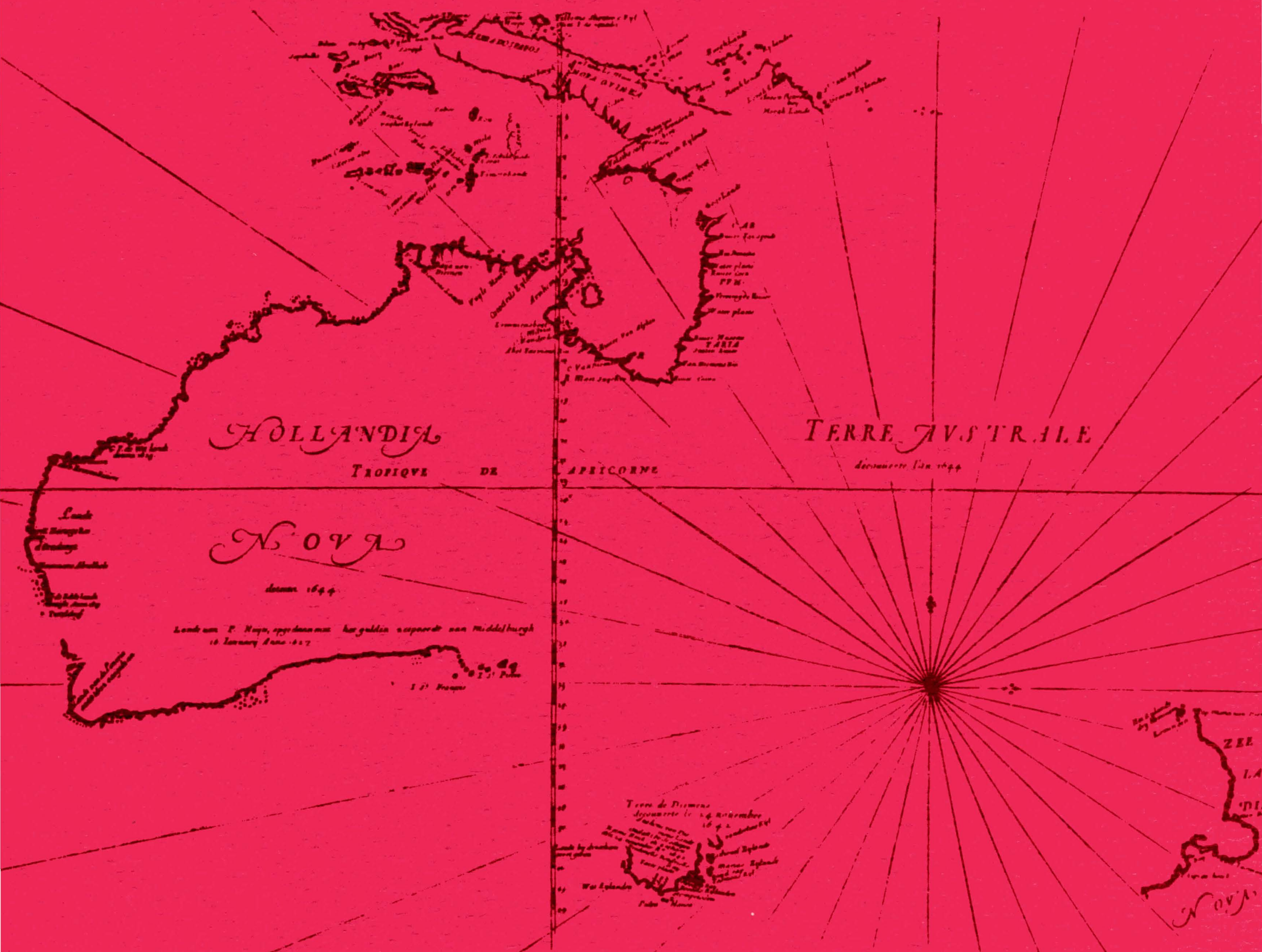
Archaeology in Eastern Timor, 1966-67

Ian Glover



TERRA AUSTRALIS
11

Department of Prehistory
Research School of Pacific Studies
The Australian National University

Terra Australis reports the results of archaeological and related research within the region south and east of Asia, though mainly Australia, New Guinea and Island Melanesia - lands that have remained *terra australis incognita* to generations of prehistorians.

