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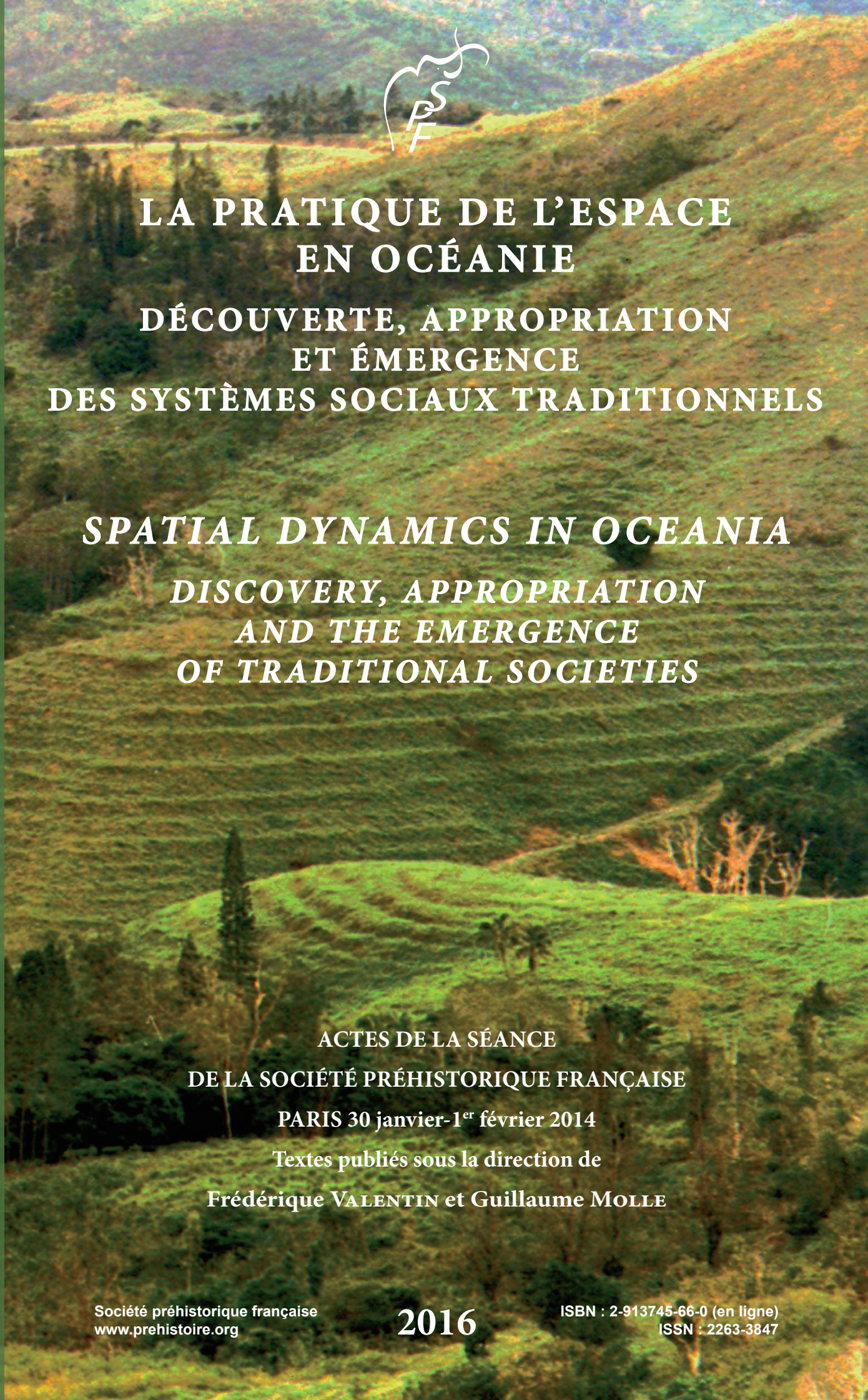

LA PRATIQUE DE L'ESPACE EN OCÉANIE

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SPATIAL DYNAMICS IN OCEANIA

DISCOVERY, APPROPRIATION AND THE EMERGENCE OF TRADITIONAL SOCIETIES

ACTES DE LA SÉANCE
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Siège social : 22, rue Saint-Ambroise, 75011 Paris
Tél. : 01 43 57 16 97 – Fax : 01 43 57 73 95 – Mél. : spf@prehistoire.org
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Adresse de gestion et de correspondance

