea that perception, experience and culture could be structured. My synthesis goes against his theory on this point.

(9) In linguistic literature, East 'Uvean is the language of Wallis islanders ('Uvea is the island's vernacular name). For the meaning of *fenua* in Wallis, see K. Rensch (Rensch, 1984).

After my fieldwork, I was able to develop the issue (Chave-Dartoen, 2000, *index* and p. 767).

(10) This configuration, termed 'included third *(tiers inclus)* by L. Dumont (Dumont, 1983, p. 121) is an 'encompassing of the contrary' *(englobement du contraire)*.

(11) All translations from French into English were made by the author.

(12) This characteristic flowing pattern diverges from other ones, as in Kerala for instance (India), where fertility stems from the grove surrounding the village (Uchiyamada, 1998).

(13) For Tonga, see Gifford, 1924, p. 68 and 88–102 and Herda, 1988, p. 26).

(14) 'Aliki Liufau (personal communication) about Nuku'ifala and Nuku'ione water springs in Wallis.

(15) P. Herda (Herda, 1988, p. 39–40) says that stones from Rotuma, Wallis, Niue and Samoa were sent to Tonga, as a ceremonial tribute (*fatogia*) to the Tu'i Tonga Tu'itaatui. In this case, stones and yams had the same function.

(16) A. G. Haudricourt (Haudricourt, 1962 and 1964) pointed out that this kind of duplication fits the conceptions of Oceanic people with regard to the reproduction of plants and social groups.

(17) In Wallis, the personal names of people and things circulate only within groups owning rights to them. The transfer of a place name therefore implies the migration of one of its owners. This may be true for the whole area.

(18) 33% of Wallisian place names probably came from Tonga (Kirch, 1984, p. 235). See Herda, 1988, p. 40 for Tuvalu.

(19) One hypothesis could be that, according to common representations in South-East-Asia, 'spirits of the place' are dead, displaced or slaughtered populations or outcasts deceased without any relationship with the people (see Platenkamp, 2007, for discussion). To my knowledge, there are no such entities in Polynesia where the cosmos is ritually made encompassing.

BIBLIOGRAPHICAL REFERENCES

Anderson A., O'connor S. (2008) – Indo-Pacific Migration and Colonization: Introduction, *Asian Perspectives*, 47, 1, p. 2–11.

Anderson A. (2009) – Epilogue: Changing Archaeological Perspectives upon Historical Ecology in the Pacific Islands, *Pacific Science*, 63, 4, p. 747–58.

Anderson E. (1952) – *Plants, man and life*, Boston, Little, Brown and Company, 245 p.

Babadzan A. (1983) – Une perspective pour deux passages. Notes sur la représentation traditionnelle de la naissance et de la mort en Polynésie, *L'Homme*, 23, 3, p. 81–99.

Babadzan A. (1993) – *Les dépouilles des dieux. Essai sur la religion tahitienne à l'époque de la découverte*, Paris, Maison des sciences de l'homme, 344 p.

Bedford S., Spriggs M. (2008) – Northern Vanuatu as a Pacific Crossroads: The Archaeology of Discovery, Interaction, and the Emergence of the 'Ethnographic Present', *Asian Perspectives*, 47, 1, p. 95–120.

Bellwood P. (2006) – Austronesian Prehistory in Southeast Asia: Homeland, Expansion and Transformation, in P. Bellwood, J. J. Fox and D. Tryon (eds.), *The Austronesians: Historical and Comparative Perspectives*, Canberra, ANU E Press, p. 103–18.

Bellwood P. (1996) – Hierarchy, founder ideology and Austronesian expansion, in J. J. Fox and C. Sather C. (eds.), *Origins, Ancestry and Alliance: Explorations in Austronesian Ethnography*, Canberra, ANU E Press, p. 18–40.

Bellwood P., Fox J. J., Tryon D. (2006) – *The Austronesians: Historical and Comparative Perspectives*, Canberra, ANU E Press, 367 p.

