State of the Art: Technological Studies on California's Channel Islands

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Abstract

To provide a context for the papers in this issue, we briefly sketch the historical development of technological studies on California's Channel Islands, from the first descriptive attempts of antiquarians, to the early typological and evolutionary exercises of culture historians, and the more integrated and scientific approaches of recent decades. Today, archaeologists have more tools than ever before to study the past, allowing us to ask and answer questions that would have been unthinkable to previous generations of scholars. These new tools and theories should not lead us to neglect the earlier paradigms that are still useful, including basic studies of typology, culture history, chronology, and culture change. As the studies in this issue demonstrate, despite over a century of archaeological research on California's Channel Islands, there is still much to be learned about variation in human technologies, resource use, production, and exchange through space and time.

Introduction

Technologies pervade every realm of human existence, from the practical challenges of day-to-day subsistence to deeply secret rituals and ceremonies. As a result, the archaeological study of artifacts and technologies can provide insights into topics as diverse as subsistence, settlement and land use, social organization, human effects on past environments, warfare, the economics of production, trade and interaction with neighboring people, health and demography, ceremonialism and spiritual practices, and many others. Because artifacts and features—the tangible expressions of past human technological systems—are such an integral part of the archaeological record, the study of human technologies has long been central to the practice of archaeology. Along the California Coast, the record of human technological change spans at least 13,000 years, and the Native American peoples who occupied the area made a diverse array of artifacts from a variety of materials, including stone, bone, shell, wood, plant fibers, and more. Unfortunately, the many artifacts made from wood and plant fibers rarely preserve in archaeological sites—and bone and shell artifacts are often lost as well—leaving significant gaps in our knowledge about technologies and their functions. The shell middens of the California Coast and Channel Islands, however, provide matrices that are conducive to the preservation of artifacts made from stone, bone, and shell, supplying a wealth of information about the evolution of these technologies over long spans of time.

If humans first entered the Americas from northeast Asia, as an overwhelming preponderance of scientific evidence suggests, they carried with them technological traditions and knowledge of Upper Paleolithic and Eurasian origins. These include: sophisticated composite technologies that featured artifacts made from chipped stone, ground stone, bone, antler, and ivory; as well as atlatl and other projectile systems; knowledge of weaving and sewn clothing; domesticated dogs; and a concern for personal ornamentation, ceremonialism, and artistic expression. An increasing body of evidence suggests that some of these anatomically modern humans (*Homo sapiens sapiens*)—at least in coastal areas—also had knowledge of boats, seafaring, and other maritime technologies (Erlandson 2001, 2002; Erlandson and Fitzpatrick 2006). These Upper Paleolithic traditions provide a common technological foundation from which early New World, California, and Channel Island technologies evolved. This is not to suggest that New World technologies were not innovative and dynamic, as these traits are also fundamentally characteristic of our species. What this common technological heritage suggests is that a level of relatively sophisticated technological knowledge should be expected from even the earliest New World assemblages. Given this broader context, we should no longer be surprised that beads, boats, and woven bags are present from the earliest occupation of the California Coast, or suppose that the use of asphaltum as a mastic or glue would only appear in the Middle Holocene (Wallace 1955).

This issue contains six papers devoted to advancing knowledge of Native American technologies on California's Channel Islands during the past 10,000 years. The papers all emerge from research conducted by archaeologists currently or formerly from the University of Oregon. Most of the research presented comes from recent projects on San Miguel Island, where University of Oregon archaeologists have been actively engaged in studies for almost 20 years. By design, the technologies reported on span much of the Holocene, reporting on artifact assemblages from Early, Middle, and Late Holocene sites. Also by design, the papers describe a variety of technologies: flaked stone artifacts ranging from crescents to microblades, bone tools, shell ornaments, and other artifacts.

One of the remarkable aspects of technological studies on the Channel Islands is the continuing discovery—despite the long history of archaeological research on the island—of new artifact types, new sources of important raw materials, new production techniques, progressively earlier manifestations of relatively sophisticated maritime technologies (e.g., Connolly et al. 1995; Glassow et al. 2008; Rick, Erlandson, and Vellanoweth 2001), and new analytical techniques with which to reconstruct the past. In the remainder of this paper, we provide a context for the papers that follow by briefly summarizing the history of Channel Islands technological studies and some of the exciting new methods or approaches archaeologists are using to reconstruct or interpret the past.