Maison de l'archéologie et de l'ethnologie,
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Tél. : 01 46 69 24 44
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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

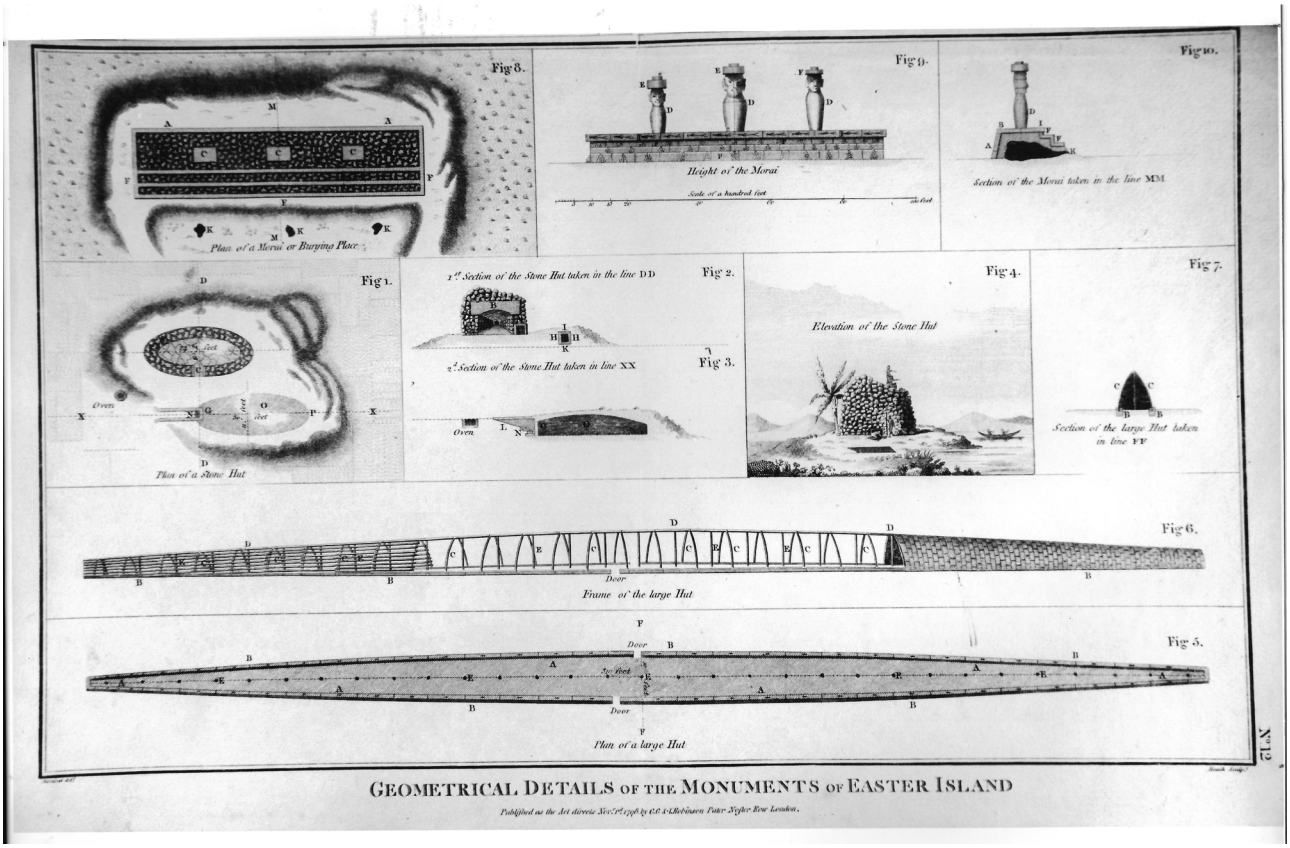

Fig. 1 – Plate of Easter Island stone structures produced from La Pérouse's voyage through the Pacific, engraved in 1798 (collection of P. V. Kirch).