Berthe L. (1965) – Aînés et cadets : l'alliance et la hiérarchie chez les Baduj (Java occidental), *L'Homme*, 5, 3, p. 189–223.

Blust R. (1987) – Lexical Reconstruction and Semantic Reconstruction: The Case of Austronesian 'House' Words, *Diachronica*, 4, 1–2, p. 79–106.

Bonnemaison J. (1987) – *Les fondements d'une identité : territoire, histoire et société dans l'archipel de Vanuatu (Mélanésie). Essai de géographie culturelle*, II. *Tanna : les hommes lieux*, Paris, ORSTOM (Travaux et Documents de l'ORSTOM, 201), 680 p.

Carsten J., Hugh-Jones S., (1995) – *About the House: Lévi-Strauss and beyond*, Cambridge, Cambridge University Press, 300 p.

Chave-Dartoen S. (2000) – *'Uvea (Wallis)* : *une société de Polynésie occidentale, étude et comparaison*, thèse de doctorat, École des hautes études en sciences sociales, Paris, 846 p.

Chave-Dartoen S. (2010) – Ignames et taros, enfants des hommes. Horticulture et reconduction du social à Wallis (Polynésie occidentale), *Journal de la Société des océanistes*, 130–131, p. 145–60.

Chave-Dartoen S. (2012) – Noms propres, catégorisation, sémantique et rapport au monde, in S. Chave-Dartoen, C. Leguy and D. Monnerie (eds.), *Nomination et organisation sociale*, Paris, Armand Colin, p. 83–125.

Chave-Dartoen S. (n. d.) – *Dynamiques sociales et pérennité des institutions. La chefferie et le monde sociocosmique à Wallis ('Uvea)*, Aix-Marseille université, CREDO, 278 p.

Chave-Dartoen S. (2015) – *Systèmes de relation et pérennité des institutions. Une approche anthropologique du rituel dans une société cosmomorphe, Wallis, Polynésie occidentale*, mémoire d'habilitation à la direction de recherches, université de Strasbourg.

Clark G., Bedford S. (2008) – Friction Zones in Lapita Colonisation, in G. Clark, F. Leach and S. O'Connor (eds.), *Islands of Inquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*, Canberra, ANU E Press (Terra Australis, 29), p. 59–74.

D'arcy P. (2006) – *The People of the Sea: Environment, Identity, and History in Oceania*, Honolulu, University of Hawai'i Press, 292 p.

De Coppet D. (1990) – The Society as an Ultimate Value and the Socio-Cosmic Configuration, *Ethnos*, 55, 3–4, p. 140–50.

De Coppet D. (1995) – Are'are Society. A Melanesian Socio-Cosmic Point of View. How are Bigmen the Servants of Society and Cosmos?, in D. de Coppet and A. Iteanu (eds.),

Cosmos and Society in Oceania, Oxford, Berg Publishers (Explorations in Archaeology), p. 235–74.

Douaire-Marsaudon F. (1998) – *Les premiers fruits : parenté, identité sexuelle et pouvoirs en Polynésie occidentale (Tonga, Wallis, Futuna)*, Paris, CNRS and Maison des sciences de l'homme, 338 p.

Dumont L. (1978) – La communauté anthropologique et l'idéologie, *L'Homme*, 18, 3–4, p. 83–110.

Dumont L. (1983) – *Essais sur l'individualisme. Une perspective anthropologique sur l'idéologie moderne*, Paris, Seuil (Points Essais), 272 p.

Firth R. (1967) – *The Work of the Gods in Tikopia*, Oxford, Berg Publishers, 512 p.

Fitzpatrick D., Barnes S. (2010) – The Relative Resilience of Property: First Possession and Order without Law in East Timor, *Law & Society Review*, 44, 2, p. 205–38.

