ARCHAEOLOGICAL FIELDWORK ON NUMUNDO AND GARU PLANTATIONS WEST NEW BRITAIN, PNG

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NOTE: This report summarizes PRELIMINARY results compiled immediately following fieldwork. For confirmed and accurate data, please consult publications.
SUMMARY

Fieldwork undertaken at Numundo and Garu Plantations in July 1999 has demonstrated that this region contains some of the most important archaeological resources in the Pacific region. A significant proportion of Numundo Plantation was surveyed by foot and truck; 14 test excavations were carried out on Numundo and Garu Plantations in a wide sample of topographic and land use zones; 2 important sections were studied and sampled; and 6 surface artifact scatters were sampled. Ancient artifacts were found inter-bedded between 7 volcanic ashes dating within the past 6,000 years, in layers immediately pre-dating the 6,000 year old eruption, and sealed under probable Pleistocene tephras whose date is not yet known. The latter site may be one of the oldest in Papua New Guinea. A preliminary reconstruction of the history of landscape and sea level change was made as a background to understanding variations in human settlement patterns. A 5 metre long sequence of peat and volcanic ashes preserved in the Garu swamp was sampled for pollen analysis. Data from this column will provide a valuable environmental record of regeneration after the various volcanic eruptions.

Preliminary analysis of the findings shows that the density and location of human activities in the area has altered quite drastically primarily in response to the severity and frequency of volcanic eruptions. The effects of the eruptions in terms of major alterations to the coastal plain were also very important since these changed the resources available for human exploitation. A major drop in population followed the effects of the W-K3 eruption c. 1800 years ago which diminished the area of swamp and mangroves. One can then track a major increase in the intensity of land use after c. 1500–1200 years ago when the plain was fully formed; subsequently, population levels of c. 500 years ago never recovered after a series of three eruptions.

The fieldwork has shown that the majority of prehistoric settlements were located on the tops of hills and along ridge tops. Current road building and terracing of hills is extremely destructive of archaeological resources, whereas clearance on flat land and ploughing has only impacted on the top layers. Levelling for houses on hilltops causes total devastation. We make 9 recommendations concerning the actions which need to be taken in order to preserve and manage the unique and important archaeological resources on Namundo and Garu Plantations.

In conclusion, the quality and quantity of the highly significant archaeological resources discovered on Numundo and Garu Plantations merit careful management. A much enlarged research project is planned for the future.
RECOMMENDATIONS

On the basis of the fieldwork we recommend the following actions be taken to preserve and manage the unique and important archaeological resources on Namundo and Garu Plantations. In the first place a number of specific actions should be taken to safeguard highly significant data.

1. Due to the extreme rarity of open sites dated to the Pleistocene period in Papua New Guinea and the possibility that this site may be among the earliest in the country, all quarrying should cease at the hill with section VI, the remainder of the hill should be preserved in its entirety, and the exposed section should be protected from erosion.

2. Additional terracing should not be carried out at section XIII in Area J in order to protect the archaeological materials dating c. 20,000-6,000 years ago. Planting of oil palm should be delayed until further archaeological investigations can be conducted.

3. No further levelling, terracing, or construction should take place on Boku Hill until thorough survey and test excavations have taken place to locate the source of the Lapita pottery and stemmed tool uncovered by bulldozing in 1999.

4. An extensive programme of sampling within the Garu swamp, particularly in the pre W-K1 layers, is urgently required before the peat deposits are completely drained.

Secondly, a number of places are identified that are not currently threatened but which should nevertheless be protected because they contain very significant data. Excavation at these sites in the near future is also merited.

5. Site FAAH is very important because it has a long sequence of cultural activity, including the relatively rare deposits pre-dating the W-K1 eruption, and it has the most extensive, intact deposits of Lapita pottery of any site on the north coast. The current land use involving oil palm does not pose a threat to the site, but excavation is still warranted because of the richness and importance of the material.
6. Site FAAX is a surface scatter of sea shells and obsidian probably dating to the past 200 years or less. The recent period is poorly represented at Numundo because surface finds are the most susceptible to disturbance. FAAX appears to be the most extensive and best preserved locality representing this period. The only threat at present is disturbance due to gardening and erosion. Test excavations should be made at the site to see if any features are still intact and to recover a good sample of Period 8 material for dating and analysis since this period is very poorly represented elsewhere in the region as a whole.

Thirdly, a number of basic principles should be adopted to guide further development activities.

7. All areas should be assessed through survey and test excavation before development activities such as road making, terracing and construction are commenced.

8. A watching brief should be carried out during development activities. If significant archaeological material is uncovered, activities should cease temporarily until rescue through surface collections and, where demanded, test excavation can take place.

9. An attempt should be made to conserve some areas on hill and ridge tops because this is the most likely place for the preservation of significant archaeological remains. In the areas where logging has already taken place (e.g. Area E) there are few if any places that have not already been destroyed. In contrast, where coconuts are still standing, conservation is possible since the plantation roads are smaller and were generally built on top of the existing ground surface.
FIELDWORK IN 1999

Significance of the Research

Recent archaeological research in West New Britain has demonstrated that this region is highly significant for the history of human settlement in Papua New Guinea and also makes a unique contribution to the world-wide understanding of how humans have adapted to changing environments. A number of remarkable discoveries have been made in the past few years. The earliest human settlement in a rainforest (Pavlides and Gosden 1994), the earliest maritime trading system (Summerhayes and Allen 1993), and the most extensive prehistoric trading system known (Summerhayes et al. 1998) have been identified using data from recent excavations and studies of obsidian sources. The importance of the region is well recognised in archaeological circles throughout the world.

Two special properties of West New Britain have led to its outstanding potential for studying changes in prehistoric lifeways from the earliest periods up to the present day. Firstly, there are a number of obsidian sources in the Willaumez and Hoskins peninsulas which have been used for at least 20,000 years. Given this length of time and the spatial scale over which obsidian from these sources has travelled, it was clearly quite an important resource. Since the chemical composition of each of the 5 main sources is distinctive, archaeologists can trace the trading patterns over large regions. The study of obsidian quarrying, artifact manufacture, and tool-use also provides important data for understanding prehistoric economic life.

Secondly, the large number of recently active volcanoes on the island has created special conditions for the preservation of archaeological materials. Many archaeological sites and entire prehistoric landscapes in West New Britain have been well preserved under volcanic ashes. More importantly, since there have been as many as 13 volcanic eruptions in the past 10,000 years, short time periods have been neatly segregated from each other by different ashes. Archaeologists can use these ashes to date artifacts found buried under them because the physical and geochemical properties of each of them are distinctive and the dates of many of the eruptions are now well known (Machida et al. 1996; Torrence et al. in press).

Previous research at Bitokara Mission, Walindi Plantation, and on Garua Island (e.g. Torrence et al. 1990; White and Torrence 1996; Figure 1) has demonstrated the importance of the volcanic ash layers for studying prehistoric lifeways. One of the most important findings so far is that the various human societies which have occupied this region have responded to the eruptions in different ways and these are not necessarily correlated with the severity of the eruption. For example, the length
FIGURE 1 Southern end of the Willaumez Peninsula showing Numundo and Garu Plantations.
of abandonment after the various volcanic disasters has changed through time probably because of innovations in agricultural practices and local disaster management through their social ties to other areas (Torrence et al. in press).

In other parts of West New Britain where archaeologists have worked, only 2-3 Holocene period ashes are generally preserved. The Numundo Group of plantations offers excellent potential for understanding human adaptation to volcanic disasters because our initial study of site FAAH has shown that during the same time period 7 ashes were deposited over the landscape and that the period dating prior to 6,000 years is especially well represented at this location (Torrence and Boyd 1996). A brief reconnaissance in 1998 also indicated the presence of very old and eroded ashes which suggested the possibility of a Pleistocene record of human settlement (Torrence et al. 1998).