Its subject is the settlement of the diverse environments in this isolated quarter of the globe by peoples who have maintained their discrete and traditional ways of life into the recent recorded or remembered past and at times into the observable present.

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Department of Prehistory, Research School of Pacific Studies
The Australian National University, Canberra
1986

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FOREWORD

The fieldwork reported in this memoir was completed in 1966 and 1967, in what was then Portuguese Timor. It was the first major attempt at systematic archaeological investigation in Timor, the largest of the Lesser Sunda Islands. Like New Guinea, it was a major land mass in proximity to the Australian continent. The Timor project was an essential unit in a series of projects developed during the 1960s by prehistorians at the Australian National University, which, amongst other research, saw the completion of this doctoral thesis, another in New Guinea and three in the top end of the Northern Territory.

One of the pressing needs 20 years ago seems an elementary issue today - to establish the antiquity of Australian prehistory. Linked with that object, and in keeping with the mild diffusionist models of that time, was the attempt to date changes in stone and bone tool technology, and to determine whether certain innovations first developed outside Australia. Another major interest related to the origin of ceramics in Melanesia and Island Southeast Asia. What relationship existed between different pottery traditions and the dating and development of horticulture? As research progressed, these individual projects diverged and developed their own momentum. The doctoral projects of J. Peter White in New Guinea (*Terra Australis* 2), Carmel Schrire in Arnhem Land (*Terra Australis* 7) and this volume, were all pioneering research within this ambience.

Ian Glover completed a distinguished honours degree in anthropology at the University of Sydney. He was one of the first prehistorians in Australia to apply statistical techniques to the analysis of stone artifacts. His period as a research scholar at the Australian National University involved him in 10 months fieldwork in Timor. This research played an important part in re-activating systematic archaeological research in Island Southeast Asia, which had largely ceased with the Second World War. In 1970, Ian Glover was appointed as Lecturer in South Asian Archaeology, at the Institute of Archaeology, University of London. For several years he conducted field research in Sulawesi and he has published the results in a number of papers. Currently, his area of research is in Thailand.

D.J. Mulvaney

PREFACE

The fieldwork on which this monograph is based was carried out in East, then Portuguese, Timor, over a period of 10 months between November 1966 and December 1967, while I held a research scholarship from the Department of Prehistory, Research School of Pacific Studies, Australian National University.

This monograph is based on my PhD dissertation, 'Excavations in Timor: a study of economic change and cultural continuity in prehistory', which was submitted in 1972 to the Department of Prehistory, Research School of Pacific Studies, Australian National University. Despite an early understanding to publish a revised version of that thesis in the *Terra Australis* series, various factors, including my teaching commitments in London and involvement in further archaeological research in Indonesia and Thailand, inhibited any action on the project. A two month visit to Canberra from September-October 1980 provided an opportunity to revise my thesis for publication.

In considering the scope of the revisions to be made, it seemed that I had two alternatives. Firstly, to take the opportunity while I was in Canberra where the excavated collections were then housed, of restudying the material with a more experienced eye and bringing the discussions up-to-date by including consideration of problems arising out of the field research of the past 10 years. Or secondly, of presenting the thesis essentially unchanged and set in the context of the problems and state of research in Southeast Asian archaeology as they were in the mid-1960s. Two months was insufficient time for the first task and so I have taken the latter option. The development of prehistoric archaeology in Indonesia has not been so rapid as to render valueless the discussion in my thesis of 1972 and, as a consequence of the unhappy political events in Timor after the collapse of Portuguese colonial rule, the coup d'etat, and the incorporation of eastern Timor into Indonesia, no further archaeological research of substance has been undertaken there.

There have been two important publications on Timor in recent years: Metzner's (1977) detailed study of the environment, land use and settlement patterns in the Baucau-Viqueque region where most of the archaeological survey and excavation was undertaken, and Sherlock's valuable *Bibliography of Timor* (1980). These two volumes have provided additional, and in many cases more accurate information which I am glad to acknowledge.