***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 while

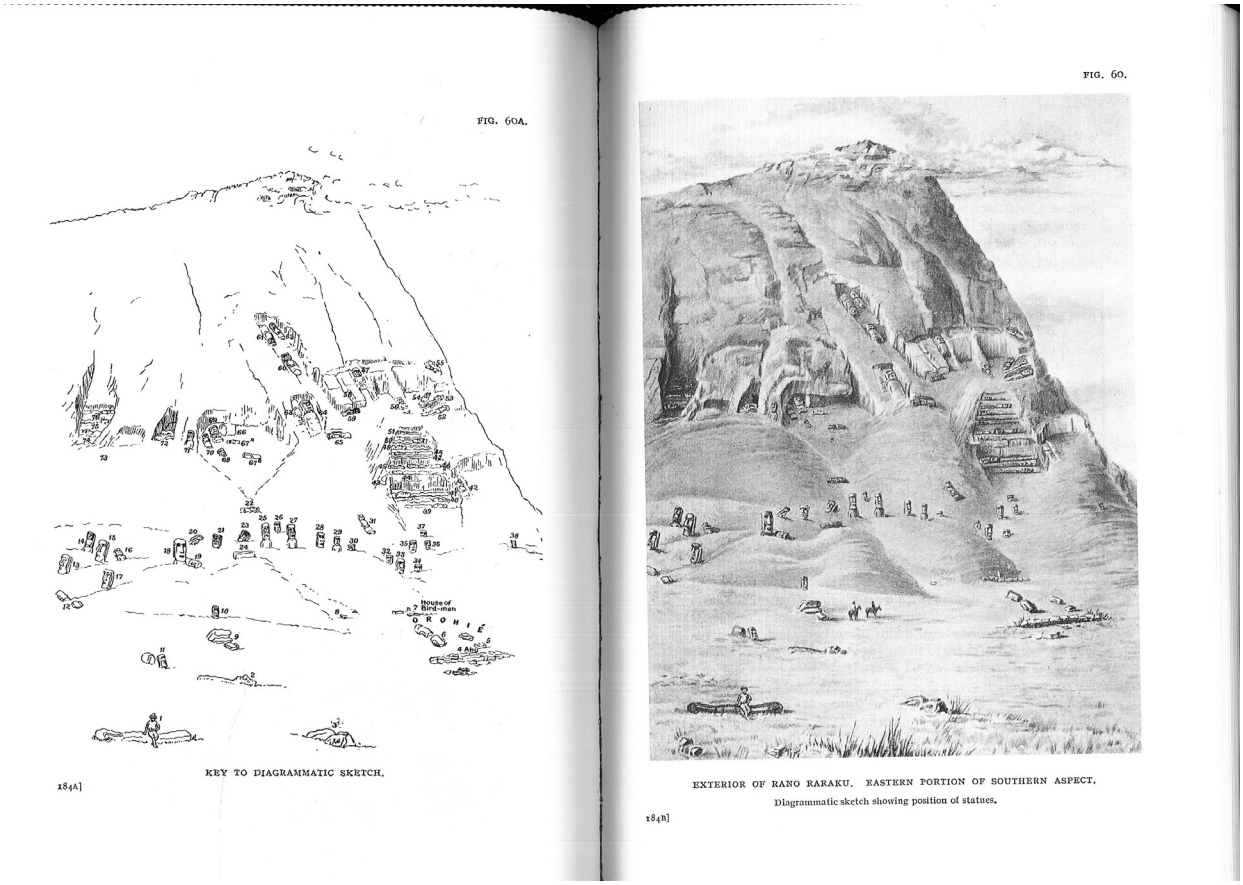

Fig. 2 – Diagramatic sketch of a portion of the Rano Raraku quarry site on Rapa Nui, produced during the Routledge expedition (after Routledge, 1919, fig. 60A).
***Fig. 2** – Croquis schématique d'une partie de la carrière de Rano Raraku sur Rapa Nui, dessiné pendant l'expédition Routledge (d'après Routledge, 1919, fig. 60A).*