Fox J. J. (1995a) – Origin Structures and Systems of Precedence in the Comparative Study of Austronesian Societies, in P. J. K. Li, C. Tsang, Y. Huang, D. Ho and C. Tseng (eds.), *Austronesian Studies Relating to Taiwan*, Taipei, Institute of History and Philology (Symposium Series of the Institute of History and Philology, Academia Sinica, 3), p. 27–57.

Fox J. J. (1995b) – Austronesian Societies and Their Transformations, in P. Bellwood, J. J. Fox and D. Tryon (eds.), *The Austronesians: Historical and Comparative Perspectives*, Canberra, ANU E Press, p. 214–28.

Fox J. J. (2006a) – Place and Landscape in Comparative Austronesian Perspective, in J. J. Fox (ed.), *The Poetic Power of Place: Comparative Perspectives on Austronesian Ideas of Locality*, Canberra, ANU E Press, p. 1–22.

Fox J. J. (2006b) – *Inside Austronesian Houses: Perspectives on Domestic Designs for Living*, Canberra, ANU E Press, 244 p.

Fox J. J. (2006c) – *The Poetic Power of Place: Comparative Perspectives on Austronesian Ideas of Locality*, Canberra, ANU E Press, 196 p.

Fox J. J. (2006d) – Postscript. Spatial Categories in Social Context: Tracing a Comparative Understanding of Austronesian Ideas of Ritual Location, in T. Reuter (ed.), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, p. 365–77.

Fox J. J. (2006e) – Genealogy and Topogeny: Towards an Ethnography of Rotinese Ritual Place Names, in J. J. Fox (ed.), *The Poetic Power of Place: Comparative Perspectives on Austronesian Ideas of Locality*, Canberra, ANU E Press, p 89–100.

Fox J. J. (2008) – Installing the 'Outsider' Inside: The Exploration of an Epistemic Austronesian Cultural Theme and Its Social Significance, *Indonesia and the Malay World*, 36, 105, p. 201–18.

Francis S. (2006) – People and Place in Tonga: The Social Construction of Fonua in Oceania, in T. Reuter (ed.), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, p. 345–64.

Friedberg C. (1997) – Ethnosciences et sciences cognitives, *Journal des anthropologues*, 70, 1, p. 41–49.

Friedberg C. (2005) – Ethnosciences et autres ethno « machins » aujourd'hui : commentaires à propos du texte de Peter D. Dwyer, *Journal de la Société des océanistes*, 120–121, p. 27–30.

Frimigacci D. (1980) – Localisation écogéographique et utilisation de l'espace de quelques sites Lapita de Nouvelle-Calédonie : essai d'interprétation, *Journal de la Société des océanistes*, 36, 66–67, p. 5–11.

Gell A. (1995) – Closure and Multiplication: An essay on Polynesian cosmology and ritual, *in* D. De Coppet and A. Iteanu (dir.), *Cosmos and society: Their Interrelations and Their Coalescence in Melanesia*, Oxford, Berg Publishers (Explorations in Archaeology), p. 21–56.

Gérard B. (1974) – Origine traditionnelle et rôle social des *marae* aux îles de la Société, *Cahiers ORSTOM Série Sciences Humaines*, 11, 3–4, p. 211–226.

Gifford E. W. (1924) – *Tongan Myths and Tales*, Honolulu, Bishop Museum Press (Bernice Pauahi Bishop Museum Bulletin 8; Bayard Dominick Expedition, 8), 207 p.

Guiot H. (1998) – Forêt taboue et représentations de l'environnement à 'Uvea (Wallis) : approche ethnoarchéologique, *Journal de la Société des océanistes*, 107, 2, p. 179–98.

Guiot H. (2000) – Gestion traditionnelle des espaces forestiers à Futuna (Polynésie occidentale) : Contenu idéel et pratiques associées, *Journal de la Société des océanistes*, 110, 1, p. 19–33.

Gunson N., (1979) – The Hau Concept of Leadership in Western Polynesia, *The Journal of Pacific History*, 14, 1, p. 28–49.

