EASTER ISLAND (RAPA NUI) ARCHAEOLOGY SINCE 1955: SOME THOUGHTS ON PROGRESS, PROBLEMS AND POTENTIAL

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In his recent assessment of progress in modern tropical Polynesian archaeology, Green (1993) thoughtfully traced a path through the relevant post-1960s scientific literature. His ambitious goal was to evaluate the scholarly changes which have taken place over three decades by asking the rhetorical question, *Tropical Polynesian Prehistory — Where Are We Now?* Specifically, he looked at the type and quality of inquiry into questions of Polynesian origins, island sequence building, human impact on island ecosystems, economic systems, settlement pattern and spatial studies, paleodemography, socio-political complexity and models of stability, change and explanation. He concluded by suggesting ten assessments of the current research situation which appeared, in his opinion, to constitute 'a useful set of conclusions from which to launch another decade or more of work in tropical Polynesia' (1993:231). While thinking about writing this paper, it occurred to me that no better model exists than Green's summary. I would like, therefore, to offer my thoughts on Easter Island (Rapa Nui) archaeology in the nearly four decades which have followed the pioneering work of the Norwegian Archaeological Expedition (Heyerdahl and Ferdon 1961, 1965) by employing, as far as possible, Green's format.

PREVIOUS SUMMARIES

Mulloy (1978) gave an archaeological overview and suggested a culture-historical research model. McCoy (1979) provided a useful summary of Rapa Nui prehistory and an overview of work accomplished to the mid-1970s, beginning with Thomson's (1891) brief survey. Kirch (1984) considered Rapa Nui as one of three case studies in his analysis of Polynesian chiefdoms and Ayres (1981a) assessed the limited progress in developing cultural chronology, reconstructing extinct lifeways and elucidating cultural process. Three international meetings of researchers in various fields have been convened to report recent investigations (Hanga Roa in 1984 [Cristino F. *et al.* 1988], Frankfurt am Mainz in 1989 [Esen-Baur 1990], and Laramie, Wyoming in 1993).

FIELDWORK: SURVEY AND EXCAVATION

American archaeologist William Mulloy, who had been a member of the Norwegian Archaeological Expedition, undertook extensive follow-up work on the island and conceptualised an island-wide survey. The first phase of the survey lasted less than a year, from February to December 1968, but accomplished a great deal. Fieldwork was carried out largely by P.C. McCoy, then of Washington State University (McCoy n.d., 1973, 1976a). The entire island was divided into 35 overlapping quadrangles. Each quadrangle is numbered in a horizontal pattern beginning with 1 at Rano Kau and ending with 35 at Anakena. Sites within each quadrangle are numbered consecutively from 1. McCoy surveyed Rano Kau and environs to the vicinity of Hanga Tee (Quadrangles 1, 2, 4, 5 and 6), recording 1738 sites in 1973 ha during eight and a half months (Fig. 1)[1]. Assisting him were Mario Arévalo P. as surveyor, W.S. Ayres and others, as well as Rapa Nui fieldworkers Felipe Teao A., Rafael Rapu, Juan Haoa and Jacobo Riroroko. McCoy also excavated a rectangular house on Rano Kau which produced an early date (see below). During this same period, *ahu* were restored and monolithic statues (*moai*) were re-erected at Tahai in Quadrangle 8 by Mulloy and Ayres, who also surveyed a portion of the immediate vicinity.

From 1969 to 1976 work on the survey halted, replaced by various *ahu* excavation and restoration projects accomplished by Ayres (1973, 1988) and Mulloy (1961, 1968, 1970, 1973, 1975, Mulloy and Figueroa 1978). Beginning in 1976, the archaeological survey team was directed by Claudio Cristino F. and Patricia Vargas C., with M. Arévalo and C. Carrasco as surveyors. Lilian González N., Roberto Izaurieta S. and N. Wilkens joined the project in 1979, and R. Budd in 1984. Investigators were based at the Centro de Estudios, the research station established on the island (now called Instituto de Estudios). At least 20 Rapa Nui people provided field assistance at various times. In 1981, a description of the survey and 19 detailed maps giving

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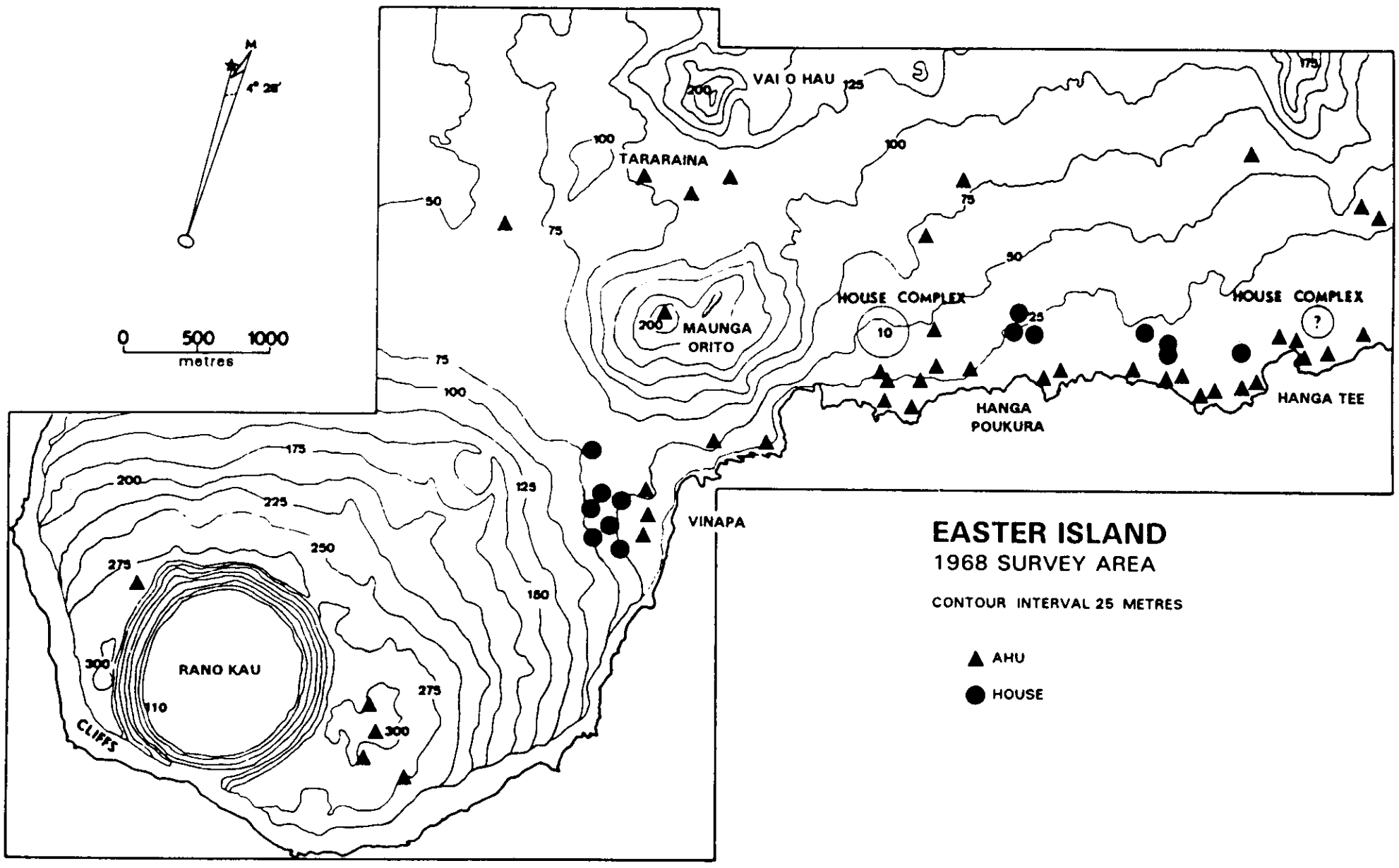

Figure 1: Distribution of *hare paenga* (McCoy's Type 1 house) and relationship to *ahu*, 1968 survey area. Courtesy P.C. McCoy.

site locations but not site type identifications were published for Quadrangles 1 to 14, 18, 28 and Rano Raraku sector (Cristino F. and Vargas C. 1980, Cristino F. *et al.* 1981). By 1981, 11,913 archaeological features constituting 6927 sites had been identified.

Rano Raraku Crater was divided into five discrete zones and 397 monolithic statues were located[2]. Rano Raraku is a satellite cone of Maunga Terevaka, one of three volcanoes which produced the island, and is formed of consolidated lapilli tuff, the most significant geological resource on Rapa Nui. From this distinctive orange-red tuff the Rapa Nui carved the vast majority (some 95%) of monolithic sculptures known today both on archaeological sites and in museum collections (Van Tilburg 1986b, 1992, Vargas C. 1988). Other specialised quarries of obsidian, basalt, trachite and red scoria exist on the island, and all but obsidian were also used to produce sculpture.

Beginning in 1979, important independent studies conducted within the framework of the survey sought further elucidation of *ahu*, caves and burial features, rock art and statue site types. Lee (1986, 1992:28-30) documented rock art using existing quadrangle/ site numbers or assigning some temporary numbers, although her published data give only site or locale names (Lee 1992:31-33 for 186 names). Esen-Baur (1983) considered iconographic and other evidence in her study of rock art meaning at Orongo. Van Tilburg (1986a, n.d. [1993], see also Cristino F. *et al.* 1981, Vargas C. 1988) documented monolithic statuary as discrete sites or features of ceremonial and other architecture. These were described and reported using assigned quadrangle/site numbers or, if found outside the surveyed area, given quadrangle and temporary site numbers (Fig. 2).