For this monograph I have condensed, and in some places updated Chapter 1 on archaeological problems in Southeast Asia, and I have cut down considerably on Chapter III which deals with preliminary surveys and test excavations. For details of the many sites identified, but not extensively excavated, interested readers should refer to the earlier publication. And what was Chapter IX in the thesis has been omitted entirely from this volume. In that section I discussed the excavations undertaken by Dr Alfred Bühler of the Museum für Völkerkunde, Basel, at Soe (Su), Nikiniki and Baguia, by W.J.A. Willems of the Oudheidkundige Dienst, Batavia at Ulnam Cave in northwest Timor, by Father Th. Verhoeven at Liang Djenilu and Liang Leluat II on the South Belu Plain, western Timor, and by Antonio de Almeida at Lene Hara Cave, Tutuala at the eastern tip of the island. I have published elsewhere (Glover 1972c) an appreciation of Bühler's pioneering work, and for details of the other research the original sources should be consulted.

Chapter V of this monograph has a new section which provides an analysis of the molluscs found at Lie Siri Cave. This has been written by Emily Glover who identified the molluscs with the help of Dr John Taylor of the British Museum of Natural History. And the analysis of molluscs in Chapter VI on Bui Ceri Uato Cave has been revised by Emily Glover in the light of new taxonomic data and better knowledge of the ecology of the various species. However, it has not been possible to re-examine the Bui Ceri Uato mollusc samples themselves which are housed in the Australian Museum, Sydney.

Volume 2 of the thesis contained the plates and 10 appendices of which only numbers 2-4, and 10 have been retained here. The other appendices contained supplementary information on the fauna of Timor, stone tool attribute lists and catalogue numbers, and a not very convincing statistical comparison of side scrapers from two Timorese sites, Uai Bobo 1 and Uai Bobo 2, and a collection from Lake Mungo, Australia. For the rest, this monograph presents, with only cosmetic changes, my 1972 thesis.

The large sub-fossil murid collections have been deposited with the Australian Museum in Sydney, and the identified bat remains are held in the Australian National Wildlife Collection, Division of Wildlife Research, CSIRO, Gungahlin, ACT. Bones of larger and domesticated land mammals are at present held by the Department of Anthropology, University of Otago, Dunedin, New Zealand, and will finally be deposited at the Australian Museum, Sydney.

Examples of modern pottery from eastern Timor and all the excavated assemblages of stone artifacts and pottery have been deposited at the Australian Museum, Sydney. The original artwork of maps, plans, artifact and section drawings reproduced in this volume are held in the archives of the Department of Prehistory, Research School of Pacific Studies, Australian National University.

Ian Glover

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Archaeological research requires the cooperation of many people and I am grateful for the opportunity to thank those who freely gave of their experience, time, and often material support, to help me complete the work. In my thesis I listed most of the people who directly aided my research; a list which came to four pages. I am sure that they will show forebearance if their names are omitted here. I must, however, mention two people in Timor who were very closely involved in the work, Sr. Manuel Bello, *livrai* of Suco Tirilolo who personally led me to many valuable archaeological sites, and Sr. Placido Lourdes Costa Perriera, my driver and field assistant. I have no idea how they have fared following the Indonesian take-over of East Timor, but I hope that they are well and as prosperous as circumstances permit.

I should like to thank my supervisor, Professor D.J. Mulvaney, for his constant encouragement, and Professor Jack Golson for his informed advice on the archaeological problems of Southeast Asia, and for his constructive criticism, and Miss Winifred Mumford for her careful and elegant drawings of stone tools and maps.

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Ian Glover

CONVENTIONS

ORTHOGRAPHY

The spelling of Timorese names has presented considerable problems since three orthographic systems are, or have been, used in Timor; Dutch, Portuguese and modern Indonesian. Where names appear on published maps I have used modern Indonesian for places within West Timor, e.g. Su and Ulnam, not Soe and Oelnam, and Portuguese for East Timor (e.g. Viqueque not Vikek). For places and proper names which I have not found in print I have been less consistent, and have mostly accepted spellings given to me by Timorese informants, who used a modified Portuguese orthography, unless the spelling is quite inconsistent with the sounds I heard. Thus I have used Uai Ma'a for the language of the Baucau Plateau and not Waimaka, which would be the modern Indonesian. In Portuguese a cedilla is used in many instances where 's' would be used in Indonesian.