Haudricourt A.-G. (1962) – Domestication des animaux, culture des plantes et traitement d'autrui, *L'Homme*, 2, 1, p. 40–50.

Haudricourt A.-G. (1964) – Nature et culture dans la civilisation de l'igname : l'origine des clones et des clans, *L'Homme*, 4, 1, p. 93–104.

Head L. (2000) – Transformed Landscapes: Human Impacts and the Palaeoecological Record, in L. Head (ed.), *Cultural Landscapes and Environmental Change*, London, Arnold (Key Issues in Environmental Change), p. 13–33.

Herda P. (1988) – *The Transformations of the Traditional Tongan Polity: A Genealogical Consideration of Tonga's Past*, doctoral thesis, Australian National University, Canberra, 330 p.

Ingold T. (2000) – *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*, London and New York, Routledge, 465 p.

Inglis F. (1977) – Nation and Community: a Landscape and Its Morality, *Sociological Review*, 25, p. 489–514.

Kaeppler A. L. (1978) – Exchange Patterns in Goods and Spouses: Fiji, Tonga and Samoa, *Mankind*, 11, 3, p. 246–52.

Kirch P. V. (1982) – The Impact of the Prehistoric Polynesians on the Hawaiian Ecosystem, *Pacific Science*, 36, p. 1–14.

Kirch P. V. (1984) – The Polynesian Outliers: Continuity, Change, and Replacement, *The Journal of Pacific History*, 19, 4, p. 224–38.

Kirch P. V. (2000) – *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*, Berkeley, University of California Press, 446 p.

Lefebvre H. (1974) – La production de l'espace, *L'Homme et la société*, 31, 1, p. 15–32.

Leenhardt M. (1971) – Do kamo. *La personne et le mythe dans le monde mélanésien*, Paris, Gallimard, 260 p.

Mcrae G. (2006) – Banua or Negara? The Culture of Land in South Bali, in T. Reuter (ed.), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, p. 83–112.

Mahina O. (1992) – *The Tongan Traditional History Tala-E-Fonua: A Vernacular Ecology-Centred Historico-Cultural concept*, doctoral thesis, Australian National University, Canberra, 598 p.

Mead G. H. (1938) – The Process of Mind in Nature, in C. W. Morris (ed.), *The Philosophy of the Act*, Chicago, University of Chicago, p. 357–420.

Monnerie D. (1996) – Nitu, *les vivants, les morts et le cosmos selon la société de Mono-Alu (îles Salomon)*, Leiden, Center for Non-Western Studies (CNWS Publications), 446 p.

Noury A., Galipaud J.-C. (2011) – *Les Lapita, nomades du Pacifique*, Marseille, IRD, 128 p.

Munn N. (1996) – Excluded Spaces: The Figure in the Australian Aboriginal Landscape, *Critical Inquiry*, 22, 3, p. 446–65.

Pawley A. (2007) – Why Do Polynesian Island Groups Have One Language and Melanesian Island Groups Have Many? Patterns of Interaction and Diversification in the Austronesian Colonization of Remote Oceania, paper presented at the conference 'Migrations' (Porquerolles, 5-7 September 2007), 38 p., http://www.vjf.cnrs.fr/lacito/images/diaporamas_colloque/Pawley.pdf [online].

Petersen G. (2000) – Indigenous Island Empires: Yap and Tonga considered, *Journal of Pacific History*, 35, 1, p. 5–27.

Platenkamp J., (2007) – Spirit Representations in Southeast Asia: A Comparative View, in J. G. Oosten and F. Laugrand (eds.), *La nature des esprits dans les cosmologies autochtones = Nature of Spirits in Aboriginal Cosmologies*, Québec, PUL (Mondes autochtones), p. 100–29.

Rensch K. H. M. (1984) – *Tikisionalio fakauvea-fakafalani = Dictionnaire Wallisien-Français*, Canberra, The Australian National University (Pacific Linguistic Series C, 86), 439 p.