Stevenson (1984) and Beardsley (1990) looked in detail at *ahu* construction and spatial patterning respectively. Seelenfreund (1988) reported the excavation of Ahu Tautira. Shaw (n.d. [1986]) studied nine caves and their secondary burials retrieved by a team directed by Gill. The caves are on the island's south coast and the burials are from about the 1700s. Excavations of a rectangular house site with occupations dating between A.D. 1400 and 1700 were conducted in Quadrangle 10 by Stevenson (1988, 1993, Stevenson *et al.* n.d. [1993], see also n.d. [1989], n.d. [1991]). A series of test units was excavated at Anakena, La Pérouse, Vaihu and Hanga Roa, and a crude pavement in Quadrangle 11 was extensively tested (Stevenson pers. comm. 1994). Two statues in-transport were examined through test excavations at their heads and bases

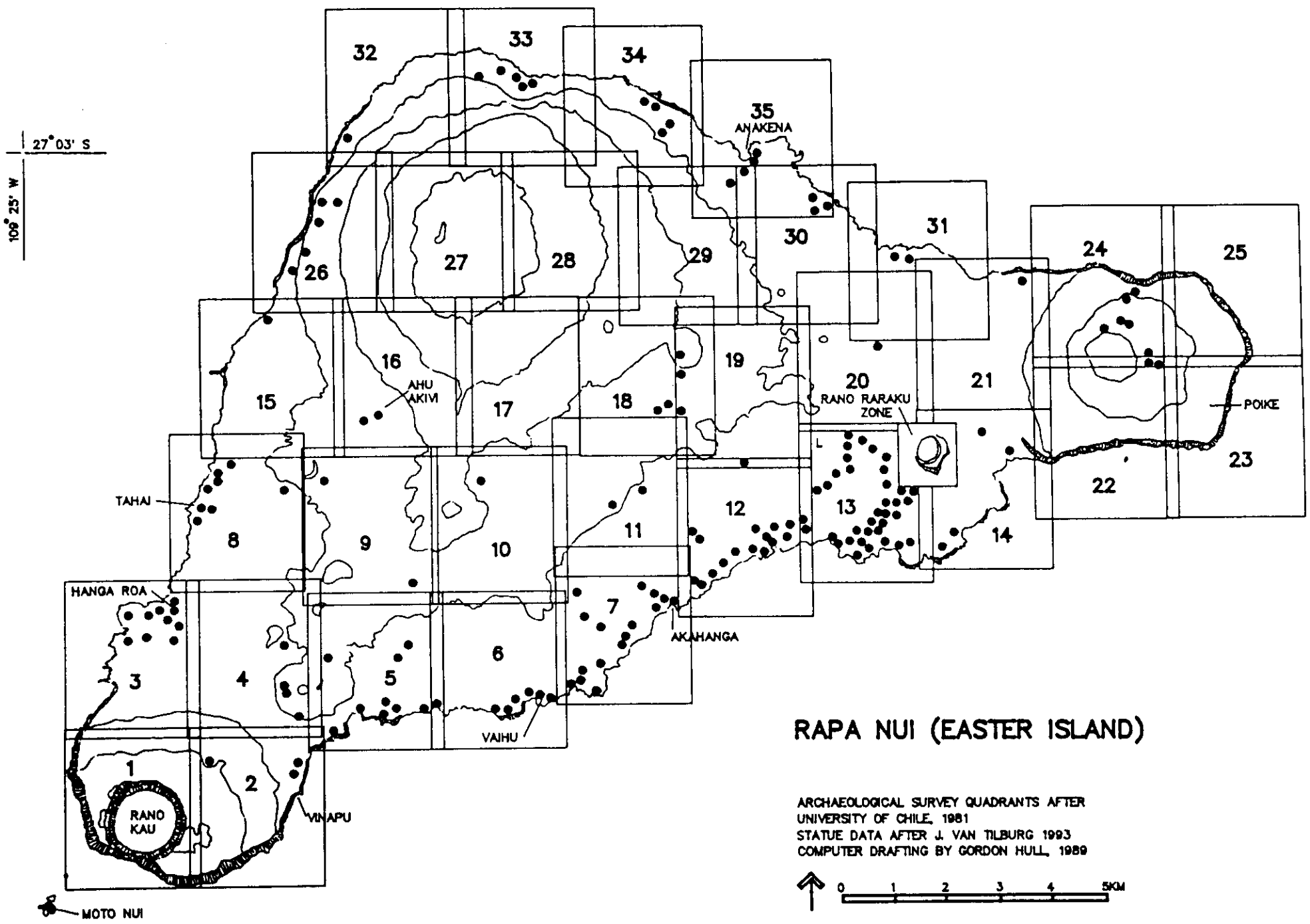

Figure 2: Distribution of monolithic statues, Rapa Nui. Computer drafting by Gordon Hull.

(Heyerdahl 1989:246, Heyerdahl *et al.* 1989). Excavations in the vicinity of Tukuturi, the famous kneeling statue on the exterior slope of Rano Raraku, were conducted (Skjϕlsvold and Figueroa G-H 1989), and the Chilean team has dug at Anakena, Poike, Akahanga and elsewhere (cf. Vargas C. *et al.* 1990)[3]. To date, 77% of the island has been surveyed and a total of 19,000 features identified (Vargas C. 1993:103).

UNPUBLISHED FIELDWORK IN PROGRESS

The massive restoration of Ahu Tongariki, undertaken as a joint international project under the direction of Chilean archaeologist Cristino F., is underway, with 13 of 15 *moai* re-erected by August, 1994. Lithic, botanical and osteological analyses are being carried out on various materials retrieved from the site (A.G. Drusini pers. comm. 1993, C. Cristino F. pers. comm. 1992).

The important site of Ahu Naunau at Anakena was reconstructed by Sergio Rapu H. with the assistance of Sonia Haoa and others in the 1970s, but a full description of the archaeological work has never been published. This is most unfortunate, as the potential significance of archaeological and ecological data from this site is great. However, analyses of osteological remains retrieved at the same time have been accomplished (Gill and Owlsley 1993). Other information, including the significant discovery of coral and red scoria *moai* eye inserts, was made available through lectures, the media or popular works (e.g., Rapu H. n.d. [1985], Heyerdahl 1989:222-24 where, incredibly, it is suggested that the practice of inlaying eyes 'arrived' on Rapa Nui from the Hittites via Mexico).

From 1986 to 1988 the Kon-Tiki Museum team (in conjunction with the island museum) conducted various test excavations in the near vicinity of Ahu Naunau, establishing that the reconstructed form of the *ahu* had

been preceded by two earlier structures and speculating that both of these may have possessed monolithic statues (Heyerdahl 1989: 226-33, Skjølsvold n.d. [1993], Martinsson-Wallin 1994:45-48). Calibrated radiocarbon dates are thought to relate to the reconstructed *ahu* (A.D. 1305-1412) and to one of the earlier structures immediately in front of the *ahu* on the inland side (A.D. 1051-1265). A French team is now analysing data from test pits at Orongo, Akahanga and La Pérouse (C. Orliac pers. comm. 1995).

USEFUL STUDIES INDEPENDENT OF THE SURVEY

Quite a few studies have been conducted independently on Rapa Nui outside the context of the survey or, in fact, of archaeology. These are generally avocational, frequently duplicate existing data or are undertaken in a quest to determine the cultural origins of the Rapa Nui but often may be, nevertheless, quite useful. Most consist of visual surveys of the more obvious archaeological remains, and several contain interesting photographs, maps or drawings. Often the main interests of the authors lie in iconography or perceived stylistic variation. Among the more interesting of these works are Klein (1988), Dominguez (1968) and Campbell (1974).

INTERPRETATION OF THE FIELD EVIDENCE

The interpretation of archaeological field evidence generated by the projects described above has been hindered by three important factors. First is the uneven quality of the radiocarbon evidence traditionally used to construct a temporal framework for any of the island's hypothesised cultural sequences, whether of periods or phases. This evidence has recently been reconsidered by Ayres (n.d., 1971), who reports recalibration at 2 σ of 52 dates using CALIB (n.d.) software (Fig. 3). In another study, 82 dates (35 from *ahu* contexts and 47 from 'settlements and statues') were recalibrated with the aid of CalibETH (1991, Martinsson-Wallin 1994:77). Of these, 10 were ruled out as uncertain or erroneous for a variety of not fully explained reasons. There is significant variation or disagreement inherent in the reported results of these two studies, and important questions are raised.

Dates secured on 'unacceptable materials for short Pacific chronologies', in no clear cultural context or which are anomalous 'compared to more acceptable dates for the same cultural material from other sites' have been questioned (Spriggs and Anderson 1993:206-7, see also Kirch and Ellison 1994). So, too, have uncorroborated dates from Gakushuin Laboratory and those based on samples of mixed isotopic fractionation (Spriggs and Anderson 1993:207). A full suite of early dates from a variety of site types, including but not limited to image *ahu*, is lacking. Although significant progress has been made, important problems exist in Rapa Nui radiocarbon dating. A dialogue has been initiated but continued efforts are required.

Second, the enormous quantity of sites and features documented by the survey demands more comprehensive publishing of site identifications. Consistently, Chilean investigators have presented quantitative reports of site types within some quadrangle boundaries (e.g., Cristino F. *et al.* n.d. [1986], Vargas C. 1988, 1989, Vargas C. *et al.* 1990). This information, coupled with the highly professional maps they have produced, is extremely important. However, many research questions cannot be framed, let alone answered, in the absence of more extensive published site identifications.

Third, the multiple tragedies of the 1860s slave trade and subsequent introduced diseases, evangelism, conversion, commercial exploitation, enforced poverty and relocation have rendered some types of ethnoarchaeological research distinctly problematic if not utterly impossible. Englert (1948, 1964, 1978), Routledge (n.d., 1917, 1919, 1920) and Métraux (1940) all worked with Rapa Nui informants (especially the gifted and indefatigable Juan Tepano Huki) to salvage a limited legacy of ethnographic data collected in the post-missionary era. Data relating to young people's initiation ceremonies, for example, are extremely useful for interpreting several site types. What is greatly needed at this point is an informed evaluation and rigorous comparative study of certain key aspects of synchronic data and data sources, including a thorough consideration of unpublished records. Until this is done adequately, the usefulness of ethnographic data on Rapa Nui is more limited than it need be.

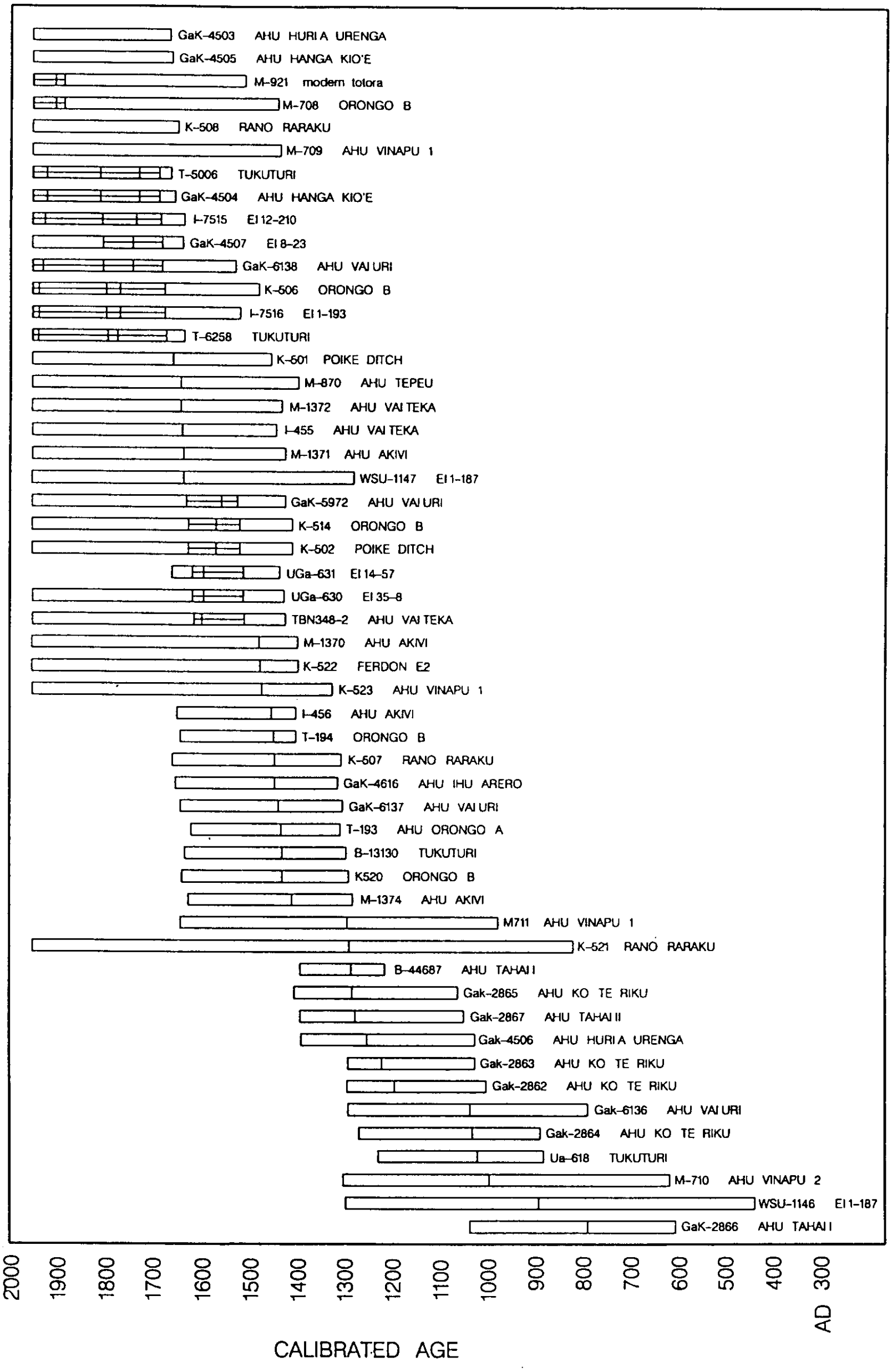

Figure 3: Calibrated ages for some Rapa Nui radiocarbon dates. Open bar denotes upper and lower values of range at 2 s.d., with a vertical line connecting highest and lowest mean values. A cross line defines mean and multiple cross lines define multiple mean values from calibration curve intersect. Courtesy W.S. Ayres, 1994.

RAPA NUI SETTLEMENT, ICONOGRAPHIC SYMBOLS AND ECOLOGY

Green (1993:222), in his discussion of Polynesian origins, noted that the current settlement model suggests that the Eastern Polynesian 'homeland' is 'a fairly quickly settled zone from the Southern Cook Islands through the Australs and Society Islands to the Marquesas'[4]. He pointed out that it is now 'extremely doubtful that Easter Island was settled from the Marquesas; a more southerly origin in the Austral, Mangareva, Pitcairn region is far more likely both culturally and in terms of known voyaging possibilities.'

Linguistic evidence remains stubbornly indicative of a relatively early Rapa Nui settlement in the first few centuries A.D., but certainly before A.D. 800 (Green 1985). Spriggs and Anderson (1993:210) largely discount these linguistic data as lacking archaeological corroboration and call for a re-evaluation. They interpret the evidence to indicate Rapa Nui settlement 'towards the end of the first millennium AD.' At Anakena, Skjølsvold (n.d. [1993]) suggests earliest settlement at A.D. 900-1000, and 'does not rule out the possibility that the Anakena chronology may be generally valid for the island' (Skjølsvold (n.d. [1993]). Cristino F. [pers. comm. 1994] believes that A.D. 800-900 is probable). Ayres (pers. comm. 1994) thinks that it would be useful to reopen some excavations at Ahu Tahai, seeking additional radiocarbon samples and adding obsidian samples in an effort to clarify the early date (cal. A.D. 713) for Tahai I.

The thesis of early Eastern Polynesian colonisation suggested by Kirch (1984, 1986a) and others is not accepted by Spriggs and Anderson (1993), who argue for A.D. 300-600 for the Marquesas *only* as the earliest possible dates for the region. Kirch and Ellison (1994: Fig. 4) follow Irwin (1992), hypothesising the date of Rapa Nui settlement to be 1500 B.P., and thus more in accord with linguistic projections. The paucity of early site data from many Eastern Polynesian islands is so significant that the current debate is completely 'academic' (cf. Green 1993 on time depths for Eastern Polynesia). I would argue against discounting or ignoring the Rapa Nui linguistic data and, on the basis of several lines of evidence, in favour of a precontact cultural sequence of at least 1000 years. Projected Rapa Nui settlement dates cannot, at this point, depend upon the larger Eastern Polynesian framework in any completely satisfactory way (see Finney 1994: Fig. 22 for patterns of general migration trends).

Finney (1993, 1994:306) believes that the apparent antiquity of many aspects of Rapa Nui culture may not reflect an actual age or time frame but is, instead, the result of retention through isolation. Further, he suggests three possible Rapa Nui settlement routes based on his experience with and understanding of seasonal patterns of winds, currents, weather and Polynesian maritime technology and traditions (Finney 1994:270-73, Van Tilburg 1994: Fig. 30)[5]. Settlement Route 1 from the Marquesas would have required a period of major El Niño westerly winds. Pitcairn, which was settled and then abandoned by Eastern Polynesians, may have been an interim destination along Settlement Route 2 from the Tuamotus/Mangareva during a period of 'winter westerlies'. Voyagers leaving the Southern Cooks or the Australs along Settlement Route 3 (which I favour) might also have used these winter westerlies to sail east toward Rapa Nui, either directly or via intervening islands including Mangareva and Pitcairn. Especially adventurous voyagers from any of the islands along the southern fringe of Eastern Polynesia might have braved the cold seas of higher latitudes to catch the westerlies which become increasingly prevalent below 30° S latitude.

The chances of actually finding Rapa Nui seem slight, but the incredible numbers and variety of birdlife which once flourished there before human colonisation and until about 900±60 cal. B.P. to 660±80 cal. B.P. (Steadman *et al.* 1994, Steadman n.d.) would have greatly enhanced the voyagers' prospects (Van Tilburg 1994:45-46). Huge flocks of birds fishing far out to sea, or equally large numbers in seasonal migration to the island from elsewhere in the Pacific, would have been recognised immediately by Polynesians as a sign both of land and of the presence of fish. In response to my query about how helpful the birds' presence would have been to Polynesian navigators, Finney (pers. comm. 1994) says that 'by taking a bearing off the flight of migratory birds, or off the flight of fishing birds returning in the late afternoon to their island nests, and then converting that bearing to a star compass heading, voyagers may have been able to sail directly to Rapa Nui.

The Sooty Tern was a central focus of the *tangata manu* (birdman) cult, which apparently emerged at Orongo some time in the mid-1400s to mid-1500s (overlapping with continued placement of *moai* on some *ahu* sites) and extended into postcontact time[6]. Flocks of these birds always follow large schools of pelagic fish, primarily Yellowfin, and feed on squid the tuna force to the surface (Croxall 1987). Tuna were obviously an important food resource to the voyagers and to the early Rapa Nui settlement population (Fisher [1958] describes pelagic fish zones related to euphausids zones in the vicinity of Rapa Nui). The emerging faunal data illustrate an early dependence on marine (fish, dolphin, crab) and marine bird resources decreasing over time and then giving way nearly entirely to greater utilisation of land resources (Martinsson-Wallin 1994:47, Steadman *et al.* 1994, Steadman n.d.). McCoy (1978b) reasonably suggests that the choice of Rapa Nui's offshore islets as breeding territory by the Sooty Tern, frigate birds and other species in late prehistoric

times was probably dictated by increasing numbers of humans on the island, decreasing bird populations and the comparative immunity the islets provided from human disturbance of sexual and reproductive functions.

Interactive ecological, environmental and cultural factors mitigated the development and increasingly dominant expression of the *tangata manu* cult on Rapa Nui. The conjunction of the seasonal arrival of the migrating Sooty Tern with the arrival of schools of life-sustaining tuna and other pelagic fish was, in my opinion, a central factor in the cult's founding rationale and iconography. The resource foci thus were not just birds and birds' eggs as has been previously assumed. Access to tuna was controlled by the highest-ranking kin groups, implying that the highest priestly levels of the *tangata manu* cult were originally dominated by these same kin groups. The integrated human/ bird (*tangata manu*) icon displayed prominently in Orongo rock art grew out of long established values of Polynesian anthropomorphic and zoomorphic symbolism, but attained its unique form in the context of the interwoven complexities of Rapa Nui history and environment[7].

SETTLEMENT PATTERN AND SPATIAL STUDIES

Religious monuments (*ahu*), monolithic sculpture (*moai*), stone-lined earth ovens (*umu pae*, McCoy 1978a) and rock art have been treated during field documentation as features or sites. *Moai* and *umu pae* have been defined more fully in the manner of artefacts. Other site types lend themselves well to similar treatment, especially houses and rock art (where panels may be either features or sites and motives may be artefacts). Some current efforts are being made by Chilean researchers to elucidate house types more fully (P. Vargas C. pers. comm. 1993). The 'big picture' of spatial, symbolic and organisational relationships within and between the highly important ritual and specialised habitation centres of Rano Kau and Rano Raraku has not yet been addressed (Van Tilburg 1994:144-47).

Some attempts have been made to broaden the site/artefact focus to the larger archaeological realm, integrating various aspects of survey data within defined island zones or in response to clearly formed research questions, although all are limited in geographic scope. McCoy (1976a) used his house type and other data to produce a settlement pattern study in one part of the island during prehistoric and protohistoric times. He postulated that the Rano Kau area pattern was unique, and extrapolated an island-wide model of dense coastal settlement decreasing to a pattern of sparsely settled and utilised inland area. The survey, however, has clearly established the existence in some parts of the island of large numbers of inland habitation sites. Many of these sites appear to be structurally different (i.e., to have different components) than those on the coast. Further, it appears likely that at least some if not many are contemporaneous with larger coastal clusters. At Tahai in Quadrangle 8 (Fig. 4), Ayres (1988) examined the coastal to inland spatial distribution of seven structure types within a transect strip 0.65 km wide.

Vargas C. (1993) described the interactive patterns of 7903 archaeological features in 8 quadrants within coastal and interior zones. These zones or 'ecological units' 'became evident through the survey as it progressed inland in the transect from south to north in Quads. 7, 11, 18, 28 and 33.' Variant 'geology, gradients, altitude, pluviometric rates, vegetation and soil carrying capacities' defined the zones (Vargas C. pers. comm. 1994). She reports that, contrary to her understanding of McCoy's model, 'the entire island was intensely utilised for residential purposes in prehistoric times' (Vargas C. 1993:103)[8].

Stevenson (1984, 1986, 1988, Stevenson and Cristino F. 1986) considered the nature and relationship of corporate descent group structure within a framework of obsidian hydration dates secured for some sites in a defined sector of the south coast area. Van Tilburg (1986a, 1986b, 1987, 1988, 1992, 1993a) showed that the *moai* as an object was widely distributed, proliferating over nearly the entire island on defined and described site types and primarily in the coastal zone. Its distribution relative to Routledge's (1919) kin group divisions illustrates that it was acquired by the lower-ranked eastern groups while stylistic innovation, although sporadic and limited, occurred largely but not exclusively in the western, higher-ranked area. Increased statue height and weight over time was suggested by Routledge (1919) and has been validated as a general trend, although specific regional differences definitely exist (Van Tilburg 1986a, Vargas C. 1988). Lee (1986, 1992) also related her rock art types to kin divisions. Van Tilburg and Lee (1987) described the relationship between monolithic sculpture, the site types on which the sculptures were found and some rock art designs present on either the statues or the related architecture.

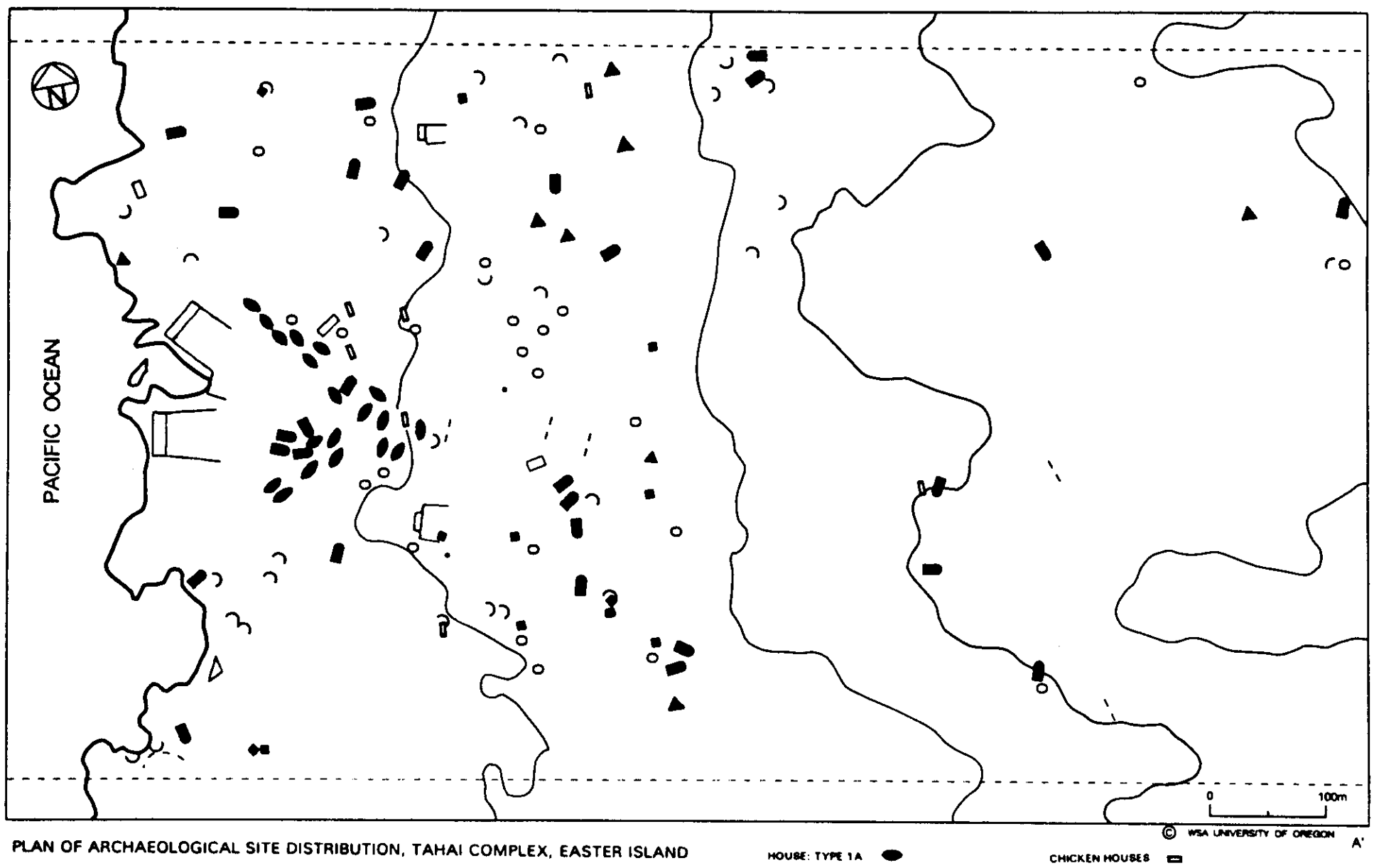

Figure 4: Plan of archaeological site distribution, Tahai complex, Easter Island. Survey transect strip is 0.65 km wide. Courtesy W.S. Ayres.

ARTEFACT ANALYSIS

Green (1993:220) suggests that the comparative approach to portable artefacts is 'not without its benefits' in the task of defining a cultural unit. Documentation of formal assemblages of portable artefacts from Rapa Nui has not been extensive. In some but not all cases, this paucity of data is a result of poorly documented context and provenance for existing objects or collections, lack of temporal parameters for an adequate sample of non-*ahu* site types or other factors which hinder or prohibit studies seeking to elucidate, for example, regional, environmental or social variability.

A scant few studies or discussions have been produced which deal with morphology, classification and use wear analyses of *toki*, *mata'a* (spear points) and expedient tools made from waste flakes (e.g., Bormida 1951, Ferdon 1961, Mulloy 1961: Figs. 37-42, Spear 1986, Seelenfreund 1988:75-80, Church n.d. [1993], Beardsley n.d. [1993] for bibliography of unpublished papers, Mellén-Blanco 1986:143-51 for overview). McCoy (1976b) discussed obsidian cores and blades relative to the New Zealand record. A collection of adzes was analysed by Figueroa G-H and Sanchez (1965). This study is limited today in its utility and requires expansion. In what is perhaps the most interesting recent development in stone tool analysis, Kaeppler (n.d. [1993]) has noted that the famous and beautifully crafted basalt adze in the Smithsonian Institution collection, long thought to be from Rapa Nui, has other possible provenances.

The existing classification of *mata'a* was made by Skinner and is based upon 194 specimens without provenance in the Bishop Museum. Six types were distinguished by shape. Five have Rapanui names, suggesting a specialised use not necessarily related to weaponry (Métraux 1940:166-67). There are two kinds of Rapa Nui spears, one a throwing spear and the other a shorter, thrusting spear. Both are made of a shaft of paper mulberry wood to which the flaked obsidian spear point called *mata'a rei pure rova* or *mata'a*

arokiri was attached. All *mata'a* vary greatly according to the probable time invested in their manufacture, their purpose and the skill level of the individual maker.

There is no doubt that obsidian artefacts in general and *mata'a* in particular proliferated widely on Rapa Nui in late or disturbed archaeological and surface contexts. Obsidian retrieved in quantity from nearly all cave contexts, for example, lacks stratigraphic control and there is little time depth evident (Ayres pers. comm. 1994). In one of the best documented cases of 1433 lithic artefacts retrieved from a test trench at Anakena and dating to between about 900 and 600 B.P., a full 90% of the total was obsidian, some of which were spear points (Steadman *et al.* 1994).

Because obsidian artefacts are so numerous archaeologically they are of obvious value for establishing chronological and intra-island comparative relationships (Stevenson *et al.* 1993:96). Obsidian provenance studies have identified four major sources, two of which can be distinguished on the basis of their chemical composition (Stevenson *et al.* 1984, Stevenson 1988, Beardsley *et al.* 1991). This has potential for verifying some museum pieces with clouded histories (such as a 'spear head' [B2195, Métraux 1940:282, Fig. 50] in the Bishop Museum). Progress toward establishing basic hydration rates has been made by both Stevenson and Ayres. Arriving at finer chronologies requires more qualitative assessments of form variation and quantitative assessments of relationships among standard obsidian tool types such as *mata'a*, scrapers, awls and others. In addition, more radiocarbon dates associated with dated obsidian samples are required.

Obsidian artefact analysis and hydration rate studies are of potentially strong utility. However, obsidian hydration studies have been least useful in the important, earlier contexts on Rapa Nui (i.e., prior to A.D. 1000). Stevenson (pers. comm. 1994) recently noted that the hydration rate utilised thus far was incorrect. His newly determined general calibration 'extends the time depth of many of the current dates back to A.D. 1100, [with] a good convergence between obsidian hydration dates and newly radiocarbon dated features' (see also Stevenson 1993).

Beardsley (n.d. [1993]) has analysed part of a bone debitage collection recovered by Ayres. The analysis was conducted on 169 chicken (and possibly other bird), mammal, fish, ray, shark and unidentified bones. This material was recovered from surface and subsurface contexts in 14 coastal and inland caves sampled from nearly every part of the island, as well as from one *hare paenga* at Anakena. Artefact types included needle fragments, probable awls, a possible fragment of a tattooing comb and one fishhook shank made from mammal (possibly human) bone. Other bone fishhooks are present in various Rapa Nui artefact collections I have examined in several museums, although the type of bone is not usually known. At the same Anakena excavations noted above, the vertebrate assemblage of 7310 identifiable bones yielded only a single human bone (Steadman *et al.* 1994:91).

The Kon-Tiki Museum excavations in settlement or activity areas in the vicinity of Ahu Naunau have uncovered several discrete cultural deposits. The earliest of these was dated with four charcoal samples to about cal. A.D. 700-1200 (Martinsson-Wallin 1994: 47). The settlement area east of Ahu Naunau was the only area where tools were found in any number. They included obsidian flakes, scrapers and awls, basalt adze fragments, bone needles and fishhooks. In this same area, a harpoon head was found (Martinsson-Wallin 1994:47). Some other test excavations in largely non-*ahu* contexts have yielded small amounts of human bone (Vargas C. pers. comm. 1992).

Rapa Nui osteological collections (all from late contexts) in eight museums have been systematically examined for evidence of intentional, postmortem modifications (Owlsley and Gill n.d. [1993], see also Gill and Owlsley 1993). Of 275 human crania examined, only 33 (12%) show evident cut marks. Some of these consist of iconographic symbols, suggesting to me preservation of bones meant to validate socio-cultural or socio-ideological (hereditary) relations and possible endocannibalism. In contrast, exocannibalism (the cannibalism of enemies, slaves or victims captured in warfare) is occasionally postulated for Rapa Nui. Primary motivations for exocannibalism include chronic and prolonged hunger stemming from famine and/or ritual requirements. There is some evidence that the Rapa Nui may have consumed human flesh.

Finally, coral files from midden on the south and west coasts are suggested to be related to coral resource availability and to have been used in bone tool manufacture (Ayres 1985:114). In a sample of fishhooks (n=25) and coral files (n=122) recovered from nine excavated sites, all of the larger fishhooks and all two-piece hooks come from the north coast (Ayres 1985:112, Fig. 1). In contrast, 'coral files are more common and coral fragments in midden are more numerous on the south and west coasts'. Ayres interprets these and related data he presents to support, in part, his areal hypothesis of fish resource utilisation. He suggests a 'correlation of cultural variation and change with spatially and temporally distributed food resources' (Ayres 1985:115, 1981b).

HUMAN IMPACT ON THE RAPA NUI ECOSYSTEM

Rapa Nui is a 'high island' with an area of 162 km^2, formed by the concentrated action of submarine volcanoes lying some 3000 m below the surface of the Pacific. The absolute ages of the volcanic structures range from 3 million years old to recent, and Rapa Nui, Sala y Gomez, San Feliz and San Ambrosio are widely spaced islands along a related chain associated with a defined 'hot line' (Fisher 1958, González-Ferrán 1987:39)[9]. The pre-settlement natural environment is rather well examined, and a good overview of some recent work in several areas of the natural sciences was published in Spanish by Chilean scholars (Castilla 1987, see also Randall and Caldwell 1973, Ferrer Fouga 1987, Grau 1987, Alden 1990, Zizka 1990).

Human impact on the limited biota and other aspects of the Rapa Nui ecosystem includes those factors which have become in recent years an increased area of focus for archaeologists and other researchers[10]. For example, while *Thespesia populnea* (*makoi*), a tree favoured by the Rapa Nui for woodcarving, was introduced and became established, other shrubs and trees (such as the massive palm thought to be similar to *Jubaea chilensis*) were eliminated (Dransfield *et al.* 1984, Spriggs and Anderson [1993: 210] cite a radiocarbon date of cal. A.D. 410-1270 on *Thespesia populnea* charcoal from a house site [McCoy 1973] as the earliest acceptable date for settlement). Vegetation types and tree cover extent on Rapa Nui have been described and deforestation shown to have occurred in different areas at a somewhat varying pace and with probable important ramifications (Skottsberg 1928, McCoy 1979, Flenley 1979, Flenley and King 1984, Flenley *et al.* 1991, who summarise previous research, Spriggs and Anderson [1993:211] claim difficulties with pollen core dates from 1360 B.P. onward)[11].

The pattern of soil erosion inside Rano Raraku has been sketched, suggesting some tentative parameters for quarrying activity there. Inland soil erosion and coastal deposition are clear in some areas (especially Poike) and assumed in others, but have not been fully examined. Further, the effect of deforestation/erosion on small seasonal streams in the Akahanga and Terevaka areas and on a perennial stream/estuary at Anakena requires investigation (Steadman pers. comm. 1994). Regional (including altitudinal) studies of soil quality and variations are badly needed, although comparative differences between north and south coastal areas and east and west regions are superficially obvious and supported by the ethnographies[12].

The emerging data describe a very high level of bird extinction throughout the Pacific (Steadman 1989), and the situation on Rapa Nui, while not yet fully known, is dramatic. As many as 25 bird species, ranging from sub-arctic to equatorial to tropical, have been identified by Steadman in archaeological contexts at Anakena. Among these are birds now extinct on Rapa Nui, including rails, owls, parrots and herons. Sooty Terns are present but scarce throughout the sequence. Further, the vertebrate fauna throughout the deposit is dominated by bones of Common Dolphin, the Pacific rat (*Rattus exulans*) and fishes. Steadman (pers. comm., Steadman *et al.* 1994:90-91) interprets this to mean that 'the prehistoric Rapanui [of the Anakena area] had seaworthy sailing canoes for harpooning dolphins offshore until at least 660±80 yr B.P. The absence or scarcity of dolphin bones in Easter Island's late prehistoric sites (<500 yr B.P.) probably reflects the lack of such canoes during the late prehistoric period'. He assumes that deforestation had eliminated the necessary raw material for canoe construction by this time and even in this high-status area.

ECONOMY AND DEMOGRAPHY

The Rapa Nui agricultural economy was centred on sweet potato cultivation, and shadows of extensive plantations are visible from several high ground locales. Household level specialisation in horticulture is indicated but not well researched. Yen (1988) has suggested that *manavai* (of which 1450 are recorded) are a 'technological miniaturisation' of the crater of Rano Kau which, in his opinion, provided a sheltered and safe repository for most cultigens. This idea is fascinating and deserves greater examination. While the generalised form of *manavai* is known, there are important variations in structural qualities which require further investigation. The same is true for *hare moa*. Juan Tepano Huki told Routledge that *hare moa* were meant to house and safeguard chickens. Most researchers believe that they may not, in fact, have served as chicken houses originally at all, and burial structures or tuber storage places have been suggested as possible alternative functions. Some may have been built for one purpose and then adapted at a later date to another, with the 'chicken house' being a protohistoric innovation. Elucidating more about these and other vernacular structures is a vital and important research task largely unaddressed.

Image *ahu*, the dominant form of semantic architecture, are basic organisational elements of settlement pattern. These structures are defined by the presence or absence of recurring structural and design attributes which are combined to produce varying forms and sizes of platforms (cf. Routledge 1919, Ayres 1973, McCoy 1973, Stevenson 1984, Van Tilburg 1986a, 1994, Beardsley 1990). Image *ahu* vary from a simple

alignment of stones on the slightly mounded or otherwise flat ground to highly elaborate, multiple phase megalithic coastal structures. In my own research, I have made a preliminary classification of image *ahu* within traditional Eastern Polynesian parameters of coastal or interior (Fig. 5). Platforms are distinguished as either elevated or non-elevated. On both of these, a clearly observable architectural methodology was widely implemented, with important variations. All of these forms, because of the presence of statuary, deserve to be called image *ahu*, although they obviously vary greatly in architectural complexity and spatial distribution. The logical implication is that the sizes and status of the groups which built them varied, as did the content of ceremonies conducted upon them.

A satisfactory formula for calculating population size does not exist for Rapa Nui. If we multiply the 3,244 house foundations recorded to date by 9 (the average size of the 456 Rapa Nui families observed by Métraux [1940:98]) or even by 5, we arrive at the extraordinary number of about 16,000 to nearly 30,000 people. Assuming that Vargas C. (1993) is correct in suggesting contemporaneous and specialised use of some coastal/ inland houses (which I suspect she is, given the frequent recycling and reuse of stone foundation materials in all parts of the island and the nearly total coastal locations of *umu pae* [considered markers of permanent houses]), we might reduce those numbers by one-third. Considering the bulk of the survey evidence, McCoy's (1976a) estimate of 7000 remains reasonable. If the total exceeded that to a peak of

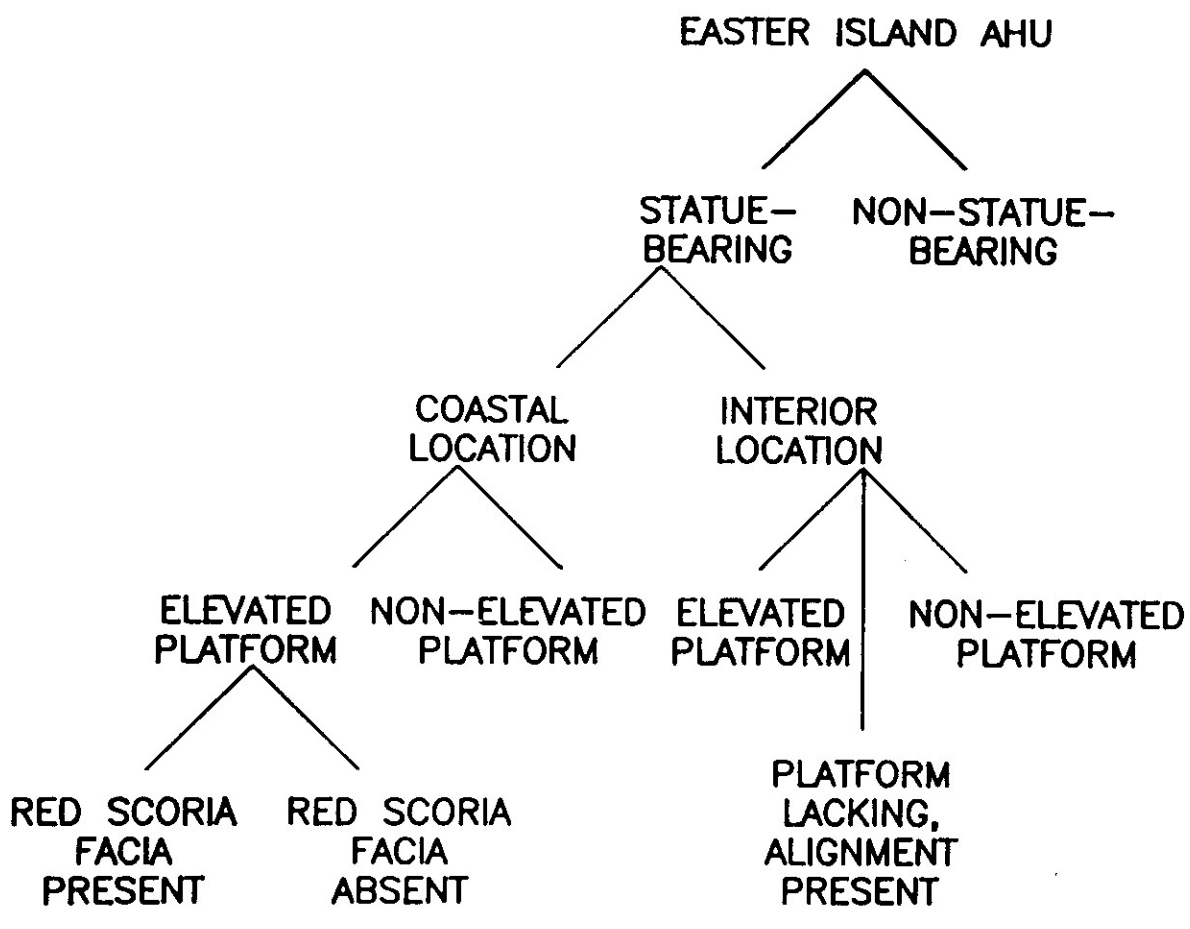

Figure 5: Classification of Rapa Nui image *ahu* architecture types. Computer drafting by Curtiss H. Johnson.

10,000, Rapa Nui could have had a gross density of between 43 and 61 people per km^2. Green (1993:229) quotes Kirch (1984:103) that 'some form of sigmoid or logistic process' determined population growth rates on Polynesian islands. Any of several population models appears to be applicable to discrete island communities, and a growth of 1% or less per year is thought by Green to be reasonable (cf. Stevenson 1984, 1986:77 for south coast estimates). At this stage of research, neither the size of the Rapa Nui population at settlement, peak population attained, nor size at contact are known beyond the estimates suggested by voyaging models, conflicting ethnohistorical data or the sorts of figures described above.

CULTURAL SEQUENCE AND EVOLUTIONARY MODELS

The first Rapa Nui cultural sequence proposed was a three-period scheme derived from perceived differences in *ahu* architecture and supplementary stratigraphic evidence as interpreted by members of the Norwegian Archaeological Expedition, followed by Mulloy's observations. This was adapted by Ayres (1973) into a

five-phase sequence which, in turn, has been variously modified (cf. Kirch 1984, Lee 1986, Van Tilburg 1986a).

As Green (1993:228) notes, the difficulty with most sequence models in Polynesia is that they 'reflect an assumed lineal progression toward increased levels of sociocultural integration which may not be fully warranted, with nearly all significant change occurring between one stage and the next'. He advocates that historical reconstructions for Polynesian islands include the 'rich data from a number of fields in addition to archaeology' to arrive at a complex and integrative model of cultural evolution, suggesting a 'triangulation strategy' to combine archaeological, ethnological and historical linguistic evidence (Green 1986:54, Kirch 1984, Kirch and Green 1987). The point is to move away from an emphasis on single explanatory factors to a narrative of general processes, each having different values and effects. Explaining Rapa Nui prehistoric social dynamics in more than simplistic causal terms requires seeking the 'complex dialectic' of social and ecological interaction (Kirch 1986b:3 citing Spriggs 1986).

Interrelated and differentially operating mechanisms of what have been called 'cultural transformations' in Polynesia may be hypothesised for Rapa Nui. Such organisational strategies as entitlements, socio-political promotions/restrictions on production and reproduction may be presumed to be reflected in the archaeological record. A narrative approach to culture history development which incorporates a revised phase structure would perceive change but also stability, causes but also multiple effects. Woven into a dependable temporal framework, such an approach can provide significant insight.

Stevenson (pers. comm. 1994) elaborates, suggesting 'a set of temporally based working hypotheses concerning the nature of all the various aspects of the general processes: extinction, geomorphology, demography, social integration, resource exchange, land distribution, etc. Depending upon temporal control, the various status of each condition and its relation to the other processes could be synthesized for various time periods.'

As we have seen, radiocarbon dates for Rapa Nui have been reconsidered but have also been called recently into more question, and temporal scenarios for settlement of the entire Eastern Polynesian region are matters of debate. Obsidian hydration analysis has chronological promise and can be more widely employed. At the moment, if we employ Green's 'triangulation strategy' and seek Sprigg's interactive ideal, the Rapa Nui cultural sequence may be conservatively suggested to begin in the first half of the first millennium A.D.

The *moai*, although not capable of being directly dated and still dependent on incomplete *ahu* and quarry contextual and structural evidence for chronological placement, have real potential for being chronologically ordered (González *et al.* 1988) (Fig. 6). In my opinion, statue form, style and iconographic evidence are significantly dependable indicators of time on site-specific levels which might be usefully extended to wider contexts (Fig. 7). There is strong evidence that defining the universal but varied attributes of 'style' contained within and describing several Rapa Nui artefact types has 'broad implications for culture-historical and societal interpretations.' Sites, features and artefacts are the product of 'shared mental templates and not ... idiosyncratic behaviour' (McCoy 1978a:15, discussing *umu pae* specifically).

I argue, therefore, for the strong continuity of Rapa Nui art and iconographic styles within all media of expression, and for the reliable utility and dependability of 'style' as a chronological indicator. In the single case of Tukuturi (Fig. 8), the famous kneeling statue of Rano Raraku excavated by Skjølsvold, four calibrated radiocarbon dates of highly problematic associations to the statue are inconclusive but suggest an age later than cal. A.D. 1000 (Skjølsvold and Figueroa G-H 1989, see Fig. 3 above). Stylistic data clearly associate Tukuturi with petroglyphic styles seen, for example, in Monument 1, Complex A, Orongo, the carved stone face of Vai A Heva on Poike, several other trachite and basalt stone carvings and some late *moai* (Van Tilburg 1994). In sharp contrast to the early chronological placement for Tukuturi suggested by Skjølsvold and Figueroa G-H (1989) on the basis of questionable radiocarbon evidence alone, the combined stylistic, larger context and even the best of the radiocarbon data all strongly indicate that this statue grew out of an evolved tradition which produced an innovative and recent (about A.D. 1500 and later), albeit limited, corpus of stone carvings.

Kirch (1984) has helpfully summarised the work of Sahlins (1958, see also 1955) and Goldman (1970), who sought explanations for Polynesian social complexity within cultural evolutionary frameworks, emphasising ecological diversity and status rivalry, respectively. Goldman typed Rapa Nui society as 'open' (along with Samoa, Mangaia, the Marquesas and 'Uvea) and Sahlins suggested that it fitted within his IIA category (as did Mangareva, Mangaia and 'Uvea). In both schemes, Rapa Nui and Mangaia have a great deal in common. Goldman says that the traditional Rapa Nui hierarchical system was sharply modified to allow military and political effectiveness and to exercise social control. As a result, Rapa Nui culture is said to be more strongly military and political than religious.

Both Goldman and Sahlins form an understanding of the entirety of Rapa Nui social history based upon their reading of the same limited, late ethnographic data, projecting a static picture of what was a more fluid

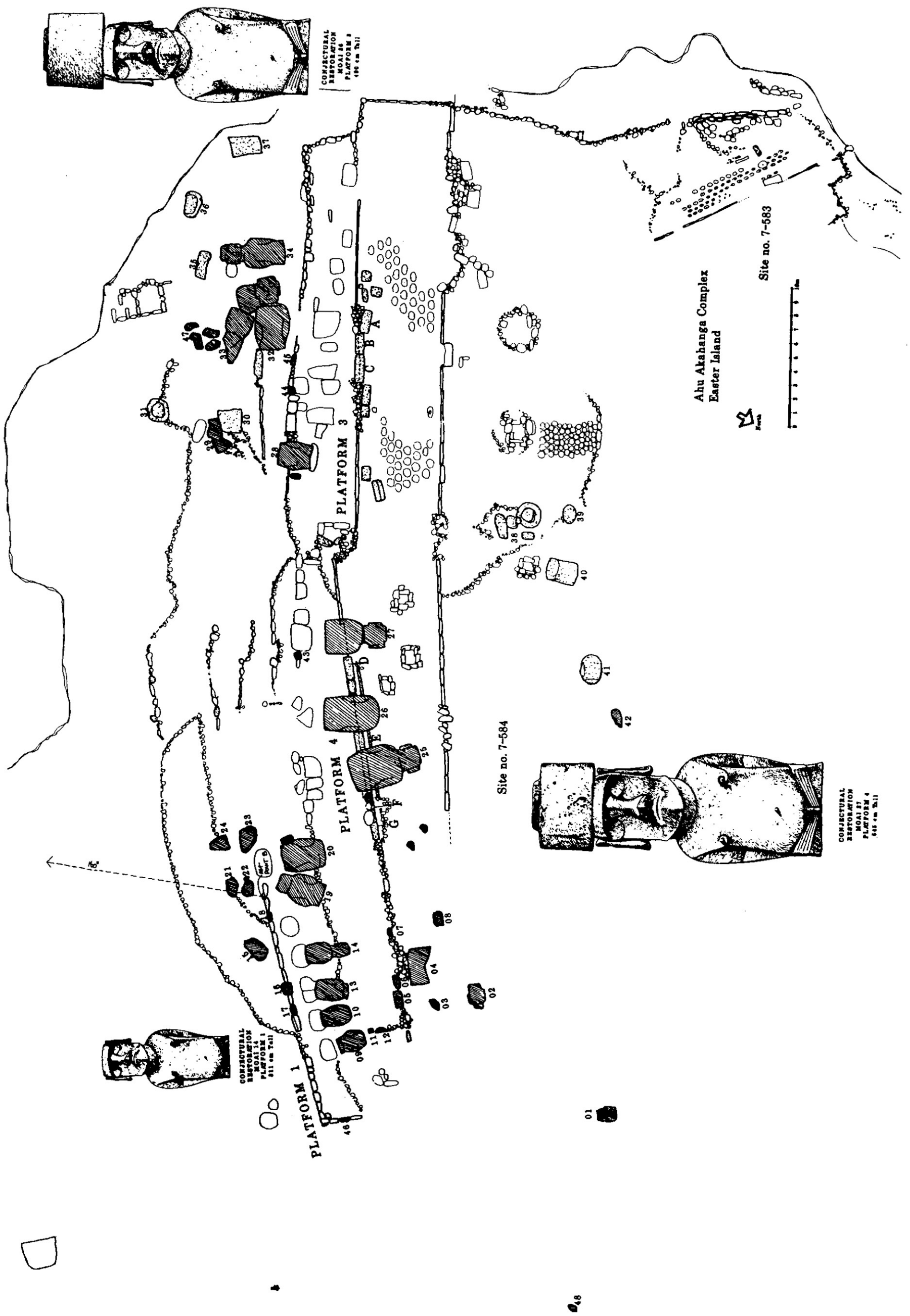

Figure 6: Plan of Ahu Akahanga (7-584) with conjectural restoration of three statues of differing sizes and proportions and related to three distinct construction phases. Plan drawn by Johannes Van Tilburg, 1983. Statues drawn by Cristián Arévalo Pakarati, 1992.

and dynamic culture. There was also a lack of important demographic data in their analyses, and this problem remains with us today. Goldman's notion of Rapa Nui 'open' society as more strongly military and political than religious is, in my opinion, overly simplistic and not fully accurate. Sahlin's structural similarities between Rapa Nui and Mangaia are more fully drawn and useful. However, his perceived relationships between population density, economic productivity and social stratification remain to be either tested or demonstrated for Rapa Nui.

My own research on statue transport suggests to me that we are far from defining the Rapa Nui chiefdom or understanding its full complexity, let alone its change over time. There is very strong evidence within the statue and context data that on at least two (and perhaps more) occasions somewhat late in time (A.D. mid-1400s to 1600s) single chiefs were able to marshal sufficient food and timber resources to put to work numbers of people which far exceeded the normal extended family involvement defined for moving and erecting the average *moai* (Van Tilburg n.d. [1993], 1995, Van Tilburg *et al.* n.d.).

These chiefs appear to have been exacting tribute in the form of labour beyond that of familial obligations, moving their segment of society tentatively towards a greater level of stratification than that suggested by either Sahlins or Goldman. Such efforts were specific to individual groups, discrete resource zones and geographic areas, and should not be generalised to the island socio-political structure as a whole. The statue data certainly illustrate that at least some *moai* production at Rano Raraku overlapped with Orongo rituals, and that other regional statue production centres (such as the trachite quarry on Poike) very probably developed postcontact.

Assuming that most researchers are not willing to abandon the five-phase structure of Rapa Nui prehistory currently in use until a reasonable substitute exists, some adjustments are in order. For example, the 'Decadent Phase (A.D. 1500-1722)' is a term 'heavy with prejudice' (Hodder 1993:280). I suggest extending its time frame to the last known enactment of *tangata manu* rituals at Orongo and recasting it as the 'Restructure Phase (A.D. 1500-1867)', thus ridding it of its negative connotation and more accurately reflecting history (Van Tilburg 1986a:361). A serious reassessment of material culture evidence from this time period (which is relatively more abundant than that for earlier phases) is essential.

The Settlement and Initial Development Phase (about A.D. 400-1000) and the *Ahu Moai* Expansion Phase (A.D. 1000-1500) remain useful if regarded as flexible parameters. In my opinion, the goal is to make a non-lineal assessment of time passing, to try to discern and then document rigorously the established stylistic traditions of Rapa Nui material culture. When that is adequately accomplished, it is then possible to assess the varying degrees of integration, stability and divergence within and from those traditions, yielding a historical reconstruction of time which approximates Green's ideal.

CONCLUDING THOUGHTS

This article has (perhaps overambitiously) tried to assess progress, note problems and describe potential in and for archaeological research on Rapa Nui. An enormous survey data base exists, and a long tradition of archaeological attention to the island has produced significant results. I detect a substantial need for more intensive critical evaluation of the record, extensive publication of site identification data, integration of existing data bases and coordinated preservation efforts to enable the structuring of more complete research hypotheses (Van Tilburg 1990, 1993b). The diachronic data are significantly able to support more intense analyses.

The definition of site, feature and artefact types should be established independently of dubious functional criteria in order to facilitate comparative analyses, including iconographic. Preliminary data illustrate slow and conservative rates of change in some Rapa Nui artefact types over time, with regional variations present. This demands rigorous definition of discrete styles and style variations, allowing testable hypotheses of value to time and space parameters. Archive and museum portable artefact collections require significant evaluative study.

Alternative approaches to reconstructing cultural history which consider interrelated archaeological, ethnographic and linguistic data are needed, and continued evaluation of radiocarbon evidence (including direct re-examination of some sites, as Ayres has suggested for Tahai) is essential. More intensive analysis of obsidian artefact types could yield better chronological control. Geographic and temporal gaps in the cultural sequence need to be addressed.

Rapa Nui's high island ecosystem holds a wealth of data and demands sophisticated palaeoenvironmental research attention. The coastal/interior classification of *ahu* has a precedent in larger Polynesian studies, but regional ecological variations on the island are at present so poorly understood that this differentiation should be considered only one of several possible. As interpretations of site-specific ecological data begin to give

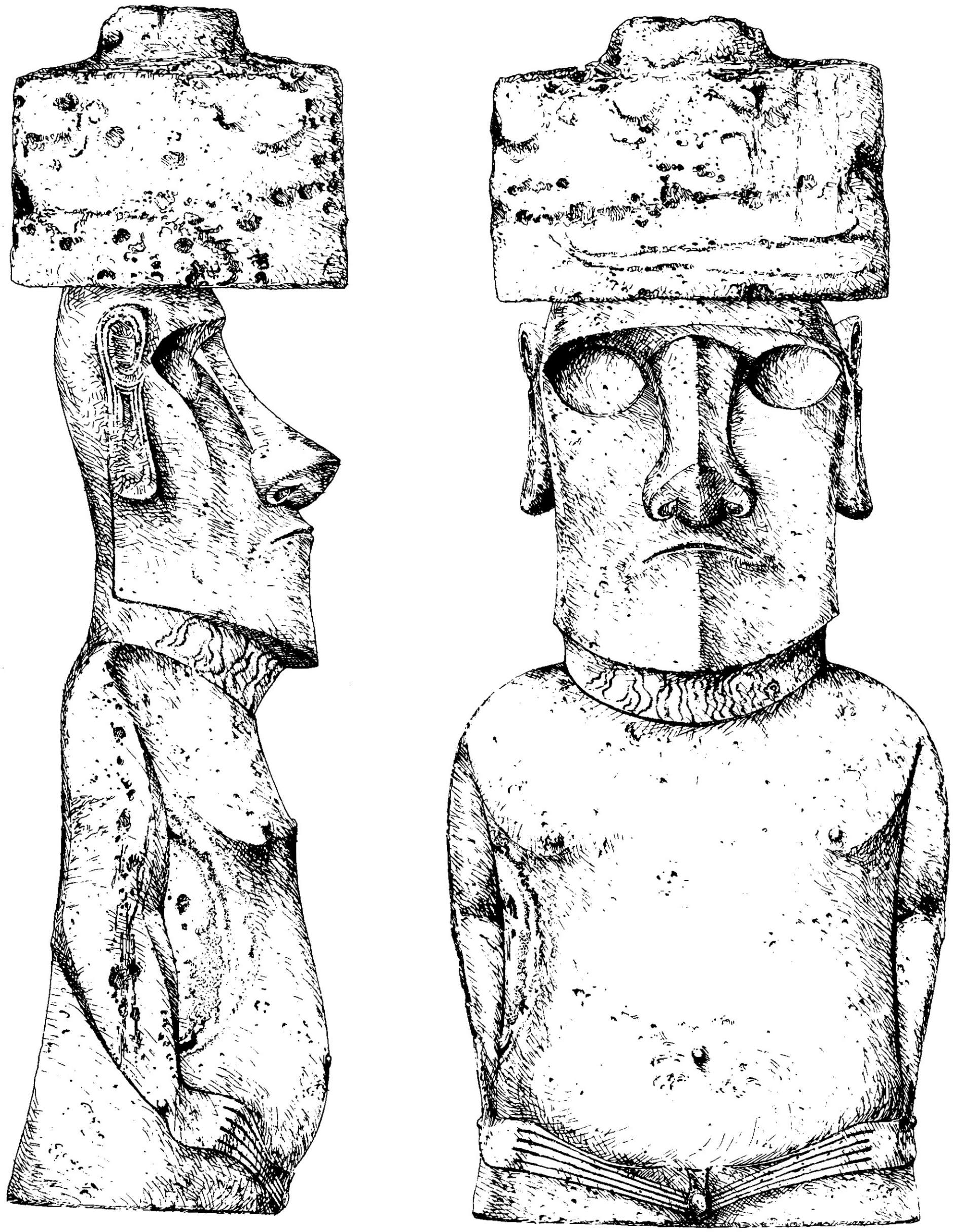

Figure 7: Conjectural restoration of *moai* (2-210-04/623) at Vinapu. Incised lines on neck, cupules and painted crescent on left side of torso and arm were added after the statue fell. J. Linton Palmer also noted an anthropomorph painted in white in 1868 (Van Tilburg 1992:169, Fig. 33). Such reuse of statues and *pukao* (here with pecked crescent and cupules) is chronologically significant and patterned throughout the island. Drawing by Cristián Arévalo Pakarati, 1992.

way to regional analyses, caution against construction of single-cause scenarios for Rapa Nui cultural development or change is urged.

Kirch (1986b, 1988) has outlined major issues in the development of 'social archaeology' in Polynesia which are appropriate to this discussion. These issues may be refined to become important objectives of intensive interdisciplinary collaboration in Rapa Nui archaeological research over the next decade. A major goal is the definition of the characteristics of the Rapa Nui chiefship which goes beyond previous speculations, and which is contained within a better understood ecological framework.

Figure 8: Left profile view of Tukuturi in Rano Raraku quarry. Drawing by Cristián Arévalo Pakarati, 1990.

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expressed here. Most especially, I am pleased to participate in a volume in well deserved honour of Roger Green, a consummate professional whom I gratefully consider friend, teacher and mentor.

NOTES

1. McCoy (1973:12), Cristino F. *et al.* (1981:6), Vargas C. (1993:103) give 2683.18 hectares and 1733 archaeological sites as corrected totals.

2. The survey first reported 391 statues in the Rano Raraku quarry zone (Cristino F. and Vargas C. 1980:213). The count was increased to 394 and then again to 396 (Cristino F. *et al.* 1981). A 5% documented sample of these (Van Tilburg 1986a) has since increased to more than 20%. In 1993 a statue which had been partially exposed by an American film crew on the exterior slope was recorded, bringing the total to 397 (*La Depeche* Feb. 1993:44)

3. A programme of excavations was initiated to obtain basic chronological control for some data obtained by survey (Vargas C. pers. comm. 1994). Inland sites with circular or rectangular houses and specialised agricultural terraces were excavated in Quads. 10, 11 and 18, with most occupations dating A.D. 1460-1645. Only one habitation site (a rectangular house) yielded evidence of early occupation, with calibrated dates of A.D. 470, 570 or 596. In Quads. 7, 12, 13, 21, 31, 32, 33 and 35 a representative sample of characteristic house sites was excavated. At the *hare paenga* village at Akahanga, occupations dated from A.D. 1442 to 1645, and a similar village at Ahu Heki'i dates to A.D. 1645. In the vicinity of Ahu Naunau at Anakena another habitation site yielded a calibrated age range of A.D. 1270-1407. In the same area, a new circular pole and thatch house type was dated to A.D. 1642 (see also Vargas C. 1993). Occupations in Rano Raraku are from about the 1700s, and dates from two sections of the Poike 'ditch' range from about mid-11th to 13th centuries.

4. Green (1993:221) notes that migration of Polynesians and their distinctive culture from the New World is not creditable. DNA evidence is as yet not definitive, but contact between the Polynesian and New World spheres is indicated. The Mangaian evidence of sweet potato presence in Central Polynesia has been described (Hather and Kirch 1991, see also Spriggs and Anderson 1993:211). Finney (1994:283-87) hypothesises Polynesian strategies for reaching the New World. Gill *et al.* (n.d. [1993]) recently described a small Amerindian element in a late, basically Eastern Polynesian adult crania sample (n=94) from Rapa Nui. A scenario proposed in explanation, wherein Rapa Nui voyagers reached and returned from the New World, is not, in my opinion, supportable from either an archaeological or temporal point of view.

5. Most demographers suggest that 80-100 people in a settlement party is the minimum number for viable Polynesian population growth (cf. Green 1993:229). Finney (pers. comm. 1993) suggests that 50 is more likely for Rapa Nui because of the general lack in Eastern Polynesia of trees large enough to construct canoes able to accommodate a larger load, 'no matter what the population experts say'. Some Rapa Nui traditions say that perhaps two canoes (of 50 people each?) arrived. Many islands refer to settlement parties in double canoes which, when land is approached, separate the hulls to create two vessels and facilitate landings on different parts of the island (Van Tilburg 1994). Finney (pers. comm. 1993) says that most of the Polynesian languages with which he is familiar refer to double canoes in the plural.

6. A photo of a nesting booby (*Sula dactylatra*) on Motu Nui was confused with another of a Sooty Tern (*Sterna fuscata*) and thus miscaptioned in my recent volume (Van Tilburg 1994: Fig. 43). Sooty terns are rare today on Rapa Nui.

7. Frigate birds (*Fregata minor*; Van Tilburg 1994: Plate 13), along with boobies and terns, are considered by sailors to be 'land finding' birds (Finney 1994:217). When coming in from sea to fly over islands, frigates are considered by contemporary Rarotongans to be a 'sure sign' of bad weather at sea (Finney 1994:169).

8. McCoy (pers. comm. 1994) believes that 'the coastal settlement pattern of *ahu*, *hare paenga*, *manavai*, *hare moa*, etc. is quite late in the sequence and many of the large centres formed just before (perhaps around A.D. 1600) and after European contact.' The densely populated area around Vaihu may date, in his opinion, to the early missionary period.

9. González-Ferrán (pers. comm. 1994) suggests that prehistoric seismic activity was a factor in the damage or destruction of *ahu* and *moai*. In one current seismic mapping experiment, the geological data base relative to Rapa Nui contains 'seismic movements [which] reach into the 7's, possibly sufficient to topple the statues' (S. Brande and B.L. Brande pers. comm. 1995).

10. The endemic biota of Rapa Nui was limited, even by Pacific standards, with insects comprising by far the largest category. An indigenous landsnail, an undescribed genus and species of Achatinellidae, has been recorded (Steadman *et al.* 1994:89). Kirch (1986b:2-3) gives spatial boundedness, limited resources (especially arable land but also water, isotropic stone, and

others) as causal factors in producing human competitive behaviour in island societies. In addition, isolation and vulnerability once isolation is penetrated are important. All of these same factors can also produce cooperative social behaviour, and may have on Rapa Nui (Van Tilburg 1994).

11. Recently, G. Velasco has measured scores of fossil palm trunk 'prints' he discovered in lava flows on the northwestern coast of the island. Those I saw vary greatly in size, and Velasco (pers. comm. 1994) says that their average diameter is 45 cm, suggesting to him that the trees thus represented were not, or not only, of a type similar to *Jubaea chilensis*. McCoy (pers. comm. 1994) believes that 'archaeological evidence for environmental change is much stronger and more readily apparent than the pollen evidence' which, in his opinion, 'is open to a lot more question.'

12. Differential access to marine resources in general and pelagic fish in particular is noted in the ethnographic record and supported by the extant archaeological evidence. Vargas C. (pers. comm. 1993) says that the ecological and resource utilisation evidence archaeologically sampled to date reads like 'two different islands' relative to north/south coastal regions.

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