A Brief History of Channel Islands Technological Studies

The earliest 'archaeologists' to work on California's Channel Islands were antiquarians of the late 19th and early 20th century. Their work was motivated primarily by the desire to collect materials for museums outside of California and to describe the material cultures of America's supposedly vanishing Indian tribes. At the time Native American people were thought to have a relatively short history in the Americas, perhaps as little as 2000 years, so there was little concern for documenting or explaining technological change. Many of the reports from this time are frustratingly vague or incomplete, with descriptions of brief investigations, "curiosities," or unusual artifacts (e.g., Schumacher 1875, 1877; Bowers 1890 [Benson 1997]; Wardle 1913; Heye 1921; Cessac 1951; Jones 1956). Most museum collections from this antiquarian period lack detailed provenience and consist of "selected" assemblages of the more complete and elaborate artifacts. Many antiquarian assemblages are also from mortuary contexts, especially those

Late Holocene cemeteries in the larger and more conspicuous village sites. Because erosion was heavy on San Miguel, parts of Santa Rosa, San Nicolas, and San Clemente islands, however, there are also some important surface collections with artifacts (e.g., crescents) representing a broader range of time. Despite problems associated with many antiquarian assemblages, they have provided valuable insights to later researchers and often still contain substantial research potential.

Starting in the 1920s with the work of David Banks Rogers (1929) and Ronald Olson (1930), California and Channel Island archaeologists began to develop a greater interest in understanding the developmental history of Native American cultures, with a heavy emphasis on material culture (technology), burial practices, and culture history—including change through time. Culture historians used the 'direct historical approach' to define the nature of ethnographic cultures and search for their origins in the deeper past represented by archaeological records. In the absence of chronometric dating techniques, such historical studies required detailed comparative analysis of assemblages based on the definition of artifact typologies and relative chronological sequences to place assemblages in proper temporal order. Considerable research was conducted on the Channel Islands in this mode, including important work by D. B. Rogers (1929), Olson (1930), Orr in the 1940s and 1950s on the northern islands, and Meighan and Eberhart (1953) on San Nicolas Island. Other work during this period remained poorly described or unpublished (Glassow 1977). Despite methodological and intellectual advances, the focus of fieldwork continued to be on the excavation of cemeteries and large coastal villages, with a strong emphasis on artifacts, architecture, and other technologies. Channel Island assemblages also contributed to important syntheses by culture historians, including early typologies for shell and bone artifacts (e.g., Bennyhoff 1950; Gifford 1940, 1947; Orr 1947). Still, the nature of this work remained essentially descriptive rather than explanatory, historical rather than evolutionary. Although D. B. Rogers (1929:257-258) hypothesized about the great antiquity of human occupation along the Santa Barbara Coast, and Orr (1968) proposed that humans had settled the islands more than 40,000 years ago. The absence of a clear Milling Stone Horizon led most culture historians to conclude that the Channel Islands were not settled until relatively recently.

The development of radiocarbon (^{14}C) dating in the 1950s fundamentally changed 'prehistoric' archaeology in America. For the first time, the age of any site containing organic remains could be established in the laboratory with reasonable accuracy, freeing archaeologists from obsessive reliance on typological analysis as a relative dating tool. With the application of ^{14}C dating to Channel Island and other coastal California assemblages, the antiquity of human occupation in the area became increasingly apparent. Typological studies continued to be important in California and Channel Islands archaeology, as they still are today. As ^{14}C dating became more widely available, reliable, and affordable during the 1960s and 1970s, however, efforts were increasingly diverted from typological analysis to the evolutionary, ecological, quantitative, and explanatory models that characterized the scientific paradigms of processual archaeology (e.g., Hoover 1971). Processual archaeologists embraced the scientific explanation of cultural and technological change, including the generation and testing of hypotheses, computers and quantitative analyses, sampling and middle-range theory, and the more sophisticated application of developing scientific techniques to address a variety of archaeological questions.

These changes were important advances in archaeology, but the new emphasis on systematic sampling and fine-screen recovery, cultural ecology, and the reconstruction of environmental and subsistence change came at some cost for archaeologists working along the California Coast. Thorough sampling of the faunal (and later floral) constituents in dense island middens, for instance, required a level of laboratory effort and analysis that progressively reduced the size of the samples many California archaeologists excavated. Frequently limited to small column or bulk samples, these resulting assemblages provided invaluable faunal data—especially for common shellfish and fish taxa—but often very small samples of the artifacts that provide an alternative and independent line of evidence for understanding human subsistence, adaptation, and technology.

At the same time, growing sensitivity and legal constraints related to tribal concerns over the disturbance of Native American burials led to a dramatic decline of cemetery excavations, restricting another source of important technological data. These changes have made the large artifact assemblages collected by earlier generations of archaeologists an important source of information for modern archaeologists interested in technological change (King 1971, 1990) and the many topics that can be addressed through the study of material culture.

During the 1980s an incredible wealth of information on Island Chumash and *Tongva* technologies was also published by Travis Hudson and Thomas Blackburn (1982, 1983, 1985, 1986, 1987; see also Hudson, Timbrook, and Rempe 1978), who synthesized the voluminous (and mostly unpublished) notes of ethnographer John Peabody Harrington and other sources. These volumes will aid archaeologists working on the Channel Islands for generations to come.

Beginning in the 1970s, criticisms of processual archaeology—including tendencies towards normative reconstructions of group behavior overly concerned with ecological adaptation and efficiency models, the treatment of humans as automatons buffeted by either external (environmental change) or internal (population growth) forces, inadequate attention to gender issues or historical connections, and others—led to significant changes in archaeological practice. Postprocessual approaches stressed that emic reconstructions of the past had been largely overlooked, and have done much to challenge the scientific epistemology and forms of ancient events and processes (Meskell 2002; Renfrew and Bahn 2004; Trigger 2006; Tringham 1991).

In terms of technological studies, postprocessual approaches challenge archaeologists to understand the creation and modification of material culture as expressions of gender, identity, power, and personhood (Hendon 2000). These approaches have enriched archaeological inquiry by increasing attention on the role of individuals or idiosyncratic behavior and humans as active shapers and manipulators of their natural and social landscapes.

New Approaches

As archaeological data accumulated, the antiquity of Channel Island cultures was recognized, and new scientific techniques were developed, increasingly sophisticated questions and explanations were possible. Despite a gradual decline in the importance of typological studies in Channel Islands archaeology, important contributions such as Chester King's (1990) evolutionary typology of beads and ornaments (See also Bennyhoff and Hughes 1987; Lee 1981) have played an important role in chronology building and the explanation of cultural changes through time.

Theoretical Perspectives

American archaeologists still rely on a variety of theoretical approaches to reconstruct the past. Theoretical changes in American archaeology are sometimes presented as revolutionary, especially by the early advocates of a particular paradigm, with a tendency (intentional or not) to denigrate earlier ways of practicing archaeology. Although it might be more satisfying to think of ourselves as revolutionaries, looking back over more than a century of Pacific Coast archaeology, the changes in archaeological practice seem more evolutionary than revolutionary. American archaeologists are still engaged in reconstructing culture history, and typological studies are widely used and invaluable aids in documenting technological changes through time. Scientific and quantitative methods are more important than ever before, and ecological and evolutionary paradigms are still essential tools (Kennett 2005). At the same time, most American archaeologists are practicing a more humanistic style of archaeology, one that recognizes the important role of individuals in past societies, eschews the generic or normative modeling that once dominated scientific theorizing, and generally avoids deterministic explanations of change based on simple models of environmental change or population growth.

In practicing archaeology ourselves, we rely on an eclectic approach that employs theories and tools from a variety of archaeological paradigms. This practical approach combines the most enduring and useful methods of culture history, scientific archaeology, and postprocessual archaeology into an integrated and interdisciplinary set of tools to understand the past. In recent years, we have relied increasingly on new approaches from historical ecology, a discipline focused on the historical study of human effects on natural ecosystems and how such impacts change through time as human technologies, demography, and economic systems evolve. Historical ecology has several advantages for archaeologists: (1) it is deeply interdisciplinary, relying on collaboration with ecologists, biologists, and other specialists to understand the ecological contexts and consequences of past human societies; (2) it sees humans as active participants in past ecosystems rather than passive organisms responding to external pressures; (3) it further bridges the gap between historical and 'prehistoric' archaeology by emphasizing the importance of understanding relatively recent historical changes in local ecosystems; and (4) it offers strong evidence that archaeology plays an important role in illuminating (and solving) some of humanity's most pressing problems—including an ongoing decline in global biodiversity, the degradation and restoration of individual ecosystems, and human contributions to environmental change (Rick and Erlandson 2008).

As Jackson et al. (2001) demonstrated, the technological capabilities of past human societies are key components to understanding their impacts on ancient fisheries and ecosystems. To understand the impact of humans on Channel Island ecosystems, therefore, we need to know as much as possible about the distribution of natural resources (physical and biological) in the past and the technologies used by people at various times to harvest or alter those resources. When did humans first arrive on the Channel Islands, and what technologies did they bring with them? What technologies were developed by islanders during the nearly invisible period of initial human occupation of the islands between 13,000 and 10,000 years ago? Clearly humans had boats from their initial exploration or colonization of the islands, but when were larger and more seaworthy boats first developed? Were the sewn plank boats used by the Island Chumash and *Tongva* during the past 1500 years or so, the first sophisticated watercraft used on the islands? Did they fundamentally alter exchange, craft specialization, and other socioeconomic relationships as proposed by Arnold (2001b)? When were the first domestic animals (dogs?) brought to the islands and did Native peoples also introduce foxes and skunks? Did the Chumash and *Tongva* regularly burn island landscapes as they did along the mainland coast? What types of hunting and fishing equipment were used by Channel Islanders at various times, and how and why did such technologies change? What resource limitations were encountered by island peoples and how did they overcome them? What raw materials were imported to the islands from the mainland, what goods were traded to mainland peoples, and how did the intensity of such transport and trade vary through time? What types of markets existed for island goods at various times and how did local production for export affect the sustainability of island economies?

Today, archaeologists have more and better tools to address such questions than ever before. In the sections that follow, we briefly review some of these tools, what they can contribute to the understanding of the evolution of Channel Island technologies over the past 13,000 years, and some key gaps in our understanding of the archaeology of the Channel Islands.

Mineral Sources and Provenance Studies

After 130 years of archaeological research, we should know the basic distribution of the major economic minerals on California's Channel Islands. For Native American peoples, these included local sources of rock used to manufacture chipped stone tools (e.g., chert, quartzite, meta-volcanics) and ground stone tools (steatite, sandstone, etc.), as well as ochres and other minerals used for pigments and medicines, asphaltum used as an adhesive or sealant, and other geological materials. We do know many major sources of valued minerals on the islands and the adjacent mainland, including Santa Cruz Island chert, Santa Catalina steatite, Grimes Canyon fused shale, Franciscan cherts, and exotic obsidians (Rick, Skinner et al. 2001). Unfortunately, despite more than 100 years of organized archaeological research, there has been no comprehensive inventory of such mineral resources on the Channel Islands or the adjacent mainland. That a thorough survey is sorely needed is demonstrated by Arnold's (2001b:15) claim that there are no high-grade asphaltum sources on the Northern Channel Islands (see also Arnold and Bernard 2005:121), when a major seep has long been known to exist off the northwest coast of San Miguel Island, where masses of pure asphaltum regularly wash ashore (Bowers 1877 [in Benson 1997:101]; Heye 1921:20; Weaver 1969:2; Braje, Erlandson, Timbrook 2005). Ten years ago, a major source of chalcedonic chert was also identified on San Miguel Island (Erlandson et al. 1997)—dismissed by Arnold (2001b:17) as a "small locality." In this issue, we report another significant source of 'mainland' Monterey chert on San Miguel Island. Off the Channel Islands and the adjacent mainland coast, vast landscapes have also been submerged by sea level rise and coastal erosion since the end of the last glacial, a landscape where additional mineral sources may have been available to early people of the Channel Islands.

Once the spatial distribution of these natural resources is defined, we may be able to apply geochemical and petrographic analytical techniques to distinguish artifacts made from materials from various sources, greatly enhancing our ability to understand the role of production, transport, cultural interaction, and trade in the use of past technologies. These techniques are well-established for obsidian sources in California and other regions, their potential has been demonstrated for asphaltum (Gutman 1979, 1983) and red ochre

(Erlandson, Robertson, and Descantes 1999), and they may also be effective for cherts, fused shales, quartzites, steatites, and other minerals found on the islands and adjacent mainland areas. Provenance studies have also been extended to artifacts made from marine shells, whose isotopic signatures can be used to determine their general area of origin (Bottman 2006; Eerkens et al. 2005).

We are not far from having a relatively comprehensive understanding of the natural distribution, geochemistry, and cultural utilization of such resources on the Channel Islands and adjacent mainland, but a thorough, geoarchaeological, and interdisciplinary approach to the problem is sorely needed. Until we can fill these gaps in current knowledge, our reconstructions of cultural patterns of resource use, technological production, and exchange will continue to be flawed.

AMS Dating and Technological Change

Along the California Coast, where burrowing animals and other taphonomic processes often cause the mixing of archaeological deposits, determining the unequivocal age or temporal association of a particular object has long been problematic, especially in sites with multiple components. For years, this problem has caused considerable uncertainty about the timing of some key technological changes. The development of AMS ^{14}C dating, which allows the dating of very small organic samples, has helped resolve some of these chronological issues, refining general chronologies for the region, and resolving some important questions about the timing of technological changes. Along the southern California Coast, archaeologists have used AMS to directly date shell and bone artifacts from coastal middens and refine the chronology of circular and j-shaped fishhooks (Koerper et al. 1995; Rick et al. 2002), shell beads (e.g., Erlandson et al. 2001, 2005; Vellanoweth 2001; Vellanoweth et al. 2003), a wooden boat effigy (Rick et al. 2004), and others.

When carefully used, AMS ^{14}C dating allows archaeologists to attain a significantly higher chronological resolution for changes in technology, production, and exchange on the Channel Islands and the broader California Coast. AMS ^{14}C dating also poses some methodological challenges that California archaeologists need to consider. While we now understand the dangers of conventional ^{14}C dating of composite samples of shell, charcoal, or bone from most California sites, for instance, it is much less widely appreciated that AMS dating of individual organic artifacts (e.g., shell beads or fishhooks, as opposed to food remains) can cause old wood, bone, or shell effects caused by the technological use of wood from long-lived tree species or driftwood, as well as bone and shell scavenged from beaches or older archaeological sites (Schiffer 1986; Rick, Vellanoweth, and Erlandson 2005). Conventional dating of a whole mussel or abalone shell (or large fragment) also provides an average age that evens out annual or other short-term variability in the reservoir effect or other corrections that can affect the apparent age of an artifact, stratum, or site (Culleton et al. 2006; Kennett et al. 1997). Because the reservoir age of seasonal or annual growth rings within a single shell may vary by hundreds of years, for instance, Culleton et al. (2006) recommended sampling across multiple growth rings when preparing AMS samples from a single shell, a technique that may provide a more reliable average age for a sample.

Artifacts, Early Trade, and the Emergence of Interaction Spheres

A number of Channel Island archaeologists have studied the development of long-distance trade networks that connected islanders and mainlanders.

Archaeologists have recognized shell beads as one of the earliest island commodities, which may have been traded for mainland obsidian, terrestrial plants and animals, or other high-value goods. Early Holocene spiral-lopped *Olivella* beads originating from the Santa Barbara Channel, for example, have been recovered from excavations as far away as eastern Oregon (Bottman 2006; Fitzgerald, Jones, and Schroth 2005). The combination of AMS dating and geochemical provenance studies offers intriguing opportunities for reconstructing trade and interaction spheres in southern California, the Great Basin, and beyond (e.g., Rick, Skinner et al. 2001).

Olivella Grooved Rectangle (OGR) beads, for instance, provide some of the earliest evidence for the development of discrete interaction spheres on the Channel Islands and adjacent mainland. OGR beads are a relatively rare bead type made from the wall portion of the shell, rectangular to ovoid in shape, with a distinctive groove cut or sawn across the dorsal (external) surface. These beads have been identified in archaeological sites on the Southern Channel Islands, the southern California mainland coast, western Nevada, and central Oregon (Howard and Raab 1993; Jenkins and Erlandson 1996; King 1990; Vellanoweth 2001), primarily in areas that conform to the historical distribution of Uto-Aztecan peoples. Direct AMS dating of many of these beads has demonstrated that most were made during the Middle Holocene about 5000 years ago (Vellanoweth 2001). OGR beads probably originated on the Southern Channel Islands and were traded widely among southern California and Great Basin peoples. No OGR beads have been found on the Northern Channel Islands, however, and only four have been recovered from Chumash territory. The spatial and temporal distribution of the beads suggests the formation of discrete interaction spheres for the Southern and Northern Channel Islands during the Middle Holocene, changes that may mark an early migration of Uto-Aztecan peoples into the south coast and Southern Channel Island areas. More research clearly needs to be done to fully understand the cultural implications of OGR beads, but such studies may provide archaeologists with a powerful tool for reconstructing ancient migrations and cultural connections within Native California and surrounding areas.

Experimental Studies

Archaeologists have long relied on replicative and experimental studies to help understand ancient human technologies, but such methods have generally been underemphasized in the study of Channel Island technologies. One of the best known and most successful of these studies involved the replication and testing of several Chumash tomols (plank canoes) by Chumash descendants and scholars following the ethnographic notes of John P. Harrington (Hudson, Timbrook, and Rempe 1978). In the late 1970s, Macko and Erlandson also used descriptions from Harrington's notes to build and test Chumash-style tule reed boats, showing them to be buoyant and seaworthy, if somewhat ponderous, watercraft (Erlandson and Ringer 1982, in Hudson and Blackburn 1982:332-333). In another important application, Salls (1989) tested the tensile strength of various natural fibers used by the coastal *Tongva* and Chumash for fishing. More recently, McKenzie (2006) used replicas of Chumash fishing tackle (bone gorges and shell fishhooks) to test the effectiveness and productivity of these technologies in modern contexts. Finally, as part of an innovative study that explored the links between technology and social organization, Corbett (2004) replicated and tested Chumash bone whistles.

These examples illustrate the potential of replicative and experimental studies for better understanding the technologies of the Island Chumash, the *Tongva*, and their ancestors. The extensive and remarkably detailed ethnographic descriptions that exist for the material culture of the Chumash and their neighbors (e.g., Hudson, Timbrook, and Rempe 1978; Hudson and Blackburn 1982; Walker and Hudson 1993) provide a vast reservoir of information that could be used in future experimental studies, and there is great potential for further study of the effectiveness, economics, and production processes of Channel Island technologies. We hope scholars will continue to make use of these methods and resources to explore a variety of unresolved technological problems or issues. Could tule balsa boats be used to colonize the islands, for instance, or to travel regularly between the islands and mainland? Can replicative experiments demonstrate that chipped stone crescents could have been used as transverse dart points for hunting sea birds or other waterfowl, especially in nearshore marine habitats of the Channel Islands (Fenenga 1984; Jertberg 1986)? How productive would simple dip nets be for catching fish close to shore and what kind of fish can be caught with such techniques? How much energy is involved in the traditional production methods of manufacturing *Olivella* wall vs. cup beads, and does the transition in bead production from the Middle to Late Periods involve a greater energy investment (and greater value) for callus cups?

Status and Social Organization

The study of Channel Island technologies has also played an important role in recent studies of the emergence of sociopolitical and economic inequality, especially among the Chumash on the Northern Channel Islands. Arnold (2001a, 2004) has edited two recent volumes exploring the linkages between Late Holocene artifact assemblages and the development of increasingly complex and hierarchical sociopolitical systems. Drawing primarily from excavations at Santa Cruz Island village sites, Arnold and her colleagues explored changing patterns of shell bead manufacture, quarrying and microlith production, bowl manufacturing, and tomol building and their relationship to the emergence of Chumash systems of wealth, power, and prestige documented in the ethnographic record.

At the time of European contact, the Chumash were a loosely allied set of groups, connected by related language dialects, common religious practices, and shared material culture (Arnold 2001b:11). Ethnographic accounts report both mainland and island political units consisting of high-ranking, hereditary chiefs who lived in large villages and asserted their authority over multiple coastal communities (Arnold 2001b:12). Chumash society was conspicuously hierarchical in structure, with defined social and political status, and variation in wealth. Arnold (2001a, 2004; Munns and Arnold 2002) and her colleagues have contributed much to our understanding of the evolution of this complex sociopolitical system through the study of technological innovation, including the only detailed studies of Chumash Historic Period technologies from the Northern Channel Islands (Graesch 2001; Rick 2004, 2007).

Arnold (1995), Arnold and Bernard (2005), and Gamble (2002) have studied the linkages between the development of the plank canoe (tomol) and the rise of political complexity in the Santa Barbara Channel area. Drawing on King's (1990) typology, Arnold and Graesch (2001), Graesch (2004), and Pletka (2004) have investigated the evolution and standardization of shell bead types in southern California and development of the complex shell bead currency networks documented by early European explorers. Island archaeologists also have studied the control and distribution of chert quarries and the microlithic industries necessary for the production of shell beads on the islands (Arnold, Preziosi, and Shattuck 2001; Perry 2004;

Preziosi 2001). Recently Wake (2001) and Corbett (2004) have studied bone tool technologies from the Channel Islands and their relationship to sociocultural changes, while Kennett and Conlee (2002; Conlee 2000) have studied the emergence of specialized stone bowl manufacture on San Miguel Island.

Acceleration of Technological Change

Worldwide, through the roughly 2,500,000 years of technological development evident in the archaeological record, there is a general trend towards the acceleration of technological change. Some of this acceleration is due to the physical evolution of hominids over time, the expansion of our intellectual capabilities and manual dexterity, and the increasing reliance of humans on technology for survival. With the appearance of anatomically modern humans (*Homo sapiens sapiens*), especially after about 100,000 years ago, this acceleration is particularly dramatic (Klein 1999), with new technologies such as formal bone and ground stone tools, basketry, ceramics, metallurgy, and more added to the human technological repertoire. Whole new classes of technology were added, as well: boats, fishhooks, sewn clothing, ornaments, and many more. Because technological change is additive, it feeds on itself and may be naturally inclined towards acceleration –once certain thresholds of intelligence and ingenuity are reached. Necessity is also the mother of invention, however, and new technologies are rarely adopted unless they meet local cultural standards of being inherently useful. Thus, the movement of people into new environments, competition or exchange of ideas between neighboring groups, the need to sustain production as the natural environment changes or human population grows, or the improvement of older technologies to increase efficiency, production, wealth, and survival can all be powerful stimulants for technological change.

In southern and central California, in general, Erlandson (1989) proposed that technology and cultural change continued to accelerate through the Holocene. This hypothesis is probably true on some general level, but there is still much work to be done to document the changing pace of technological change through time. We still don’t know when certain key artifact types were first developed or introduced on the Channel Islands, for instance, including crescents, bone gorges, abalone pry bars, asphaltum water bottles, and stone mortars. We still don’t know how many different bead types were in use during various periods of time during the Early and Middle Holocene, or how these might differ between the Northern and Southern Channel Islands. As discussed in greater detail above, some of these issues can be solved through the direct dating of artifacts (e.g., shell beads or fishhooks, canoe planks, basketry, etc.), but this work is in its infancy and many other artifact types cannot be directly dated. There also has been far more excavation in Late Holocene sites than in Middle or Early Holocene sites on the Channel Islands, raising questions about how well we understand the diversity of earlier technologies.

Although the diversity of artifacts found in Late Holocene sites is generally much higher than in earlier sites, the density of artifacts is also usually exponentially greater. Consequently, the greater diversity of artifacts in Late Holocene sites may be related primarily to sample size, to differential preservation, or to the greater sedentism of later islanders. Despite such problems, none of them insurmountable, documenting the development of technologies through time remains an important focus of study. A deeper understanding of the development of Early and Middle Holocene technologies—as well as the changing pace of technological and cultural change on the Channel Islands—must await further research, including the excavation of larger and more representative samples from early sites.

Conclusion: Technologies and the Future of the Past

The archaeological study of Channel Island technologies has a long history and has produced results that have contributed important data to California and American archaeology as a whole. The stratigraphic resolution of many island sites—where gophers, earthworms, and other burrowing animals are rare or absent (Rick, Erlandson, and Vellanoweth 2006)—makes the Channel Islands an ideal place to study technological change. The limited range of resources available on the islands also emphasizes the importance of technologies, craft specialization, and exchange in the long-term survival of island peoples. Despite the many contributions of Channel Island archaeologists to understanding technological development along the California Coast, there is still much to be learned.

Two major shortcomings of early archaeological explorations on the Channel Islands involve the highly selected samples of artifacts collected—focused primarily on museum-quality specimens of the larger and more elaborated artifact types, often from cemetery contexts—and the lack of detailed provenience or other contextual data for many assemblages. The focus on large coastal sites also resulted in early museum collections that are dominated by the younger end of the occupational spectrum, predominantly the Late Holocene. The lack of screening (or fine-screening) and other relatively crude recovery methods often resulted in the loss of many smaller artifacts, especially beads, and the production debris associated with tool manufacturing was often discarded. Despite these problems, some of the early museum collections from the Channel Islands are relatively large and contain a variety of artifacts rarely found during excavations conducted in the last several decades. More use of museum collections, many of which have yet to be studied or published in detail, is clearly warranted. Such collections can still provide valuable information on the nature of ancient island technologies, trade patterns, and other topics. Organic specimens can also be dated and tested for ancient DNA, and bone, shell, ochre, asphaltum, and other samples can be analyzed for isotope and trace element composition to provide a variety of valuable data on ancient islanders and their environments.

In recent decades, one of the most critical deficiencies in island artifact collections is related to small sample size, the result of Channel Island archaeologists often excavating samples that are too small to provide representative assemblages of the technologies that were used at a particular site or during a particular time period. This problem is especially apparent on the Northern Channel Islands, where archaeologists have often relied solely on small column or bulk samples to characterize assemblages and identify broad patterns of cultural and environmental change. Small column or bulk samples provide valuable information on site chronology, environmental context, and subsistence patterns, but they rarely provide adequate samples of the technologies associated with such sites, except for the more common types of artifacts (shell beads, bead detritus, microliths, etc.) found in some Late Holocene sites. Where many sites are threatened simultaneously by erosion or other disturbance processes, such small samples may be justified as a means of quickly salvaging information from a broad range of sites. Recognizing the limitations of such small samples, however, we have been increasing the size of our own excavations at individual sites in an attempt to gather more representative faunal, artifactual, floral, and other samples (Braje 2007). The work of Raab and his colleagues at Eel Point and other sites on San Clemente Island amply illustrate some of the merits of larger excavation samples in island sites (e.g., Raab 1997; Raab, Bradford, and Yatsko 1994, Raab et al. 2002; Cassidy, Raab, and Kononeko 2004).

As noted earlier, we also need more research on the geographic distribution of raw materials used in Channel Island technologies (cherts, soapstone, ochres, marine shells, etc.) and their potential for provenance studies, the reconstruction of past patterns of production, transport, trade, and cultural interaction through space and time. In particular, we must expand our efforts to identify a wider range of raw materials and finished goods traded from Channel Islanders to the mainland.

Finally, there needs to be greater emphasis on the earlier and on the most historic end of the technological spectrum on the Channel Islands. There is still a tremendous amount to be learned about island technologies during the terminal Pleistocene, Early Holocene, and Middle Holocene. This is true of virtually all classes of artifacts, from perishable technologies (boats, basketry, etc.), to flaked stone tools and production methods, and a variety of utilitarian and ornamental artifacts made from bone and shell. On the other end of the spectrum, we also have a major gap in our knowledge of Channel Island technologies during historic times, particularly after the Island Chumash and *Tongva* were removed from the islands. There have been important studies of Chinese abalone camps on both the southern and northern islands (Bentz 1996; Berryman 1995; Braje and Erlandson 2006; Braje 2007; Braje, Erlandson, Rick 2007; McKusick and Warren 1959; Schwartz 1995), but few of these sites have been systematically excavated or collected. More and better archaeological data are sorely needed on other historical uses of the islands, including Russian-Aleut-Tlingit sea otter hunting, other specialized fishing or hunting sites, the ranching period, more recent military and recreational uses, and the work of archaeologists themselves. Phil Orr's camp on the northwest coast of Santa Rosa Island, for instance, has the potential to provide a fascinating glimpse into the practice of archaeology on the island during the mid-1900s.

Ultimately, we hope the papers in this issue will help stimulate further research on a variety of issues related to the long history of Channel Island technologies. Where we have identified shortcomings in previous research, including our own, our intent has not been to be critical of colleagues past and present, but only to help move the archaeological study of Channel Island technologies forward toward a better understanding of island peoples and the material culture they used to survive in a diverse and dynamic maritime environment.

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