Reuter T. (2006a) – Land and Territory in the Austronesian world, in T. Reuter (ed.), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, p. 11–38.

Reuter T. (2006b) – Ritual Domains and Communal Land in the Highlands of Bali, in T. Reuter (ed.), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, p. 65–82.

Reuter T. (2006c), *Sharing the Earth, Dividing the Land: Land and Territory in the Austronesian World*, Canberra, ANU E Press, 385 p.

Saura B. (2000) – Le placenta en Polynésie française : choix de santé publique et identité, *Sciences sociales et santé*, 18, 3, p. 5–28.

Sahlins M. D. (1957) – Differentiation by Adaptation in Polynesian Societies, *The Journal of the Polynesian Society*, 66, 3, p. 291–300.

Sahlins M. D. (1976) – *Culture and Practical Reason*, Chicago, Chicago University Press, 259 p.

Sahlins M. D. (1985) – *Islands of history*, Chicago, Chicago University Press, 180 p.

Sahlins M. D. (2008) – The Stranger-King or Elementary Forms of the Politics of Life, *Indonesia and the Malay World*, 36, 105, p. 177–99.

Sahlins M. D. (2012) – Alterity and Autochthony. Austronesian Cosmographies of the Marvellous: The 2008 Raymond Firth Lecture, *HAU: Journal of Ethnographic Theory*, 2, 1, p. 131–60.

Spriggs M. (1997) – *The Island Melanesians*, Oxford, Blackwell, 327 p.

Spriggs M. (2008) – Are Islands Islands? Some Thoughts on the History of Chalk and Cheese, in G. Clark, F. Leach and S. O'Connor (eds.), *Islands of Inquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*, Canberra, ANU E Press (Terra Australis, 29), p. 211–26.

Ross M. D., Pawley A., Osmond M. (2007) – *The Lexicon of Proto Oceanic: The Culture and Environment of Ancestral Oceanic Society*, 2. *The Physical Environment*, Canbera, ANU E Press (Pacific Linguistics, 545), 417 p.

Terrell J. E. (2002) – Tropical Agroforestry, Coastal Lagoons and Holocene Prehistory in Greater Near Oceania, in Y. Shuji and P. J. Matthews (eds.), *Vegeculture in Eastern Asia and Oceania, International Area Studies Conference VII*, Osaka, Japan Center for Area Studies, National Museum of Ethnology (JCAS Symposium Series, 16), p. 195–216.

Terrell J. E. (2004) – Introduction: 'Austronesia' and the Great Austronesian Migration, *World Archaeology*, 2004, 36, 4, p. 586–90.

Terrell J. E., Hart J. P., Barut S., Cellinese N., Curet A., Denham T., Kusimba C. M., Latinis K., Oka R., Palka J., Pohl M. E. D., Pope K. O., Williams P. R., Haines H., Staller J. E. (2003) – Domesticated Landscapes: The Subsistence Ecology of Plant and Animal Domestication, *Journal of Archaeological Method and Theory*, 10, 4, p. 323–68.

Thomas P. (2006) – The Water That Blesses, the River That Flows: Place and the Ritual Imagination among the Temanambondro of Southeast Madagascar, in J. J. Fox (ed.), *The Poetic Power of Place: Comparative Perspectives on Austronesian Ideas of Locality*, Canberra, ANU E Press, p. 23–42.

Uchiyamada Y. (1998) – "The Grove Is Our Temple": Contested Representations of Kaavu in Kerala, South India, in L. Rival (ed.), *The Social Life of Trees: Anthropological Perspectives on Tree Symbolism*, Oxford, Berg Publishers, p. 177–96.