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

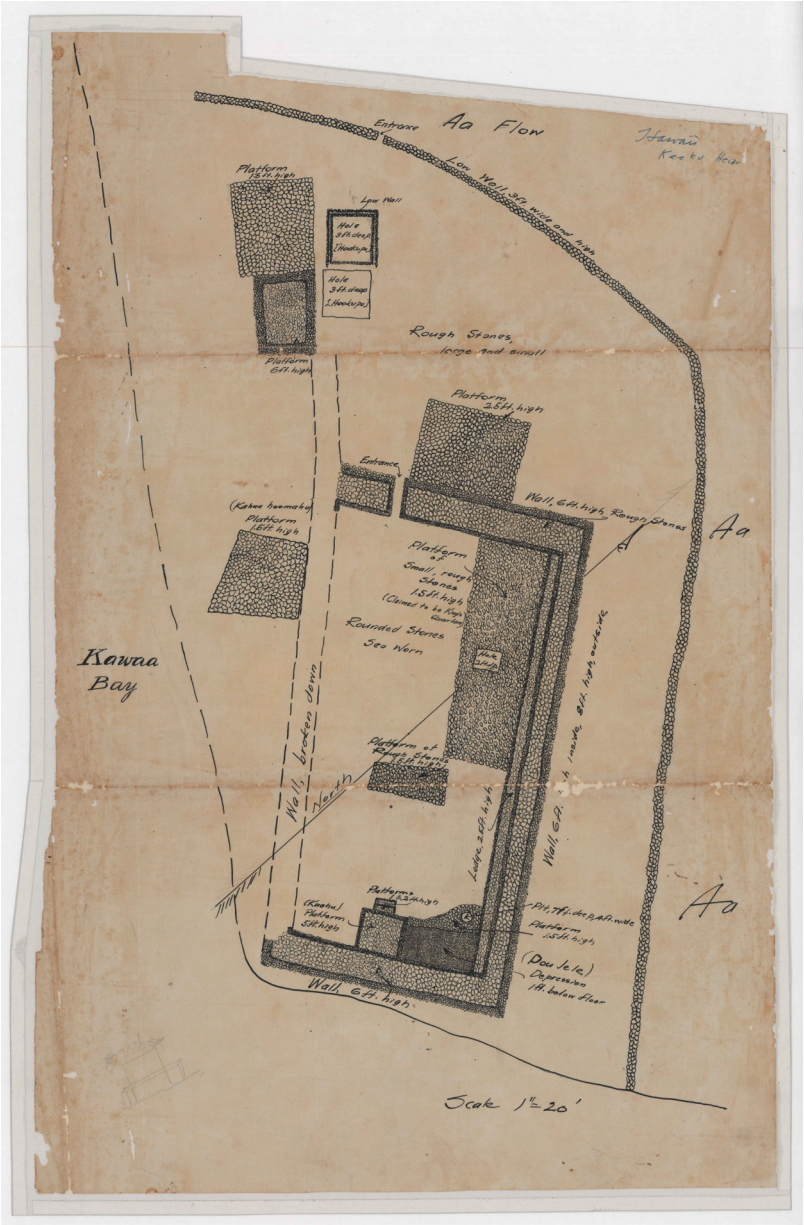

Fig. 3 – Plan map of Ke'eku *Heiau*, Hawai'i island (original map by J. F. G. Stokes; reproduced with permission of the Bernice Pauahi Bishop Museum, scan SP 202437).

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

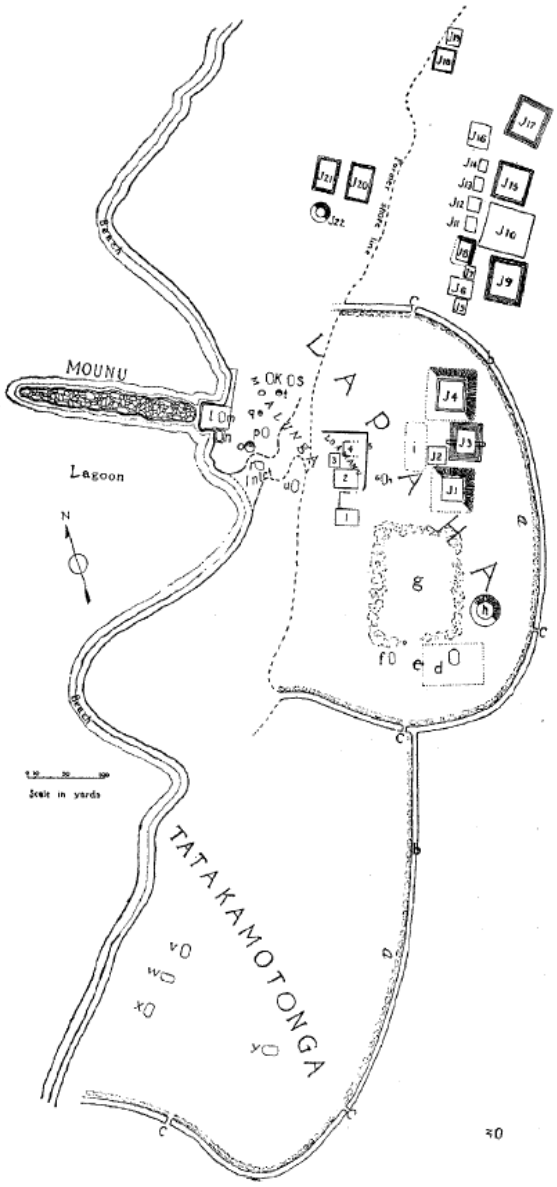

Fig. 4 – Schematic plan of the site of Lapaha, Tonga (from McKern, 1919, p. 95).
Fig. 4 *– Plan schématique du site de Lapaha, Tonga (d'après McKern, 1919, p. 95).*

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,

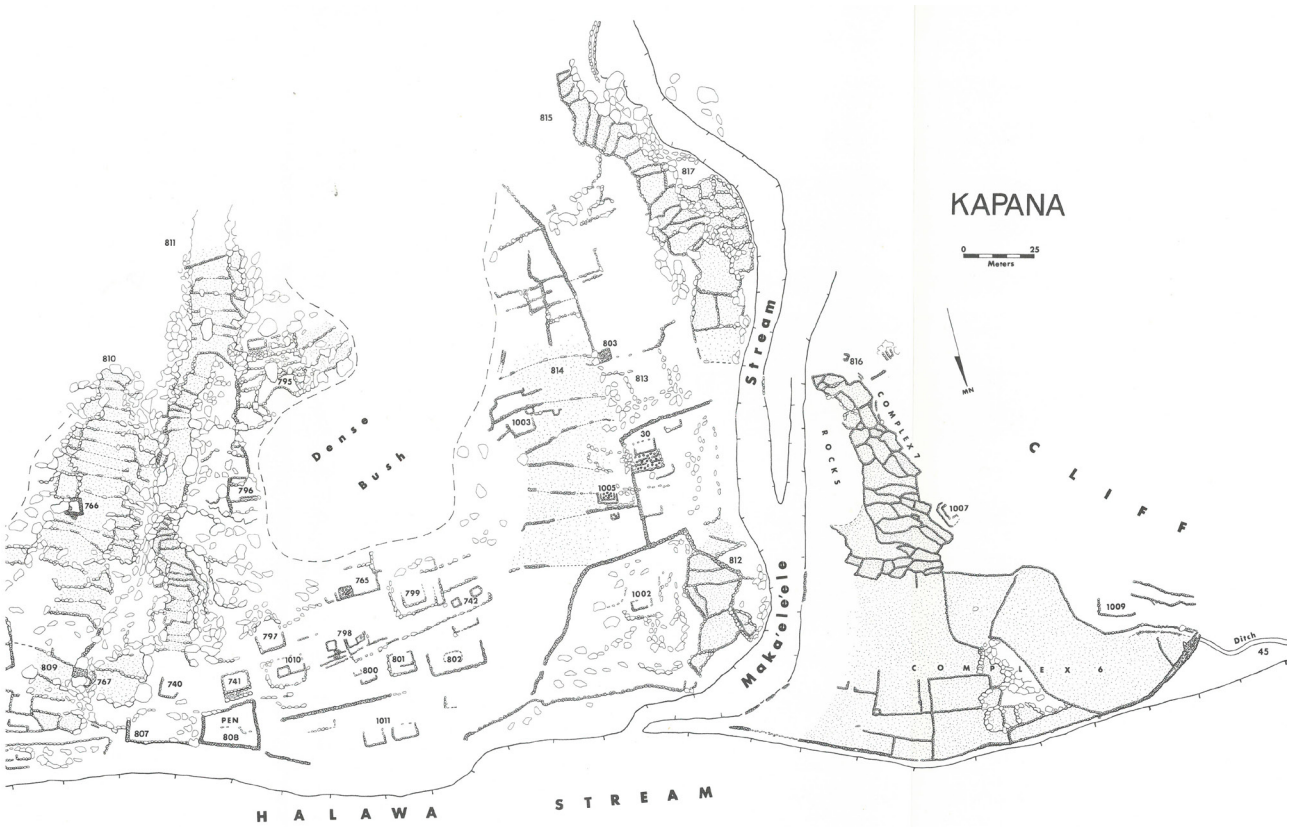

Fig. 5 – Part of the settlement pattern map of Kapana, Halawa (from Kirch and Kelly, 1975).
***Fig. 5** – Extrait du plan d'occupation de Kapana, Halawa (d'après Kirch et Kelly, 1975).*

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.

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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.

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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