Since the potential for recovering a very long and extremely well preserved record of human settlement is present at the Numundo Group, it was imperative that archaeological research be undertaken prior to possible destruction through the development associated with road building, terracing, and ploughing in preparation for replanting with oil palm. Fortunately, New Britain Oil Palm Ltd. has been sympathetic to the need for adequate research. The managing director, Nick Thompson, granted permission for an programme of survey and test excavation in July 1999 and provided financial and logistical support.

Our archaeological fieldwork has made it abundantly clear that we seriously underestimated the potential of the archaeological resources at Numundo and Garu plantations. With the finding of probable Pleistocene tephras sealing obsidian artifacts, an inland site with Lapita pottery, and a deep peat sequence, this region now has the finest continuous stratigraphic record of human land use anywhere in Papua New Guinea and it therefore ranks as one of the most important archaeological landscapes in the Pacific region.

Objectives

The immediate aim of the fieldwork was to rescue archaeological data which was threatened by development activities on Numundo Plantation. Within this broad aim the following specific objectives guided the research activities.

1. Determine the extent, chronology, and content of the archaeological resources on Numundo Plantation through a programme of sample survey and test excavation;
2. Assess the damage and further threat to archaeological sites by development activities;

3. Where possible, rescue information from threatened sites through surface collection and excavation;

4. Collect environmental data necessary for reconstructing the effects of sea level change and volcanic activity on human settlement.

**Environmental Studies**

Obtaining a reasonably accurate and detailed reconstruction of the environment for the various periods represented at Numundo and Garu is extremely important to the archaeological research because the high degree of volcanic activity in this area means that significant changes in relative sea levels and vegetation are a common feature of the history of the area. These would have had a major impact on human subsistence and settlement patterns. For this reason we have been carrying out environmental research on a rather casual basis at Numundo for several years but lack of funds has prevented a full scale research programme. This year Boyd was only able to visit the area for a very short period of time.

Previous archaeological research in West New Britain has demonstrated that ancient volcanic eruptions affected human populations in different ways. In some cases after a deep layer of volcanic tephra was deposited, people fled the region and did not return for many hundreds of years. After some events, however, the residents either did not leave or returned to their villages after a relatively short period. In order to find out why some eruptions had more serious effects than others, we need more information about what the environment was like before and after each eruption and how long it took for the forest to grow back. One way to reconstruct ancient environments is to study plant fossils, such as pollen, phytoliths and starch grains, which are preserved in sediments. The best place to find stratified layers of these fossils is in the bottoms of lakes, swamps, and lagoons where the damp conditions also help preserve the material. These areas also reflect regional changes in vegetation (especially for pollen which blows in the wind some distance before it falls down) as well as local conditions. In these settings, the oldest material is deep in the deposit and the youngest fossils are in the surface layers.

The analysis of pollen from deep cores has already provided important information about environmental change in the Highlands of Papua New Guinea, but currently there are no published studies of cores from the Lowland areas. In 1998
we collected several pollen cores from West New Britain and Leigh Jago, a PhD student at Southern Cross University, has begun analysing these. This year, with the help of a NBPOL excavator, two deep sections in the swamp at Garu Plantation were cleared revealing alternating layers of volcanic tephra and peat. We removed column samples of the peat and bulk samples of the tephra for analysis. Jago will now focus on these very high resolution data and hopefullly the information locked in the peat samples will reveal the environmental history of the wider region since the W-K 1 eruption at about 6,000 years ago.

Phytolith analysis is quite a new approach to environmental reconstruction but analysis of modern soils has already been shown to be able to discriminate between different environments in West New Britain (Boyd et al. 1998). Another technique which has been developed by archaeologists working on Garua Island is starch analysis (Therin et al. 1999). Lentofer collected column samples from the following sample pits for phytolith and starch analyses: I, III, V, VII, XI. If we can obtain the requisite funding, the results of this work will help us understand regeneration after volcanic eruptions and compare these patterns to prehistoric land use.

A brief, preliminary geomorphological study of the coastal plain was undertaken by Boyd. His work is based on the examination of exposed sections at several places on the current coastal plain of Numundo Plantation. His observations combined with archaeological work provide evidence for a temporal development of the landscape. Beginning in the Pleistocene, one can reconstruct a landscape of active sediment deposition followed by extensive erosion and the reduction to an undulating surface. Following this, marine incursion during the early Holocene sea level rise flooded part of the land surface. The flooding was relatively short-lived at the northern end of the Plantation but lasted longer in the remainder of the study region. Subsequent infilling of tidal areas and blanketng of swamp and dry areas by airfall tephras culminated in the contemporary environment. This process was not uniform over the whole area. Some areas were converted to dry land at a much later date than others. At the southern end in the swampy land north of Baure Hill, a lake persisted after most of the current plain had been formed.

One of the consequences of these landscape changes were differences in the spatial patterning of resource zones. In particular, the maximum period of environmental diversity was during Periods 3 and 4 (c. 6,000 - 1,800 years ago) but on-going reduction in the number of zones has gradually diminished since then. This conclusion has major implications for the variety of resources that would have been available to human populations utilising the coastal area of Numundo Plantation.
The drainage ditches at Garu Plantation cut across a series of inter-bedded peat layers and volcanic tephras. A column sample of the peats was sampled to a depth of c. 5 metres through a freshly cut section similar to this one.
Archaeological Methodology

The archaeological fieldwork entailed a programme of sample survey and test excavations. The choice of survey method was based on the visibility of deposits, which is determined by current land use, and the planned development activities for the area. Sample size was limited by the length of the three week fieldwork period, which in turn was established by available funds. Excavations were undertaken to examine the state of preservation and nature of subsurface deposits in areas with poor ground visibility.

We began by dividing Numundo Plantation into a number of areas on the basis of current land use and topography (Figure 2). A summary description of the areas and the methods used in each one is provided in Table 1. Given time restrictions, a decision was made to concentrate on areas where development activities had been initiated and to bypass areas where the coconut trees are still standing and which are being used for pasturage. Unstudied areas have not yet been assigned letter designations. Ideally, one would undertake test excavations in these areas prior to clearance, ploughing, and terracing since the heavy ground cover prohibits effective ground survey. Archaeological resources are most threatened in the hilly areas, especially in and around Area K, since these will be terraced. If conditions permit, these will be targeted in planned fieldwork for 2000. Survey was also not undertaken in areas where extensive building has taken place, as for example near the workshop, offices, staff housing, workers’ compounds, and feedlot. Five survey methods were employed.

1. In areas where ground cover was very dense and visibility was extremely poor, a truck survey was undertaken along the roads. Where dense artifact scatters were located, a foot survey was made and if possible sections were examined in road cuttings or in small spade pits. The Lapita pottery scatter in Area E (IV) and the obsidian scatter (4) in Area L were located in this manner. The logging roads, which were recently bulldozed and have not been gravelled, provided better visibility than the old gravel roads in the coconut plantations: e.g. in Area C very little artifactual material was observed on the roads. Only a very short time was spent in Area K at the beginning of the project. Truck and foot surveys within Areas B (hills), E, and L were also not comprehensive. Truck and foot survey are limited because only surface material can be inspected and where possible these were followed up with test excavations.

2. Systematic foot survey was carried out in several area which had been cleared and planted in wide rows of oil palm. In Area B (limited to fields on the southern side of Garu road) the survey took place in advance of ploughing and so
FIGURE 2 Location of survey areas at Numundo Plantation.
ground surface was only visible around oil palm trees and most of this was upcast from tree planting. Very little was found. Area D was inspected directly following ploughing and so surface artifact scatters were highly visible. In Area G the grass was still immature so ground visibility was also excellent. In Area I survey was restricted to the visible ground surface around oil palm trees planted in rows over two small hills and in an erosion patch between the two hills. Area J is a very large area of wide oil palm rows with mature, tall stands of grass planted in between. Only a small portion of the area was surveyed and visibility was restricted to ground surface around palm trees. Surprisingly, scatters 5 and 6, containing obsidian artifacts and some sea shell were noted. Further surveying in Area J is warranted. Material which is deeply stratified is unlikely to be detected by field survey and so the most recent periods may be over represented. The results of the area surveys are presented in Table 3.

3. A combination of detailed foot survey with inspection of exposed sections was carried out at Baure Hill (Area A) which had recently been terraced. Teams walked along every terrace noting surface exposures and paying particular interest to the colour and thickness of soils dating to the various periods and spot checking for artifacts still in situ. Detailed observations were noted on a terrace by terrace basis. Very few collections were made since in most cases surface scatters of obsidian could not be dated by reference to adjacent section. The Baure Hill survey is very important because one can assess the relative density of cultural material from many periods over a large area. On the other hand, the survey revealed that the majority of cultural deposits had been seriously disturbed or totally destroyed.

4. Detailed studies of exposed sections in two localities were made: VI, XIII (Figure 3). At VI, a small hill which had been extensively quarried, artifacts were located under very old tephras (Period 1). The stratigraphy was measured, photographed, and sampled. The same procedure was applied at XIII, a terrace section on the edge of a low hill in Area J. Here efforts were concentrated on Period 2 which was very rarely uncovered in the excavations.

5. Test excavations were carried out on Boku Hill at Garu Plantation (Figure 1) and on Numundo (Figure 3). The choice of the 14 tests pits was made on a mix of criteria including assessment of past and potential damage and the desire to sample cultural materials in various topographic zones. At Baure Hill 2 pits were designed to salvage deposits threatened by erosion. Three pits were investigated at Boku Hill as an attempt to locate the source of Lapita pottery and stemmed tools that we found on the bulldozed site of the mill manager’s house and to see if there are other undisturbed deposits. Two pits were dug at FAAH to determine the past and present effects of erosion. The remaining test pits were chosen to test a range of landscape
FIGURE 3 Location of surface scatters, sections, and test pits at Numundo Plantation.
zones and in the case of XI to find out how much damage has been caused by ploughing. The concentration of 3 pits in Area C was deliberate since terracing is proposed in the near future and will probably destroy the majority of archaeological deposits in this area. Other areas had either already been damaged by logging roads or ploughing or are in less immediate risk.

Units of one square metre were dug down to the diagnostic red brown clay which forms the boundary between Periods 1 and 2. In most cases, however, Period 2 deposits had not been preserved intact. In units VIII, IX, and XI excavation ceased above the red-brown clay because the water table had been reached. Excavation proceeded in natural stratigraphic units, with soils sub-divided by arbitrary spits of 10 cm. Cultural bearing layers were sieved or sorted carefully by hand. After completion all pits were backfilled.

**Archaeological Results**

The fieldwork resulted in a great deal of important information regarding the distribution and preservation of archaeological deposits at Numundo Plantation. These data can be used to predict the general location and nature of archaeological remains elsewhere on the Plantation and in the surrounding area. The predictions should form a firm basis for a plan of management for the archaeological resources of the Numundo Group and for the region as a whole. These preliminary results can also be used to write a basic prehistory for the area with a focus on changes in the density of population and spatial patterning of activities through time. Furthermore, they raise a number of important questions concerning the impacts of environmental changes (global sea level changes, volcanic eruptions, tectonic activity) on human settlement and land use. In addition to the important distributional data, two sites with especially large significance for the archaeology of Papua New Guinea were discovered and are discussed below (Boku Hill, Section VI).

**Overall stratigraphy**

One of the reasons why Numundo is so important for archaeology is the geological stratigraphy, which is comprised of a series of at least 7 volcanic tephra (technical terms for ashes) dating to the past 6,000 years. This year 5 older tephra, probably dating to the Pleistocene period, were also identified in place in at least two locations (FAAY and VI) and may be present at XIII in Area J. The recent tephras are especially critical to the interpretation of the archaeology because (1) due to their individual macroscopic properties each one is quite distinctive and is easily
STRATIGRAPHIC SECTION
Test pit I

The light layers are volcanic tephras (ashes) and the dark layers are soils which contain obsidian artifacts and fire-cracked rocks. Note the orange/light brown layer which is under the W-K4 tephra and above the dark soil on the W-K3 tephra. The origin of this layer is not well understood. This trench is one of the few places where Period 7a is present.
recognised in the field; (2) the tephras have buried and sealed deposits thereby preventing mixing of cultural materials from different periods; and (3) for these reasons they provide a sound basis for relative dating of deposits found anywhere in the study region. Fortunately, the date of many of the tephras is also known due to previous geological and archaeological research (Machida et al. 1996; Torrence et al. in press). The result is that archaeological findings can easily be assigned a relative date and results from different parts of the Plantation can be compared readily.

The basic geological sequence comprising a series of stacked tephras, with associated soils, is shown in Figure 4. The names for the tephras were given by Machida et al. (1996). Machida made notes on a section at site FAAH in 1991 and our sequence is comparable to his record. One difference identified this year was the presence of an additional tephra above the soil developed on W-K3 and below W-K4. Since there is no soil on W-K3 at many localities, this layer is not always easy to detect. There is a very clear expression of it at test pits I, III and VII. It is characterised by an orange colour and has a distinctive lens of hardened pumice pieces in the range of 1-2 cm in diameter. There is no soil formation between it and the W-K4 tephra. At present we are uncertain whether this represents a second phase of the W-K3 event or something preceding W-K4. Hopefully samples taken for geochemical analysis can help clarify the volcanic history.

It is difficult to differentiate between the various tephras within the W-H series because the layers are quite thin. We have tentatively assigned two tephras to W-H4 and W-H5 because Machida observed these at the road section at FAAH in 1991. Geochemical analysis is required to confirm our identification. We also located an additional tephra immediately below W-H4 which was generally represented by fine, light brown ash, but in pit XII has a basal yellow component. We assume this is another belonging to the W-H series but correlation with the Machida et al. (1996) sequence also requires geochemical analysis.

Due to differential patterns of erosion, slope angles, etc. not all layers are present at every locality. In particular, W-K4 has a patchy distribution and W-K1 is only very rarely preserved in situ. As on Garua Island, W-K2 appears to be quite susceptible to erosion from slopes but is present on most hills.

In most localities red-brown clay is found directly below the W-K2 tephra since W-K1 has rarely been preserved, but Area J is important because in test pit VII and in section XIII an extra layer of large rocks and pieces of solidified, bedded tephra was observed directly under the W-K1 tephra. Artifacts were found on the ancient land surface both directly below the W-K1 tephra and below the blocky layer. Also at XIII an orange clay which may be equivalent to tephra E at VI was observed (see below), but there were no artifacts associated with it.
FIGURE 4 Generalised stratigraphic sequence for the Holocene period in the study area.
Section XIII in Area J is one of the few locations in the study area where layers pre-dating the W-K1 tephra, i.e. older than c. 6,000 years, have been preserved. The W-K1 tephra in this photo is a sandy brown layer visible at about the midpoint of the staff. The pink ribbons indicate where artifacts have been found in situ above and below a blocky layer which directly underlies the W-K1 tephra.
Using this basic stratigraphy, one can establish a cultural chronology using the period designations presented in Table 2. Not all stratigraphic layers occur at every location and cultural materials are not present in all soils. Periods 2 and 3 are distinguished by the presence of the W-K1 tephra. Where it has not been preserved, the artifacts in the red brown clay under the W-K2 tephra have been classified as belonging to Period 3. When it was possible to distinguish a lens of cultural material between the W-H4 and W-H5 tephas, this was assigned to Period 7a. Since it is so thin, this layer was rarely distinguished during the excavation of the test pits and so in most cases material can only be assigned to the larger unit of Period 7.

**Large-scale Temporal and Spatial Patterning**

On the basis of the survey and excavation, large-scale patterning in the temporal and spatial distribution of cultural material can be noted. These observations are further supplemented by the more detailed studies at Baure Hill, sections VI and XIII, and the survey work at Boku Hill, which are all discussed below. A summary of the temporal and spatial distribution of cultural materials observed in each of the periods is presented in Tables 3 and 4. Areas F, H, and K were not surveyed sufficiently intensively for them to be included in the table. The designations of Rare, Common, and Abundant were chosen as general categories for the combined results of truck and foot surveys and excavation within the various areas (Table 3). In the case of the test pits actual counts of obsidian artifacts were used as the basis for scoring the periods into ranked categories 1, 2, and 3 (Table 4).

The sum total of the ranks for each period provides a useful general measure of the density of the cultural deposits and is therefore a proxy measure for intensity of land use and/or size of the human population. The results shown in Table 4 indicate that major population declines took place in Periods 5 and 7 and that the highest intensity of land use occurred during Period 6. Surprisingly, the data suggest that the area had much higher densities of people in the past than during the past 500 years. A major factor in this change may have been the loss of coastal environments such as mangrove swamps as a consequence of the falls of volcanic tephas. A summary of each Period based on all the data at hand is presented below.

Period 1 is restricted to Section VI and is discussed in a separate section below. Period 2 is only rarely preserved in Areas A, C, and J at Numundo and on Boku Hill at Garu. It is generally represented by a thin scatter of material, except in VII where 52 obsidian artifacts were recovered in the red brown clay under the W-K1 tephra. Clearly Area J represents a focus of activities for this period. At this time the current coastal plain was largely under water and so VII may have been a coastal site.
Period 3 is also thinly spread across all areas of the landscape with a concentration in VII and the nearby FAAY hill on which test pit V is placed, as well as at Boku Hill. Again the coastal location of these places may have been focuses of activity at this time, although the presence of Period 3 in Areas A, C, and E shows that the whole landscape was used to some degree.

The survey data suggest that after the W-K2 eruption the region was repopulated in much the same way as before. Site FAAH was clearly a focus of activity because it has a very high density of pottery, however, rare sherds have been found in nearly all topographic zones and as far inland as IV and Boku Hill. These data corroborate the findings on Garua Island (Torrence and Boyd 1997) that people using Lapita pottery were not restricted to the coast, especially in the later part of this period.

Although the W-K3 eruption was not as severe as the previous Witori events (Machida et al. 1996), the effects on human settlement appear to have been at least as disastrous because population levels remained extremely low after the W-K3 tephra was emplaced until after the W-K4 event, as much as 300-500 years later. One problem in interpreting the impacts of the eruptions is that the W-K4 eruption is very poorly dated at present; dates range from 1300-1500 years ago (Machida et al. 1996). The W-K3 tephra is not well preserved on Garua Island and so its effects are difficult to track, but it is notable that there are very few radiocarbon dated levels in the period between 1800 and 1100 bp, which is roughly equivalent to the time between the W-K3 and W-K4 eruptions.

It is hard to believe that the W-K3 eruption is the sole cause of the population decline over such a large an area including places where the tephra is very thin. One possibility is that the landscape experienced major changes after the W-K3 eruption. Although the W-K2 event began the process of building the current coastal plain, large areas of the lowlands were still under shallow water or swampy. However, the W-K3 tephra would have created a great deal more coastal plain and eliminated much of the mangrove swamps. Depending on the nature of subsistence of the people who inhabited and used Numundo, this could have made the area much less desirable. We also need to know more about what happened at the end of the Lapita pottery period and whether the cessation of pottery is linked to important social changes that by themselves could explain such a major change or whether the eruption is also a key factor in this dramatic decline in population density.

Period 6 deposits make a dramatic contrast with the previous period. They contain by far the densest concentrations of obsidian and are common over the entire study region in all environmental and topographic zones. Layers of this date are frequently very thick and extremely black with high quantities of charcoal even when
there are few artifacts present, indicating a very intensive land use pattern characterised by much burning (?clearance). In XI the layer resembles a line of pits which are suggestive of gardening activities although surprisingly few artifacts were recovered here. A major new research question raised by these new data is the cause and timing for this apparent population explosion. Was it as rapid as it appears in the archaeological record? One wonders whether one explanation for the rise in the intensity of land use is due to immigration from the region immediately north which was heavily hit by the Dakatau eruption of c. 1100 bp. What we may be observing in the various decline and peaks in the Namundo data is the movement of peoples in and out of small areas in response to volcanic activity in the region.

Period 7 represents another drastic decline in the intensity of land use in the region. What with 3 closely spaced eruptions, it is perhaps not surprising that the area was abandoned until the environment was more stable. There were, however, some people in the area during or between the periods of volcanic activity, as illustrated by the black, organic rich layers observed in Areas A and G between the W-H4 and W-H5 tephas and the abundance of artifacts in the former case. Whether there were very few people living in the area or whether activities of many were highly focalised in space cannot yet be determined with the data at hand, but this must be a high priority for further research.

In contrast to Period 7, surface scatters of Period 8 material are relatively common and widespread, although very little artifactual material was recovered from the test pits. It appears that the intensity of land use never recovered to Period 6 levels before the Plantation was acquired by the Germans. It has normally been assumed that settlements of this period were restricted to inland hills and this was also the finding on Garua Island (Torrence and Boyd 1996; 1997). We were therefore surprised to find small quantities of sea shell on the flat ground in Area J (scatters 5, 6) and two pieces of recent pottery below the ridge of the workers’ compound in Area G (scatter 9) in addition to the inland, upland scatters in Areas A and D (scatters 1-3). Site FAAX is also characterised by abundant obsidian artifacts and sea shells. At scatters 2 and 3 in Area D pieces of thick, green bottle glass were also recovered. It is hoped that these may prove to be dateable. In contrast, almost no artifacts belonging to Period 8 were recovered from the excavations. We can therefore conclude that Period 8 material is fairly clustered and most common on inland hills, but it is also present in smaller quantities on the coastal plain. We may be observing differences in patterns of artifact deposition between settlements and gardens.
Terracing exposes long stretches of section but destroys a large proportion of the archaeological deposits.

Detailed study of the sections exposed on Baure Hill provides useful information about the spatial and temporal distribution of archaeological deposits. Here a cluster of fire-cracked stones (visible above the trowel) is associated with obsidian artifacts in a layer belonging to Period 4.
**Area A, Baure Hill**

Baure Hill is located at the southern end of Numundo Plantation just south and east of where Avenue 13 makes an obvious jog in order to skirt the foot of the hill (Figure 3). The hill, which is c. 40 m above sea level, was covered in secondary forest which was logged before roads and terraces were bulldozed (see cover photo). To the west and south of the recently cleared area the hill rises slightly and continues into Haella Plantation where oil palm was planted several years ago. The final stages of bulldozing and planting were in progress during the fieldwork and so Area A gave us an excellent opportunity to assess the impact of this type of land use on the archaeological resources.

The analysis of numerous terrace sections on Baure Hill provides an excellent overview of the density and spatial distribution of archaeological deposits that were present prior to the bulldozing. Our understanding of land use in this area is limited, however, by the extent that visibility was not uniform over the entire hill and the fact that road building and terracing have removed the majority of archaeological deposits. In some cases remnants of cultural material were found to be in situ and could be excavated in the future.

Survey was undertaken by small teams who made notes about each section of terrace placed between the various roads running up the hill from Avenue 13, each of which was assigned an arbitrary number. Terraces were generally numbered from Avenue 13 up the hill with 7 terraces existing in most parts of the hill and a Terrace 8 or Terrace 0 existing in only a few places. Sections were examined and surface scatters noted. Since the bulldozing redeposited material along the terrace in order to ensure it is level, the surface material was not considered to be a good measure of what had been disturbed. Most emphasis was placed on the study of cultural material exposed in the terrace sections. In addition, test pits were carried out at I, located in the central portion near the top of the hill and XII, which was on the eastern end of a subsidiary ridge which had not been totally destroyed.

Our study of Baure Hill has led to a number of conclusions about the preservation of archaeological material on terraced hills. Firstly, Period 8 deposits are the most susceptible to damage from modern land use because they are surficial and quite shallow. For example, all the sea shells observed, which probably date only to this period because of the high rate of decay in this region, and stone axe fragments were only found in bulldozer push along the roads. These places were all near the top of the hill, but we cannot be absolutely certain that Period 8 land use concentrated on the hilltop as it appeared on the basis of the survey, because there is virtually no modern ground surface remaining on Baure Hill.
Secondly, the majority of material observed for all periods is clustered near the top of the hill and along the most prominent ridges. These are all the places where road building has caused most damage and so there are unlikely to be any substantial undisturbed deposits remaining. Future excavations, especially those focusing on Periods 5-8 would be most productive if concentrated along the sections on Terraces 7 and 8. In contrast, the majority of sections containing Periods 3 and 4 artifacts were located adjacent to the roads running up the slopes on Terraces 3-6. Period 4, in particular, was often characterised by scatters or clusters of cracked volcanic stones and thinly distributed obsidian artifacts. Ideally one would like to know whether the various periods had more or less clustered distributions on the hill, as suggested by the concentration of material from Periods 6-8 and the more scattered and less dense artifacts associated with Periods 2-4, but this hypothesis would be extremely difficult to test adequately with the data remaining at Baure Hill.

Thirdly, not all ridges were used to the same degree. Those in the center of the hill appear to have higher densities of artifacts than those at the southeastern and western flanks of the hill. The reason for the favoured spots may have to do with their locations on the best routes of access up the hill and to other places further inland. That this is the case was dramatically illustrated by test pit XII which returned very few artifacts in all periods. The test pit was located on a terrace which did not have a road on it (which is why excavation was possible), thereby demonstrating that it was not on a good route to the center of the hill.

The time and resources needed to collect extensive spatial data comparable to what we gained from the terrace surveys using conventional test excavation would be prohibitive for most archaeological projects. The very long exposures created by the bulldozing have allowed us to suggest a number of tantalising hypotheses for changes in land use in this region over time. The problem is that testing these hypotheses is now virtually impossible given the nature of destruction of archaeological material at Baure Hill. Future research in other areas of the region, however, could examine these suggestions further if excavation in advance of terracing is possible. In addition, a better integration of archaeological research and terracing could permit a closer examination of the data before and especially during road building since this is what causes the most damage. Alternatively, developers could reconsider their plans in terms of the density and placement of roads on areas where our results predict that the densest distribution of archaeological material will occur.
FAAH

Section study and soil sampling were carried out in 1996 and 1998 at a gully exposure at the south-eastern end of the FAAH hill. At this time it was noted that all the tephas from W-K1 to W-H5 are well represented. Artifact densities were observed to be particularly high in Periods 2-4 and a relatively high density of Lapita style pottery (dentate stamped, incised, notched rims) belonging to Period 4 was noted. After Period 4 there is very little indication of human presence at this locality, which is quite surprising given the density of material elsewhere on Numundo. It seems likely that the focus of human use shifted from the coastal side of the hill to other areas when the coastal plain was fully formed in the adjacent area after the W-K3 eruption. A series of test pits distributed across the hill are needed to test this hypothesis.

In 1999 surface survey at the foot of the hill along the mangroves identified a large number of potsherds, many of which appeared to have been excavated from drainage sumps. In addition, an extremely unusual retouched piece of quartz was also found.

Pits VIII and IX were dug to find out whether the pottery found there was in situ or had eroded from higher levels and if a beach had been present at the foot of the hill at any time in the past. Sites with Lapita pottery are typically associated with beaches but we did not locate beach sands. It appears that prior to the W-K2 tephra, the sea was closer to the hill than at present, but the coastline was muddy and probably a mangrove swamp as it is today. The W-K2 eruption created drier land and more swamp and so at the time of the Lapita pottery, it is highly unlikely that there were stilt houses in this area, similar to those found elsewhere in the Pacific region. The results also showed that the pottery found at the foot of the hill was derived and was eroding until the W-H tephras were deposited and the current dry land and at the base of the hill was created.

Pleistocene Deposits

A schematic section for the stratigraphy observed at locality VI is presented in Figure 5. The section is the quarry face of a hill which is c. 4.5m high and 17 m long. Several Holocene tephas are lying unconformably above at least 5 very weathered tephas and associated soils. The early tephas are lying horizontally and represent a series of flat surfaces, the youngest of which is approximately 4 m higher above sea level than the current coastal plain. This old landscape was then heavily eroded leaving this small, isolated, remnant hill. The more recent tephas (W-K3,
FIGURE 5  Stratigraphic sequence at section VI.
W-K4) were deposited after the erosion and are draped unconformably over the eroded hill. A similar stratigraphy has been recorded for site FAAY, another small hill to the west of VI, but at this locality no artifacts have been observed under the old tephras. In test pit V on top of FAAY the W-K2 tephra lies unconformably on top of the red-brown clay which contained abundant obsidian artifacts in the top 20 cm, but it was not feasible to excavate deeper in a small test pit.

The Pleistocene soils at both sites are red-brown in colour and are clay rich, whereas the tephras are yellow and have a sandy texture. The soil above Tephra B contains rare, scattered cobbles oriented randomly. The tephras are mainly altered to clay minerals although a preliminary analysis by Ainge and Davies has identified some rare glass fragments. Tephra C is the least altered and contains the coarsest clasts, with a more concentrated layer of pebbles to 1 cm at the base. One piece of lava 3 cm in diameter contains phenocrysts of plagioclase, orthopyroxenes, clinopyroxenes and fine opaques within a glass groundmass. In future work samples such as these may be suitable for potassium-argon or argon-argon dating of the tephras.

Eight obsidian artifacts were observed, photographed in situ, and sampled from the soil developed on tephra C and 1 from the soil developed on tephra B. All the artifacts are small flakes or fragments of obsidian with a maximum dimension of less than 3 cm. Most are highly weathered and have a characteristic pitted surface under magnification. All the flakes and flake fragments are noncortical. Three of the flakes from the soil above tephra C have dorsal scars that suggest they were also removed during the process of trimming and reshaping other tools used in this locality. Two flakes from the soil on tephra C may also have been used. The flake above tephra B was removed from a bifacially flaked artifact and bears retouch on its proximal end. It also has evidence for use. The interpretation of use-wear is very difficult because of the advanced state of weathering: only small fragments of original surface remain. Residues in the form of red smears probably from resinous plants are present on two artifacts. Given their distribution, it seems likely that they are not associated with use and may not be contemporary. However, the preservation of plant residues is such old contexts is very encouraging.

A small, isolated cluster of c. 20 volcanic rocks, ranging in size from c. 4–10 cm in diameter and identified by Davies as phrytic latite or trachyte, was noted in the soil on tephra C. The stones are identical in size and geological composition to those which have been excavated from younger features at Numundo and are considered to be fire-cracked, cooking or ‘mumu’ stones. The difference is that the stones at VI are much more heavily weathered with a skin as much as 2 mm thick. Scattered directly above and under the stones were 3 small obsidian artifacts. It seems probable that the
Alternating layers of highly weathered tephras and soils at this location may date to the Pleistocene period (i.e., earlier than 10,000 years ago). Team members point to artifacts found in situ in the soil formed on tephra C. The Holocene tephras mantling the highly weathered red brown clay are just visible below the tree trunks at the top of the photo.

Peter Ainge points to an artifact in situ in the soil formed on tephra C. The cluster of rocks and obsidian artifacts thought to be a hearth is on the right. The white scale is 5 cm long.
stones and artifacts represent a feature, possibly the remnant of a hearth or the waste from a roasting pit.

The age of the tephras and therefore the artifacts is unknown but is predicted to be late Pleistocene due to the depth of weathering of the red-brown clay and tephras that overlay them and the thickness of the weathering rinds on the volcanic rocks and obsidian artifacts. In addition, the tephras had to be laid down and then eroded before 6,000 years ago, the youngest possible age of the red-brown clay given sections elsewhere on the Plantati on. It is also likely that the erosional phase took place during a time of lower sea level, i.e. prior to 6,000 years ago and possible during the glacial maximum at c. 20,000 years ago.

It is interesting to compare this site to those where Pavlides has recovered chert artifacts dating to c. 35,000 at Yombo, inland Kandrian region (Pavlides and Cosden 1994). In that case the Pleistocene material was stratified under a highly weathered, consolidated tephra dating to c. 14,000 years ago. If tephra E at VI is equivalent to Pavlides' 14,000 year old tephra, then the artifacts are certainly Late Pleistocene in age and may even pre-date 35,000 years since she recovered her dates immediately below this tephra. Unfortunately, the history of Pleistocene volcanism in West New Britain is virtually unknown and there is no glass remaining in the 14,000 year old tephra that can be used to match the Numundo sequence (Pavlides, pers. comm.). The absolute age of the site will have to remain in question until appropriate dating techniques. We are currently investigating the feasibility of TIMS, OSL, K/AR, AR-AR dating of the tephras and AMS dating of the soils.

An additional component of the Pleistocene landscape may also be present in Area J. It is notable that the low angle of the slope is completely different from the ridges running east from Mt. Krummel on which the staff housing and worker's compounds are placed. The general configuration of the low-lying hill where XIII and VII are located suggests that it may be a colluvial fan which is associated with the earlier plain preserved at VI. Since a pre-W-K1 tephra similar to tephra E was also observed, Pleistocene tephras may also be preserved at this locality. Further exploration is certainly warranted.

The finding of stratified artifacts in section VI represents the first evidence for human land use on the north coast of West New Britain. Since this is such an important result, a short report describing the site has been submitted to the journal *Australian Archaeology*. 
Test pit VII is under the shelter on top of the low-lying hill. Section XIII is on a bulldozed terrace indicated by the arrow. This area may be a remnant of the Pleistocene landscape.

Volunteers Allison Spence and Gerald Atkinson sieve for artifacts excavated from test pit VII. Scatter 6 is on the lowland in the background.
Boku Hill

The second very significant discovery this year was the site of Boku Hill, on Garu Plantation (Figure 1). The team located 6 potsherds in the bulldozer push of sediments resulting from levelling to create a platform for the new mill manager’s house. Two are decorated: one bears Lapi ta style dentate stamped décoration and another is a typical late Lapita notched rim. The pottery is unusual because it has shell temper. Calcareous temper is extremely rare in Lapita pottery from Numundo Plantation and sites in the Talasea region and is absent on Garu Island. This unusual temper suggests that the pottery was not made locally and was also probably not imported from nearby sites on the east coast of the Willaumez Peninsula. Boku Hill may have taken part in a different trade network. The site also raises important questions about the nature of interaction between coastal dwellers who made Lapita pottery and inland people who did not.

Boku Hill is a very unusual location for a Lapita site. It is c. 10 km inland and at 80 m above sea level, the site is perched above extensive swamps. The pottery was probably derived from a location on the edge of the hill with an excellent view of the coast. The site is currently accessible from the coast by boat up the Kulu River and then a short distance by foot (Figure 1). This route is now commonly taken by villagers who use the road access from Garu Plantation to travel to Kimbe.

Pottery does not appear to have been very abundant at the site and it is likely that the Lapita age component was quite restricted in space. Test pit XX located within 25 m of the pottery findspot did not contain the Period 4 deposits, although pit XXII which was within 10 m of the bulldozer dump recovered abundant obsidian and a possible hearth feature dating to Period 4, but no pottery was found. Test pit XXI which was placed on a prominent hill inland from the bulldozed area had a very disturbed stratigraphy and produced no results relevant locating the Lapita site. Pit XXII did contain an enormous number of artifacts within the tree hole suggesting that there is a very dense concentration of material in this area of Boku Hill, although we could not determine the exact date of the obsidian artifacts. Since the W-K2 tephra had eroded from this hill, it is difficult to assign the artifacts to a definite period.

An exquisite stemmed tool made on a Kombewa flake with extremely fine retouch was also collected in the bulldozed area. The overall shape of the artifact is a U with a stem jutting out between the two thin, pointed wings. The possible working edge is unretouched and semi-circular in outline. The stem is unusual in having flat bifacial flaking instead of the more typical steep unifacial retouch. This is certainly one of the most highly crafted tools of its type known and displays extreme mastery of flaking technology. It is difficult to believe that this artifact was meant to
be used. It seems more likely that it was a valuable for display and/or ceremonial exchange. Another very small stemmed tool which is more typical was also found in the same area.

Pits XX and XXII have confirmed that obsidian flakes are relatively common in the pre-W-K2 levels, where stemmed tools are usually found, but no retouched artifacts were located in these test pits. The excavations have demonstrated, however, that Boku Hill had relatively dense occupation in Periods 3 and 6 and a smaller presence in Period 4. A ground stone axe dating to Period 8 (?) was also collected by Jarmaine Boromana from the bulldozer push.

The setting of this site on top of a long, flat ridge leading up to Mt. Garbuna surrounded by lowlands and swamp makes this place an obvious focus for human settlement. The presence of two possible status or ceremonial items, decorated pottery and a large stemmed tool, is also highly suggestive of a special use for the site. Unfortunately modern house building all along the edge of the hill where the pottery and stemmed tools were found may have completely destroyed the prehistoric settlement, but further testing of the hill is an urgent priority before any more building is carried out at this locality.

Stemmed tool recovered from Boku Hill. Natural size.
FUTURE RESEARCH PLANS

The main conclusion of the fieldwork is that the Numundo group plantations offer many exciting opportunities for research into the relationship between human settlement and environmental change in the past 20,000 years (or more). This potential will only be reached if the archaeological resources are protected and managed carefully according to the recommendations given above. Good management practices need to be based on the most accurate knowledge and for this reason continued research on the Numundo Group is planned.

In the short-term we will be conducting specialist analyses of the archaeological and environmental data collected during the 1999 fieldwork and will be seeking funds for dating. Highest priorities for dating are the Pleistocene site, pre-W-K1 artifacts at site VII, peat layers from Garu Plantation, and cultural phases with especially rich cultural remains. We will also be further investigating some of the problems raised by the new fieldwork, such as the source of the unknown tephras, and will be seeking further collaboration to assist in geological and environmental analyses. PIXE-PIGME analyses of obsidian artifacts, which will be carried out in October at ANSTO, may help establish the relative age of the Pleistocene site, since the Talasea sources have been dated by fission tracks to be younger than c. 35,000 years. If the artifacts are sourced to the older Mopir source, which is further away than Talasea, then the site may predate the formation of the Talasea obsidians. Discussion with experts about the possible use of K-AR and AR-AR dating of minerals in the tephras and of radiocarbon dating of the soils has been initiated. A grant proposal to the Australian Museum requesting funds for dating is now under review: if successful funds will not be available until the end of 1999.

Our final short-term strategy is to maintain a watching brief over the development activities, especially at Boku Hill and on Numundo Plantation. It is hoped that the management is now fully aware of the importance of the archaeological materials in these places and so they and their staff will monitor the situations as best they can and report all finds as they occur. Further bulldozing is likely to uncover many new localities with archaeological materials. It is important to record these as soon as possible after they are disturbed and where possible to undertake test excavations in advance of terracing. We therefore hope that funds can be found for additional salvage fieldwork to take place in July or August 2000.

The potential to study such a long history of human and environmental interaction means that a large inter-disciplinary research project based on the Numundo group plantations and nearby regions should be carried out before agricultural activities further damage the archaeological resources. Major
archaeological excavations should be conducted at the very least at the Pleistocene site, A rea J alluvial fan, Boku Hill, FAAH, and FAAK to provide a better basis for understanding human settlement in all the major periods represented. Alongside this work a thorough analysis of the Garu swamp sediments and ecofacts is warranted with deep coring for samples dating before the W-K1 eruption a high priority.

Further geomorphological studies using the extensive ditch sections could also be carried out to reconstruct the history of the swamp in relation to sea level change and climatic change. Ideally, coring with drilling equipment at inland lakes, such as Lake Umboi, should also be undertaken to get a pollen record which is at least as old as the Pleistocene site. Additional geological study of the tephra sequences and sources is also required to provide a basis against which to understand differences in the timing and density of human settlement.

Toward this end the team leaders will be submitting a proposal to the Australian Research Council in February 2000 for a major project to begin in 2001. Proposals will also be made to a number of other possible sources of funds.
CONCLUSIONS

The excellent preservation of a series of landscapes dating from the Pleistocene period up to the present day means that the region including and surrounding Numundo and Garu Plantations is highly significant for understanding the history of human land use in relationship to environmental change over a very long time period. A brief geomorphological study has produced a preliminary picture of changing coastlines and associated environmental zones associated with the history of volcanic eruptions. This provides an important background to the archaeological survey and test excavations which have shown that there were major fluctuations in the intensity of land use through time and that these are probably related to the effects of volcanic activity.

The exciting discovery of obsidian artifacts in association with a stone feature stratified beneath a series of Pleistocene tephas has greatly extended the prehistory of the north coast of West New Britain. Previously it has been difficult to locate deposits dating greater than 6,000 years old, but a very conservative estimate for the new finds is that they pre-date 10,000 years and may be as old as 30-40,000 years.

Boku Hill produced some stunning material including decorated, Lapita-style pottery with an unusual fabric type and a remarkable obsidian stemmed tool. The site is also important because of its inland location and excellent stratigraphy. Close to the hill are extensive deposits of inter-bedded peats and volcanic tephas which can be used to reconstruct the impact of the Holocene volcanic eruptions on vegetation in the region and to track patterns of regeneration following these disasters.

Due to the unique conditions of preservation and the great wealth of the archaeological record, further research is highly justified and should produce important results. Finally, 9 recommendations have been made concerning the future management of these very significant archaeological resources.
COMMUNICATION OF RESULTS

At the beginning of the field trip Torrence and White visited the National Museum in Port Moresby to discuss fieldwork plans with members of the Anthropology and Prehistory sections. Torrence presented a seminar about the proposed fieldwork to the staff and met with Nick Araho to learn about his recent surveys in West New Britain. Specht also met briefly with Araho enroute to Hoskins. At the end of the fieldwork Torrence and White met Araho and Dr. John Muke (University of Papua New Guinea) in Mt. Hagen and briefed them on the results.

In West New Britain we discussed our work with the Deputy Governor, Isadore Tei. Torrence gave a public lecture with slides to a large and enthusiastic audience at the Mosa Social Club and team members showed our finds and answered questions. Torrence talked about archaeology with a group of students from Kimbe High School as part of the Mahonia Na Dari Saturday School. A number of books and articles about archaeology in West New Britain were donated to the library at the Mahonia Na Dari research station. We also gave a tour of the archaeology on Baure Hill, Numundo Plantation to grades 7 and 8 from Kimbe International School.

Torrence presented John Namuno with a Macintosh SE computer and printer for the Provincial Cultural Centre and provided basic tuition in its use. Posters with scale drawings of the rock art on Garua were presented to the Provincial Cultural Centre for public display and to the landowners, Garua Plantation and Kimbe Bay Shipping Co.

A short report describing the Pleistocene finds has been submitted to the journal Australian Archaeology for publication in the December 1999 number.

ACKNOWLEDGEMENTS

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assistance with permits and visas: National Museum of PNG, National Research Institute, West New Britain Provincial Cultural Centre, PNG Consulate in Sydney. Professor Hugh Davies hosted us in Port Moresby and established productive collaboration with the Department of Geology, University of Papua New Guinea. Assistance of various sorts from the following was also critical to the success of this research: Walindi Resort, Kimbe Bay Shipping Agencies, Nuigini Tours. Thanks also to Les and Norelle Hartwig, Max and Cecilie Benjamin, Tim Denham, and Jack Golson for their hospitality. Finally, this project depended a great deal on the good spirits and hard work of all the team members. We are especially grateful to the local volunteers who worked with us, gave us much hospitality, provided transport and gave much appreciated assistance: Brenda Senior, Diana Hart, Jarmaine Boromana, and especially Allison Spence. Peter White did the mapping, made the drawings, and helped in the preparation of this report. Huw Barton and Richard Fullagar advised on the use-wear and residue analyses of the artifacts from section VI.

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Torrence, R., J. Specht and B. Boyd 1998. Archaeological fieldwork in West New Britain, PNG. September-October. Submitted to the West New Britain Provincial Government and various organisations in PNG.


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Allison Spence, Brenda Senior, Diana Hart, New Britain Palm Oil Ltd.
Visitors: Dr. Tim Bayliss-Smith, Cambridge University, UK; Inga-Marie Mulk, Saami Museum, Sweden

ITINERARY

July 1 Torrence and White fly to Port Moresby; meet with Davies and attend lecture by members from the Ocean Drilling Project.
July 2 Torrence presents seminar on proposed fieldwork to staff at the National Museum and Art Gallery. Torrence and White discuss current research with Nick Araho. Torrence, White, and Specht fly to Hoskins, collect truck from NBPOL, and set up project at Mahoni a Na Dari.
July 3-5 Team to Garua Island to collect stored equipment. Brief survey of site FAP.
July 5 Return to Mahonia Na Dari, meet with staff at the Provincial Cultural Centre, collect equipment from KBSA, begin preparing for fieldwork. Spence joins the team.
July 6 Meet with Bob Wilson, Mike Hoare, and Kefu Boromana at Numundo, Haella, and Garu Plantations respectively to discuss fieldwork plans. Brief survey of Boku Hill.
July 7 Lentfer, Jago and Henderson arrive.
July 8 Fieldwork begins.
July 11 Professor Davies, Tim Bayliss-Smith, Inga Marie Mulk, James Culley, and Gerald Atkinson arrive.
July 12 Peter Joe Ainge arrives.
July 14 Davies departs.
July 24 Boyd and Parr arrive. Torrence speaks to Kimbe School High School students.
July 27 Torrence presents public lecture about the project at Mosa Social Club.
July 29 Torrence and White fly to Mt. Hagen to visit research team working at Kuk Swamp.
July 30 Specht, Henderson, Culley, and Atkinson depart for Australia.
August 1 Torrence and White return to Sydney.
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<th>Visibility</th>
<th>Method of Study</th>
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<td>Baure Hill&lt;br&gt;Coastal foothills</td>
<td>Secondary forest; logged; bulldozed roads, terraces</td>
<td>Excellent. Cleared areas; Extensive sections; New dirt roads</td>
<td>Foot survey; Detailed section study; Test excavations: I, XII</td>
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<td>Coastal foothills;&lt;br&gt;Coastal plain;&lt;br&gt;Swamp</td>
<td>Coconuts cleared;&lt;br&gt;oil palm planted; ploughed;&lt;br&gt;ditches; culverts; roads</td>
<td>Poor. Scrub cover; Several sections visible; Some ditch sections; New dirt roads</td>
<td>Truck survey on roads; Foot survey on lowlands prior to ploughing; Minimal ditch survey</td>
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<td>Coastal foothills</td>
<td>Coconuts cleared</td>
<td>Very poor. Thick ground cover; Old gravel roads</td>
<td>Truck survey on roads; Test excavations: II, III, X</td>
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<td>Inland plateau, gently sloping</td>
<td>Coconuts cleared;&lt;br&gt;oil palm planted; ploughed;&lt;br&gt;grass seed sown</td>
<td>Excellent. Recent ploughing; New dirt roads</td>
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<td>New gravel roads</td>
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<td>J</td>
<td>Coastal plain and remnant alluvial</td>
<td>Coconuts cleared; minor terracing; oil palm planted;</td>
<td>Poor; thick ground cover except</td>
<td>Minor foot survey on lowland around oil palm;</td>
</tr>
<tr>
<td></td>
<td>fan</td>
<td>grass full grown</td>
<td>near new oil palm; Recent gravel</td>
<td>Test excavations: VII, XI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>roads; Section on terraced hill</td>
<td>Section study: XIII</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Artifact scatters observed: 5, 6</td>
</tr>
<tr>
<td>Area</td>
<td>Landforms</td>
<td>Landuse History</td>
<td>Visibility</td>
<td>Method of Study</td>
</tr>
<tr>
<td>------</td>
<td>----------------------</td>
<td>----------------------------------</td>
<td>----------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>K</td>
<td>Coastal foothills</td>
<td>Coconuts; houses</td>
<td>Very poor. Thick ground cover</td>
<td>Minimal truck survey; No records made</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Old gravel roads</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Inland foothills</td>
<td>Secondary forest, logged; bulldozed logging roads</td>
<td>Very poor. Thick ground cover; Old dirt roads</td>
<td>Minimal truck survey</td>
</tr>
<tr>
<td>Period</td>
<td>Stratigraphic Position (See Figure 4)</td>
<td>Date (years before present)</td>
<td>Cultural Material</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Period 1</td>
<td>Under ?Pleistocene tephas</td>
<td>pre-?10,000</td>
<td>Small obsidian flakes</td>
<td></td>
</tr>
<tr>
<td>Period 2</td>
<td>Under W-K1 tephra and above ?Pleistocene tephas (usually reed-brown clay but includes blocky layer in Area J)</td>
<td>pre-6,000</td>
<td>Small obsidian flakes, Split cobble</td>
<td></td>
</tr>
<tr>
<td>Period 3</td>
<td>Soil on W-K1 tephra and/or under W-K2 tephra</td>
<td>6,000 - 3,500</td>
<td>Obsidian flakes, Stemmed tools</td>
<td></td>
</tr>
<tr>
<td>Period 4</td>
<td>Soil on W-K2 tephra</td>
<td>3,500 - 1,800</td>
<td>Lapita pottery, Obsidian flakes</td>
<td></td>
</tr>
<tr>
<td>Period 5</td>
<td>Soil on W-K3 tephra</td>
<td>1,800-1,200</td>
<td>Obsidian flakes</td>
<td></td>
</tr>
<tr>
<td>Period 6</td>
<td>Soil on W-K4 tephra</td>
<td>1,200-500</td>
<td>Obsidian flakes</td>
<td></td>
</tr>
<tr>
<td>Period 7</td>
<td>Soils associated with W-H tephras</td>
<td>Less than 500</td>
<td>Obsidian flakes</td>
<td></td>
</tr>
<tr>
<td>Period 7a</td>
<td>Between W-H4 and W-H5 tephras</td>
<td>Less than 500</td>
<td>Obsidian flakes</td>
<td></td>
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<tr>
<td>Period 8</td>
<td>Modern topsoil</td>
<td>Less than 200</td>
<td>Obsidian flakes, Groundstone axes, Sea shells, Pottery, Glass</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Distribution of Cultural Material Found in Surveys by Area and Period
(For locations see Figure 2)

<table>
<thead>
<tr>
<th>AREA¹</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>7a</th>
<th>8</th>
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<tbody>
<tr>
<td>A</td>
<td>--</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C, S</td>
</tr>
<tr>
<td>B</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>R</td>
<td>0</td>
<td>A</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>C</td>
<td>--</td>
<td>--</td>
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<td>--</td>
<td>--</td>
<td>--</td>
<td>R</td>
<td>--</td>
</tr>
<tr>
<td>D</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>A</td>
<td>C</td>
<td>--</td>
<td>A, G, S</td>
</tr>
<tr>
<td>E</td>
<td>--</td>
<td>--</td>
<td>R</td>
<td>C, P</td>
<td>0</td>
<td>A</td>
<td>C</td>
<td>--</td>
<td>C</td>
</tr>
<tr>
<td>G</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>A</td>
<td>--</td>
<td>C</td>
<td>C, P</td>
<td></td>
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<tr>
<td>I</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>A</td>
<td>0</td>
<td>0</td>
<td>R</td>
<td>--</td>
</tr>
<tr>
<td>J</td>
<td>--</td>
<td>C</td>
<td>R</td>
<td>R</td>
<td>0</td>
<td>C</td>
<td>0</td>
<td>--</td>
<td>C, S</td>
</tr>
<tr>
<td>L</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>A</td>
<td>R</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Key

-- Period absent or not observed

P, Pottery present
G, Glass present
S, Sea shells present

Obsidian artifacts
0, None
R, Rare
C, Common
A, Abundant

¹. The survey data from Areas F, H, and K is not complete enough to be included in this table.
Table 4. Distribution of Cultural Material in Test Pits by Period
(For locations see Figure 3)

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>TEST PIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7a 7 8</td>
</tr>
<tr>
<td>I</td>
<td>-- -- 2 3 1 3 3 -- 1</td>
</tr>
<tr>
<td>II</td>
<td>-- 1 1 1 0 1 -- 0 0</td>
</tr>
<tr>
<td>III</td>
<td>-- -- 1 1 0 3 -- 2 0</td>
</tr>
<tr>
<td>IV</td>
<td>-- -- 1 3 -- -- -- 1 0</td>
</tr>
<tr>
<td>V</td>
<td>-- -- 3 3, P 0 1 -- 1 0</td>
</tr>
<tr>
<td>VII</td>
<td>-- 3 3 1, P 2 3 -- 2 1</td>
</tr>
<tr>
<td>VIII</td>
<td>-- -- -- 2, P -- -- -- --</td>
</tr>
<tr>
<td>IX</td>
<td>-- -- -- 2, P -- -- -- --</td>
</tr>
<tr>
<td>X</td>
<td>-- -- 2 -- -- 3 -- 0 0</td>
</tr>
<tr>
<td>XI</td>
<td>-- -- -- 0 1 1 -- 0 0</td>
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<tr>
<td>XII</td>
<td>-- -- 1 1 1 3 -- 1 0</td>
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<tr>
<td>XX</td>
<td>-- -- 2 -- 1 3 -- 2 2</td>
</tr>
<tr>
<td>XXI</td>
<td>-- -- 3 0 0 2 -- 0 0</td>
</tr>
<tr>
<td>XXII</td>
<td>-- 1 0 2 0 1 -- 0 0</td>
</tr>
<tr>
<td>Total Ranks</td>
<td>-- 5 19 19 6 24 3 9 4</td>
</tr>
</tbody>
</table>

**Key**

-- Period absent

P, Pottery present

Obsidian artifacts
0, None
1, (1-10)
2, (11-30)
3, (31+)