Vayda A., Rappaport R. (1963) – Island cultures, in F. R. Fosberg (ed.), *Man's Place in the Island Ecosystem: a Symposium*, papers of the 10th Pacific Science Congress (Honolulu,

21 August – 6 September 1961), Honolulu, Bishop Museum Press, p. 133–142.

Wessing R. (1999) – The Sacred Grove: Founders and the Owners of the Forest in West Java, Indonesia, in S. Bahuchet, D. Bley and H. Pagezy (eds.), *L'homme et la forêt tropicale*, Châteauneuf-de-Grasse, Éd. du Bergier (Travaux de la Société d'écologie humaine), p. 59–74.

Wessing R., Barendregt B. (2005) – Tending the Spirit's Shrine: Kanekes and Pajajaran in West Java, *Mousson*, 8, p. 3–26.

Sophie Chave-Dartoen
UMR 5185 « ADESS »
Université de Bordeaux
sophie.chave-dartoen@u-bordeaux.fr

7

LA PRATIQUE DE L'ESPACE EN OCÉANIE

DÉCOUVERTE, APPROPRIATION ET ÉMERGENCE DES SYSTÈMES SOCIAUX TRADITIONNELS

SPATIAL DYNAMICS IN OCEANIA

DISCOVERY, APPROPRIATION AND THE EMERGENCE OF TRADITIONAL SOCIETIES

Actes de la séance de la Société préhistorique française de Paris,

30 janvier-1er février 2014

Textes publiés sous la direction de Frédérique Valentin et Guillaume Molle

Dotées d'une double identité, maritime et terrestre, les îles du Pacifique, des Bismarck à l'île de Pâques, constituent des espaces physiques, sociaux et cognitifs aux caractéristiques variées et apparemment contraignantes. Or, des sociétés parvinrent à s'y adapter et à y maintenir des populations nombreuses que découvrirent les voyageurs occidentaux. Quelles ont été les dynamiques spatiales mises en œuvre par ces communautés ? Problème aux multiples facettes qu'explore cette publication réunissant seize contributions centrées sur « La pratique de l'espace en Océanie ».
Si, depuis les premières études de « settlement patterns », menées en Océanie dès les années 1960, de nombreux travaux ont documenté la variabilité des modes d'occupations de l'espace insulaire, les auteurs engagent ici une réflexion renouvelée sur la façon de concevoir la cartographie des structures et de l'espace et son usage pour reconstruire les trajectoires historiques ; interrogent les rapports entre contraintes environnementales et choix des zones d'implantation des habitats, des jardins et des zones d'approvisionnement ; envisagent l'espace anthropisé comme révélateur des liens économiques, politiques, religieux, mais aussi sociaux et familiaux, entre les membres des communautés ; et finalement démontrent que les systèmes de relations, organisant l'espace social océanien, fonctionnent à de multiples échelles : locales et régionales, et dépassent les limites géographiques des îles, donnant à leur isolement terrestre une dimension toute relative.

The Pacific Islands, from the Bismarck to Easter Island, are defined by both marine and terrestrial identities. As such, they form physical, social and cognitive spaces of various and seemingly constraining characteristics. However, human societies succeeded in adapting to these landscapes and in growing large populations which were later discovered by the first European explorers. What were the spatial dynamics developed by the communities? This publication gathers sixteen contributions that tackled this multifaceted issue.
Since the first settlement patterns analyses led in Oceania from the 1960s, many works have documented the variability of human occupation on the islands. The authors here renew our perspectives on mapping structures within the landscape and its use for reconstructing historical trajectories; they investigate relationships between ecological constraints and choice of dwelling places, horticultural and procurement areas; they consider the anthropogenic landscape as an indicator of economic, politic, religious, social and familial connections between individuals and groups; they finally demonstrate that the relationships on which the social space is founded operate at different scales, local and regional, exceeding the geographic boundaries of the islands, and leading us to put the idea of isolation into perspective.

Les « Séances de la Société préhistorique française »
sont des publications en ligne disponibles sur :

www.prehistoire.org

ISBN: 2-913745-66-0
9 782913 745667

SÉANCES DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE