Micronesian Prehistory: An Archeological Overview

John L. Craib

Summary. The majority of archeological work in Micronesia has occurred in the last 5 years. Prehistoric peoples moved into this area from two separate areas—insular southeast Asia and eastern Melanesia. The high islands of western Micronesia were settled at least 4000 years ago. Settlement in eastern Micronesia occurred at least 2000 years ago. On high islands, complex, stratified societies developed, each with distinctive material remains. Atolls have proved to be significant sources of archeological materials and figure prominently in the prehistory of the area.

Micronesia (Fig. 1) is composed of nearly 3000 islands having a combined land area of approximately 2700 square kilometers. These islands are dispersed across an ocean area of roughly 7.4 million square kilometers (*1*). Although high volcanic and raised reef islands are found, it is the low-lying coral atolls that characterize the area and from which Micronesia—small islands—derives its name.

Nearly all archeological research in Micronesia, unlike that in the rest of Oceania, has occurred during the last 5 years. Between 1945 and 1977, only 15 archeological projects were undertaken in Micronesia (*2*). The resultant poverty of archeological data is evidenced in recent syntheses of Oceanic prehistory (*3, 4*).

The initiation, in 1977, of the Micronesian Archeological Survey of the Office of Historic Preservation for the U.S. Trust Territories of the Pacific Islands has resulted in a significant increase in archeological attention to this area. Recent fieldwork has produced data useful in establishing or refining local culture histories and in examining variations in settlement patterns and the development of complex societies on high islands. Atolls, long considered to be of limited archeological value, have also received more intensive investigation. Because most of this research is very recent, many of the data reviewed here are contained in preliminary articles and unpublished reports (*5, 6*).

The author is a doctoral candidate in the Department of Anthropology, University of Sydney, New South Wales 2006, Australia.

Peopling of Micronesia

Until recently, Micronesia has been studied, if at all, primarily as the avenue for the settlement of Polynesia. Micronesia was favored as the main migration route of the "proto-Polynesians" as they journeyed from Asia, through the western Pacific, to western Polynesia (*7*). This interpretation was based largely on the apparent physical similarities between the populations of Micronesia and Polynesia. Little specific attention was given to settlement within Micronesia; though it was strongly implied that all movement was in a definite west-to-east direction and that settlement, at least of the high islands, occurred rapidly.

Discussion of Micronesian prehistory has been based almost entirely on linguistic data (*8–11*). All Micronesian languages belong to one of two distinct linguistic groups of the Austronesian family (*12*). The languages of the western high island groups (Palau, Marianas) are Indonesian (Western Austronesian) types. They are not closely related, and their closest affinities are to the languages of southeast Asia. With the exception of Yapese and Nauruan (both apparent isolates), the remaining languages are classified together as nuclear Micronesian, a subgroup of eastern Oceanic (Eastern Austronesian). These languages are related to those from eastern Melanesia (for example, the southeastern Solomon Islands, Banks Island, and Vanuatu) (*13*).

Dates put to initial settlements are tenuous at best, but on the basis of this linguistic division, it has been argued that initial settlements occurred from opposite ends of Micronesia (*8–10*). Under this theory, the western high islands were settled first, from insular southeast Asia, because the divergence of their languages argues for a long period of relative isolation. The other settlement was through movement of peoples northward from eastern Melanesia, into the eastern Carolines, Marshalls, and Kiribati with eventual westward expansion from these areas.

Howells (*14*) has attempted to revitalize the "Micronesian route" theory of Polynesian migration in order to account for the greater physical similarities between Polynesians and Micronesians than either group has with the Melanesians. When Howells proposed his model, the earliest Lapita sites were in eastern Melanesia. He argued that the proto-Polynesians came from the east and that linguistic relations supported the idea of movement through Micronesia. This argument suffered from the difficulty of showing the derivation of nuclear Micronesian languages from those of western Micronesia and from subsequent archeological work demonstrating the antiquity of Lapita sites in western Melanesia.

Archeological discoveries in the last two decades in western Polynesia and throughout island Melanesia have firmly associated the distinctive, dentate-stamped Lapita pottery tradition with the origins (and, by implication, the migration route) of the Polynesians (*15*). To date, Lapita pottery has not been found in Micronesia, and the area now figures little in archeological discussions of Polynesian origins.

Archeological Evidence: The West

Much of the initial archeology in Micronesia was directed toward establishing local culture histories. Yet establishing a temporal framework for Micronesia as a whole, on the basis of extant archeological data, is difficult. The archeological sample is meager and geographically uneven; the western high islands, particularly the Marianas, have been the focus of most research.

Archeological evidence of earliest occupation in Micronesia comes from the northwestern high islands. The sites of Chalan Piao on Saipan and Nomna Bay on Guam, in the Marianas, have produced dates of 3479 ± 200 (C-669) (*16*) and 3270 ± 170 years ago (GaK-1364) (*17*), respectively. No equally early dates have yet been recorded in the Yap and Palau groups. The earliest dated site in

Yap is Pemrang, a midden along the southern coast. The oldest dates are 2310 ± 80 (*18*) and 1750 ± 259 years (*19*). For Palau, a 4000-year sequence has been derived largely from traditional histories and site survey data (*20*). It is divided into three major periods: archaic (approximately 3800 to 2200 years ago), early (2200 to 600 years), and late (600 to 200 years). Recent test excavations have provided some support for this sequence (*21*). All sites in the western high islands contain pottery, presumably derived from that of insular southeast Asia where it has existed for over 4000 years.

The earliest well-dated Micronesian ware comes from the Marianas. This is a finely made, undecorated, red-slipped pottery, initially termed Marianas Red (*16*). Attempts have been made to relate it to other Oceanic ceramics because of its red slip (*4*). As the ceramic sample from Oceania has increased, however, more sites have yielded red-slipped ware so that it is not now uniquely characteristic of any regional tradition.

The definition of surface coloration as a primary attribute of Marianas pottery has been questioned. Reinman, whose sample of early ceramics from Guam exhibited a variety of surface colors, argued that temper is a more consistent distinguishing feature (*17*). The earliest ceramics are characterized by a calcareous sand temper, differentiating it from later Marianas pottery with volcanic sand temper (both tempering materials are local) (*22*). A recent analysis of pottery from early deposits at Tarague Beach in northern Guam supports Reinman's argument (*23*).

Some early deposits have yielded a few calcareous sand-tempered shards containing incised, lime-filled designs (Fig. 2, A to C). Originally classified separately (*16*), these decorated shards may be rims of calcareous sand-tempered bowls (*24*). The circular and chevron design elements are vaguely reminiscent of some Lapita motifs, although the Marianas ware is more likely akin to decorated ware from the Philippines (Fig. 2, D and E) (*25*).

There seems to have been little material exchange among the western high island groups. The most notable exception is the voyages by Yapese to Palau in order to obtain aragonite, which they shaped into circular disks. These became the stone money for which Yap is noted. Aragonite quarry sites have been recorded from Palau (*21*). When these contacts first began is unknown.

Gifford and Gifford claimed Yapese materials had specific affinities to the Marianas assemblage (*19*), particularly the pottery and shell adzes, but this claim is poorly documented. Tempering, or its absence, distinguishes two main types of Yapese pottery. In excavations, the most common shards are the untempered, "laminated" ware, which becomes numerically dominant after about A.D. 850 (*19*). The tempered unlaminated pottery predominates in earlier levels. Both Spoehr (*16*) and Reinman (*26*) have examined the Yapese collection and agree on the similarity between the unlaminated ware and the Marianas volcanic sand temper.

However, the Yapese shell adze sample has no specific affinities to the Marianas, where many adzes are made of stone, primarily basalt. Marianas shell adzes are small, thin blades fashioned from the outer portion of *Tridacna* and with a few made from *Terebra*, tool types common to Micronesia and Melanesia (*27*).

Marianas prehistory is marked by its continuity. The appearance of limestone pillars used as house supports (*Latte*) about 1100 years ago (*16*) has been suggested as evidence of later, secondary settlement of the islands (*28, 29*). There are no indications that the *Latte* result from external contact and, more probably, they represent a transition from the use of wood to stone in house construction.

Palau appears much more complex in terms of outside influences. Although it is difficult to date these events, Palauan art styles, house forms, and domestic fauna show affinities to Indonesia and the Philippines (*21, 30*).

Excavation of the southern Palauan island of Aulong yielded pig (*Sus scrofa* and *Sus leucomystax riukiuanus*) and possibly goat remains associated with a date of 1420 ± 400 years ago (UCLA-1855H) (*21, 31*). If confirmed, this would be the first firm evidence of prehistoric pig within Micronesia.

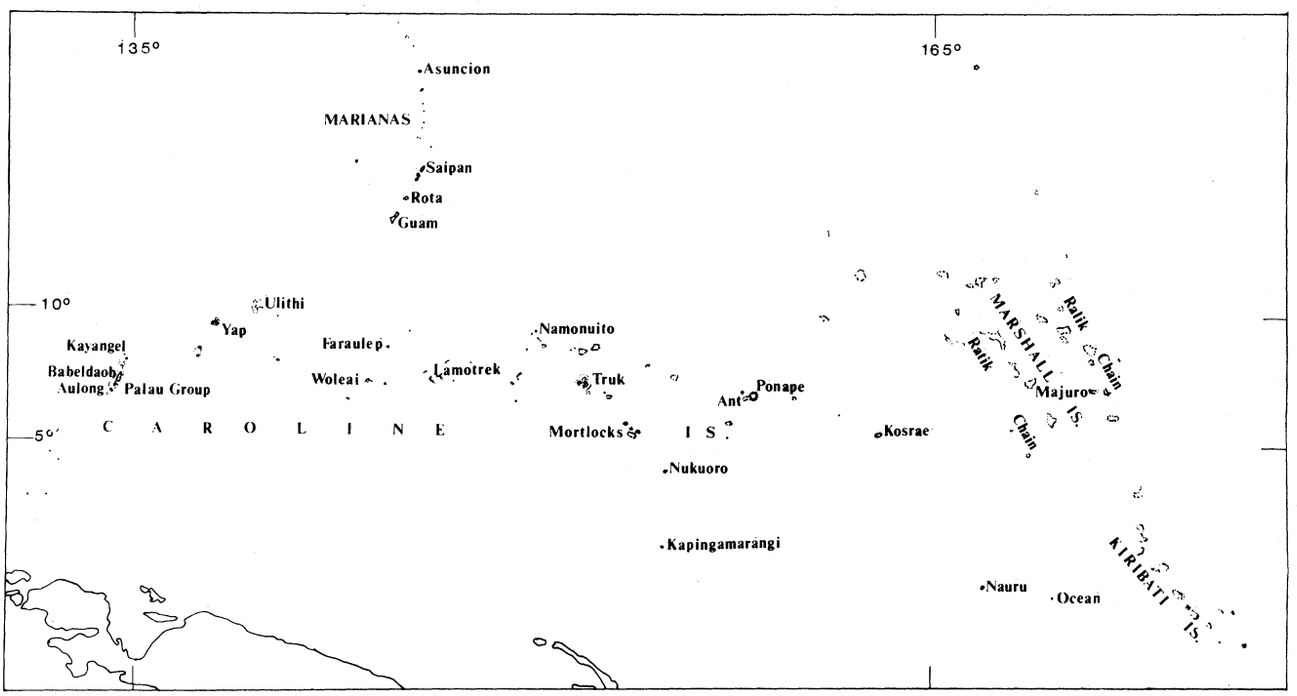

Fig. 1. Micronesia.

Archeological Evidence: The East

If movement from eastern Melanesia did occur, earliest evidence is most likely to be found in eastern Micronesia where the shortest distances between the two areas are found. Archeological data are rare from the atolls (Kiribati) and raised reefs (Nauru and Ocean) in this area; those from an interior village on Ocean Island indicate a late occupation (*32*).

Currently, the uncorrected dates of 1970 ± 110 (ISGS-671) and 1890 ± 75 years ago (ISGS-669), from Majuro atoll in the Marshalls (*33*), are the oldest from eastern Micronesia. The associated artifact assemblage contains no pottery or artifacts specifically diagnostic of eastern Melanesia.

Recently, shards were found at a coastal site in Awak Valley, northeast Ponape (Fig. 3A). The small sample, which lacks rims or any other diagnostic attribute, is tentatively associated with a date of about 1500 years ago (*34*). A larger sample (518 shards) was collected within the Nan Madol complex in southeast Ponape (*35*). Decoration is limited to V-shaped notches along the rims. Whether these shards are associated with the use of the site (possibly no older than 1000 years) or came from other, earlier deposits used in the construction of Nan Madol is unclear.

Additional, more inferential evidence for early occupation in eastern Micronesia also comes from Awak Valley. Soil cores taken from two taro swamps suggest that forest clearing by humans—based on the occurrence of wood detritus, charcoal, and inwashed clays—may have taken place at least 1500 to 1700 years ago (*36*).

Work on Kosrae is now beginning. Coastal middens, cave sites, and elaborately constructed walled enclosures have been recorded (*5, 6, 37*). Five radiocarbon dates (all from shell) have just become available (*38*). The earliest goes back about 1850 years; all others cluster at about 500 years ago. As the closest high island north of eastern Melanesia, Kosrae occupies a strategic position for studies of settlement of Micronesia.

When first contacted by Europeans (about A.D. 1800), the inhabitants of Nukuoro and Kapingamarangi atolls were physically and linguistically Polynesian. Archeological work has now been done on both atolls (*39, 40*).

Chronological indications suggest that Kapingamarangi may have been settled first, about 1000 years ago (*40*) and that settlement of Nukuoro occurred perhaps 400 years later. There is no firm evidence to show that the ancestors of the current Polynesian populations were the initial settlers or that they replaced an earlier Micronesian occupation. Variations between the archeological assemblages and economies have been used to argue that each atoll was settled and developed independently of the other (*40*).

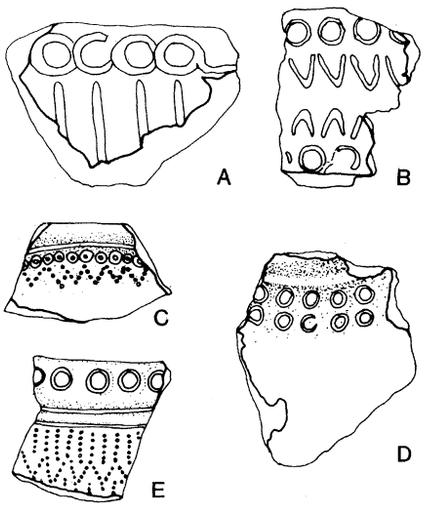

Fig. 2. Lime-filled impressed shards. (A to C) Marianas; (D and E) Philippines.

The distribution of pottery within Micronesia now seems widespread, although temporal association and areas of origin are not always clear. In addition to the shards from Ponape, Yapese laminated ware has been reported from Ulithi and Lamotrek atolls (*41, 42*), perhaps as a result of trade with Yap.

Calcareous sand-tempered shards from Fefan, the only pottery-bearing area yet discovered in the Truk group (Fig. 4A), seem to have been made locally and have no clear affinity to other Micronesian ceramics. These shards derive from the oldest dated Trukese deposits (about 1500 years) (*43*). An equally early date may be associated with midden materials from the Iras site on Moen, Truk (*44*). No pottery was reported in that small sample. The few other excavated sites in Truk are very late (*45*). Further archeological testing may reveal or disprove a hiatus in the occupation of the Truk group. The existence of the Trukese pottery does not resolve the question of whether there was earlier movement from the pottery-making areas in the west or, instead, that the initial nuclear Micronesia speakers brought pottery from the east (that is, Ponape), with the ultimate origins of the ceramics being in eastern Melanesia. Central Micronesia may prove to be a key area in providing data regarding directions of movements within Micronesia.

Settlement of Oceanic atolls has generally been thought to occur after that of high islands (*46*), and Howells specifically proposed this sequence for Micronesia (*14*). His hypothesis is supported by the linguistic data: all atolls (except Kayangel and Ngulu, both of which are in the west) are inhabited by nuclear Micronesian speakers, and the degree of linguistic differentiation in the western Caroline atolls is so slight as to suggest a settlement of perhaps only 500 to 1000 years ago. Fujimura and Alkire (*42*) have suggested confirmation by radiocarbon dates from Lamotrek and Faraulep atolls, the oldest of which is 800 ± 85 years (N-3126).

We now report disconfirming archeological evidence from Ulithi, an atoll linguistically related to Faraulep and Lamotrek though located about 650 km farther west, and only 160 km north of Yap. A sample of charcoal and burnt coral, taken from a fire hearth on Mogmog (Fig. 4B), were fractionated into carbonate and organic components and dated separately to avoid error due to possible transfer of carbonates (*41*). The uncorrected dates were 1690 ± 100 years [(carbonate) (UCR-174A) and 1460 ± 90 years (organic)] (UCR-174B). A sample from a lower midden level contained insufficient charcoal to be dated. The discrepancy in dates between these linguistically related areas raises questions. Was there movement from the western high islands onto atolls before nuclear Micronesian speakers arrived, and could such movement have been responsible for the presence of pottery on Truk? Recent excavations from Ngulu, 135 km southwest of Yap, suggest a possible association of Yapese and Palauan shards with dates of 1620 ± 75 and 1100 ± 60 years ago (*18*). Alternatively, could movement of peoples from eastern Micronesia have occurred earlier than is now suggested?

Movement and settlement outside of western Micronesia appear more complex than is suggested by the linguistic model. For example, there is at present no clear evidence of movement from eastern Melanesia, although further, more intensive work in eastern Micronesia may provide that link.

High Island Adaptations

Micronesian high islands are small by Oceanic standards. Only Guam, Babeldaob, and Ponape exceed 130 km^2. Nevertheless, historical and ethnographic documentation indicate that these islands had been densely populated, often exhibiting complex, stratified societies

(*11*). Although initial research emphasized cultural sequences, recent studies have concentrated on adaptation to high island environments, and particularly on description and explanation of settlement patterns.

One such project has recently begun on Ponape: its goal is to reconstruct the process of political centralization and the increase in rank ordering of Ponapean society (*36*). The initial survey has recorded extensive clusters of features within the Awak Valley in northeast Ponape. Settlements were concentrated within the secondary growth zones between the shoreline and the cliff base, and they reflected a dispersed residential pattern correlated with the distribution of arable land (*36*).

Because of the scarcity of portable artifacts, stone structures provide the preponderance of evidence for analysis. They exhibit a variety of functional and stylistic forms, with the major categories being tombs, platforms, enclosures, terraces, walls, and pavement-rock alignments. Variations of platforms and tombs have been linked to social rank. For example, platform sizes form a skewed distribution with the larger platforms (≤ 30 m^2) constituting about 30 percent of the sample. This coincides with ethnographic descriptions of high-ranking families living on larger platforms within a village. A continuing problem is uncertainty regarding the relative ages of the stone structures, which results from the lack of temporally diagnostic artifacts and stratified deposits. Ayres (*34*) states that status-related elaboration of structures (especially tombs) postdates the 9th century and culminates in the Nan Madol complex.

Nan Madol Island is the best known archeological site in Micronesia. Its unique structures of immense proportions, and their apparent abandonment before European contact in 1595 have made Nan Madol the focus of fanciful conjecture (*47*).

The site consists of stone structures built on 92 artificial islets, clustered within 60 hectares of reef flat immediately off the southeast coast (Fig. 4A). Structures include high-walled enclosures and tombs constructed from local columnar basalt. Recently, sustained systematic archeological investigation (clearing, mapping, and surface collection) of Nan Madol has been started (*35*). Correlating spatial patterning and dating of site components will help document the development of the site complex.

It is not known when these islets and structures were first built. Only three radiocarbon dates have been published from the site (520 ± 65, 690 ± 50, and 770 ± 60 years ago) (SI 90–92) (*48*). Certainly, if status elaboration did not occur until after the 9th century, as Ayres suggests, these dates fall within the expected range and support the contention that this site was built late in Ponapean prehistory.

Attempts have been made to explain the unique construction of Nan Madol by proposing contacts with various outside cultures (*49*), but, because many architectural antecedents of Nan Madol exist on Ponape, there is no need to look outside for the builders of this site. Further, Nan Madol is not unique. The ruins of Lelu on Kosrae resemble it in layout, construction materials, and technique, although variations in construction style have recently been noted (*38*). Like Nan Madol, these structures were built on an artificial base, augmenting the naturally occurring islet of Lelu, about 2 km offshore (Fig. 3B). Because, Lelu was inhabited at first European contact and has continued to be the major center of Kosrean population, the stone structures have been significantly modified and only a portion of the original site, mapped in 1910 (*50*), remains today. These structures may have sat on individual islets, and subsequent filling may have joined these into a single landmass (*51*). Surveys, remapping, and test excavations of the existing structures have been undertaken (*38*). Three types of compounds—residential, mortuary, and sacred—have been identified, and a shell date of almost 300 years ago was obtained from the surface of a residential compound.

On Yap, recent studies have emphasized regional settlement and intravillage patterning. A generalized, descriptive model of Yapese settlement during the immediate period before contact has been formulated from historic and ethnographic data (*52*). Specific components of high-status villages (men's and women's houses, residence platforms, and graves) were expected to be correlated with specific microenvironments. Limited survey data originally supported this model, but additional, more extensive surveys, have shown the patterns to be more variable (*53*).

Intensive survey and mapping of Toruw village in Yap was undertaken to examine the internal spatial ordering (*54*). Approximately three-quarters of the 75-hectare village area has been surveyed, resulting in the mapping of 84

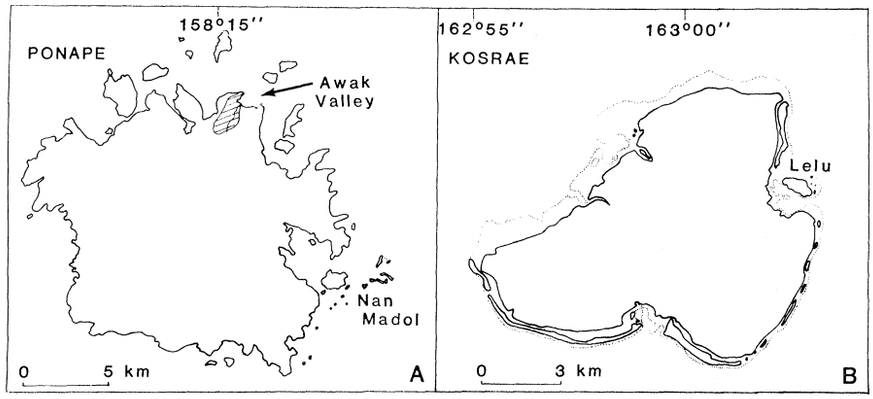

Fig. 3. High islands of (A) Ponape and (B) Kosrae.

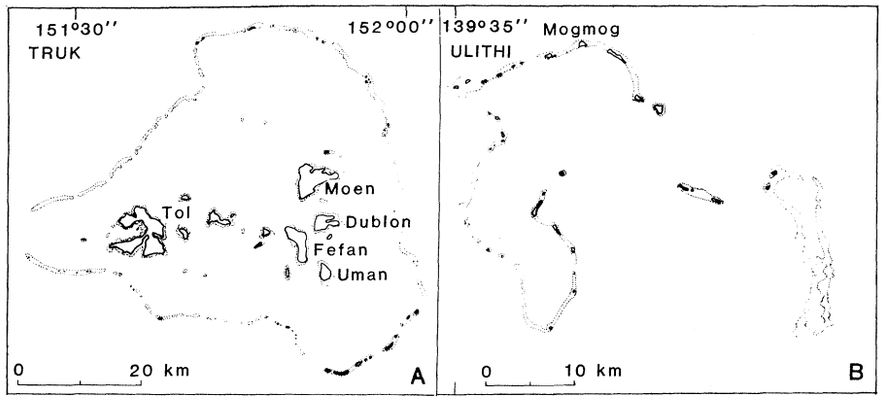

Fig. 4. Atolls (A) Truk and (B) Ulithi.

residential complexes. Specific land plot boundaries were also mapped with the aid of local informants. Even within a high-status village there was an archeologically detectable ranked hierarchy of families. The size of house platforms and sitting platforms increased with rank. Specific sections of the village contained families of similar rank, thus creating recognizable clusters of similarly sized residences. Examination of nine villages of various rank and environmental setting have demonstrated that, although architectural styles are consistent, the rank of a village affects the size and number of house platforms. Additionally, the presence and number of meeting houses (*Pebaey*) and young men's houses (*Faluw*) vary significantly according to rank (*53*).

A program of archeological fieldwork to examine settlement, population growth, and the development of Palaun society has recently begun (*55*). The results of initial surveys are currently being analyzed.

In 1965, Reinman made an extensive survey of Guam, an island divided into two primary physiographic regions—a northern limestone plateau and southern, highly dissected hills. He found 138 sites, of which the majority were in the southern half, along the coast and in the interior river valleys and uplands. The northern settlements were primarily coastal, with few sites in the interior of the plateau. In all areas, most of the sites contained *Latte* characteristic of the late (after A.D. 850) phase of Marianas prehistory. Early, pre-*Latte* sites were rare and always coastal.

The general pattern of settlement, together with established dates of cultural sequences, suggest that occupation of the coastal environs has been continuous since initial settlement. The lack of midden accumulation in the interior sites has led Reinman to argue that occupation was either very late (perhaps historic), seasonal, or both (*17*). Movement into the southern interior appears to have occurred during the *Latte* phase and may be associated with population growth and the corresponding expansion of agricultural areas.

At the time of European contact, the Micronesians on high islands cultivated typical Oceanic crops. Aroids (*Colocasia*, *Alocasia*, *Cyrtosperma*), breadfruit (*Artocarpus* spp.), and yams (*Dioscorea*) were grown throughout Micronesia; betel nut (*Arcea cathecu*) and pepper leaf (*Piper betel*) only among the western high islands; and *Piper mythesicum* root, used in the making of *sakau* (*kava* in Polynesia and Melanesia) only on the eastern high islands of Ponape and Kosrae. The prehistoric cultivation of rice in the Marianas has been widely claimed, with some suggesting great antiquity (extending to the original settlers). The data available in the literature are inconclusive (*56*).

Although little attention has been directed to prehistoric agricultural patterns in Micronesia, regional variations are evident. Extensive mound and ditch features are found in the interior upland of Yap (*54*). The terraced hills in Palau were no longer used at contact; their function may have been defensive or agricultural (*21*). Recent excavation in southern Babeldoab has produced evidence of possible water retention features (*57*). Simple terracing has been recorded in the interior of Ponape; it is thought to have been done more for soil retention than water retention (*36*).

Atoll Archeology

Although atolls are the most common landform in Micronesia, archeological research on them is very recent. The archeological value of atolls has been dismissed by some on the grounds that midden deposits could not develop on these coral islets because minimal soil aggradation was possible (*58*) and typhoons would destroy any accumulations (*14*).

Initial attention to atolls was usually ancillary to larger survey work (*21, 36*). Davidson's investigation of Nukuoro in 1965 was the first excavation of an atoll in Micronesia (*39*). Within the last 5 years, survey or test excavations have been made on atolls in the western Carolines (*41, 42, 59*), eastern Carolines (*36, 60*), and Marshalls (*33, 61*).

Excavations on Nukuoro revealed subsurface deposits containing a variety of cultural materials. Davidson suggested that these deposits may have survived because Nukuoro is peripheral to the typhoon belt (*62*). Recent excavations on other atolls (Ulithi, Faraulep, Woleai, and Lamotrek) situated well within the typhoon belt have, however, yielded substantial stratified subsurface deposits (*41, 42*).

Knowledge of the geomorphological processes responsible for the creation and modification of individual islets is crucial to the understanding of atoll habitation because establishment and placement of settlements is strongly influenced by the fluctuations of islet morphology, and the horizontal extent of subsurface midden deposits can be greatly altered by natural and cultural processes. Nonetheless, excavations on Micronesian atolls have revealed a wide range of artifactual materials preserved in the typically sandy soils, and these should figure prominently in establishing the chronology of Micronesian prehistory. Indeed, Ayres hopes that the stratified deposits on Ant atoll, located approximately 15 km southwest of Ponape, can be used to establish a technological and cultural chronology for Ponape (*36*).

Conclusion

Although archeological research in Micronesia is relatively new, its potential for contributions to our understanding of the Oceanic culture history, the development of complex societies, and the adaptation to limited environments is great.

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Understanding Nonrenewable Resource Supply Behavior

Douglas R. Bohi and Michael A. Toman

The response of nonrenewable resource supplies to changes in prices and other economic incentives is widely debated and extensively analyzed, yet poorly understood. The issue has been raised repeatedly in recent years in connection with crude oil and natural gas, where the presumed response plays a major role in shaping national energy policies and assessing the future performance of the world's economies.

At the broadest level, the perception that nonrenewable energy resources are scarce in an absolute physical sense, and that market prices cannot be relied on to limit their use and to avoid "running out," has led to widespread support for government intervention to regulate production and consumption of energy (*1*). It is sometimes argued that society should not leave decisions about the use of energy resources to private firms that are motivated by the desire to earn profits. More specifically, debates in the United States about decontrolling prices of crude oil and natural gas, about the wisdom of taxes on oil companies, and about the need for government subsidies to stimulate synthetic fuel alternatives often turn on perceptions of how production of crude oil and natural gas will respond to increases in their prices. If oil supply is not responsive, it is argued, an increase in the price will serve to benefit the oil industry at the expense of the rest of the economy.

The supply process for nonrenewable resources in general, and for oil and natural gas in particular, is very complex and difficult to describe in a simple theory. Oil and gas production involves decisions at many stages in the process of finding, developing, and extracting the resource, with complicated dynamic interrelations operating both within and among stages in the process. Economists have developed a theory about how the supply process works, building on the initial work of Hotelling (*2–4*), which gives an internally consistent and intuitively plausible description of how decisions are made by profit-motivated firms. The theory provides numerous insights concerning how resource prices may be expected to behave over time, how prices affect supply decisions in a competitive market, and how government intervention may be expected to alter those decisions.

Yet there is a serious gap between the conceptual models of supply in economics and the empirical application of those models. It is difficult to test hypotheses derived from the theory, and empirical models give notoriously unreliable predictions of how supply will behave when prices and other economic incentives change (*5*). To illustrate the complexities, Fig. 1 shows the pattern of crude oil prices (adjusted for inflation), output, and discoveries in the United States from 1960 to 1980. In many years, output and price moved in opposite directions: production rose (fell) when the price declined (increased). Discoveries also showed no clear relation to price: generally they rose when the price increased, but with a lag of varying length. Economic theory can shed some light on how these patterns result from complex

Douglas R. Bohi is a senior fellow and Michael A. Toman is a fellow of the Center for Energy Policy Research, Resources for the Future, 1755 Massachusetts Avenue, NW, Washington, D.C. 20036.