SITE CODES

The following code was used for the four excavated sites:

TL	Lie Sirie
TB	Bui Ceri Uato
TO1	Uai Bobo 1
TO2	Uai Bobo 2

ABBREVIATIONS

ANU	Australian National University
CNL	Chambered Nautilus Newsletter
CSIRO	Commonwealth Scientific and Industrial Research Organization
HCl (dil.)	Hydrochloric acid at normal concentration
INRI	Iezus Nazarenus Rex Judaeorum (Jesus of Nazareth, King of the Jews)
MHR	Member of the House of Representatives
Munsell	Munsell Soil Charts
RSPacS	Research School of Pacific Studies
USA	United States of America

Ian Glover

I ARCHAEOLOGY IN SOUTHEAST ASIA

INTRODUCTION

The archaeological problems which led to my fieldwork in Timor are discussed below and the data resulting from excavation and analysis are presented in Chapters V-VIII. Field archaeology, however, is not an experimental science, and results often depend on the vagaries of fortune in the field. Finds may be irrelevant to initial problems, and hypotheses have to be tailored to fit. The extent to which this is the case here may be judged by comparing the research aims set out below and the conclusions in Chapter IX. For some problems the evidence was negative or irrelevant, for some inconclusive, and for only two of the original problems were the data consistent and unequivocal. On the other hand, the finds and analysis produced new problems not previously envisaged; not all of which have been satisfactorily solved. It is easy to claim that one's work is exploratory, pointing the way for future research, that conclusions are tentative and provisional. And considering the very small amount of archaeological research in island Southeast Asia, this must be the case. However, there is an onus on the archaeologist in such a situation to state clearly what he thinks the data mean and to provide enough information for his interpretation to be examined by other workers. Evidence from excavation is normally fragmentary and ambiguous and its implication for social and economic history is seldom clear-cut and self-evident. I am well aware that other explanations to those offered in this monograph are possible and may be preferred by other archaeologists. I make no apologies, therefore, for the interpretations put forward; they are, to me, the most satisfactory explanations of what I found, seen in the context of the present knowledge of prehistoric cultural development in Southeast Asia.

RESEARCH AIMS

In 1966 and 1967 I spent 10 months locating and excavating archaeological deposits in the eastern part of Timor, the largest of the Lesser Sunda Islands (Fig.1). The principal aim of the excavations was to recover sequences of stone and pottery artifacts and bone food remains from the main environmental zones, in order to date the principal technical and economic changes in the eastern end of the island, and to provide a chronological framework to which surface finds and undated excavated material could be related.

Archaeology in Timor was intended to investigate a number of problems relating to the role of the Lesser Sunda Islands in the Pleistocene and later immigrations into Australia, and the effect of the sea barriers in eastern Indonesia on the later expansion of agriculture from Southeast Asia.

Between mainland Southeast Asia and Australia lies the world's most pronounced zoological barrier, separating as it does the 'extraordinarily different' Oriental and Australian faunal regions (Darlington 1957:462). A.R. Wallace, one of the first zoogeographers, recognised the importance of this barrier and it has been the focus of attention for generations of workers after him.

The area between mainland Southeast Asia and Australia can be divided into three major regions (Fig.2). The Asiatic continental shelf, sometimes called Sunda Land, which, during much of the Pleistocene, was part of the mainland, and included the four important islands of Sumatra, Java, Borneo and Palawan. To the south, there is Australia, New Guinea, and the drowned continental shelf, sometimes known as Sahul Land. Between the two continental land masses lies an intermediate area of numerous islands often separated by deep troughs, which is called Wallacea (Dickerson *et al.* 1928:101). Despite the tectonic instability of this region, the evidence from geology (Audley-Charles 1968:1) and from the faunal distributions, particularly those of freshwater fish (Darlington 1957:463), shows that there have been no through land connections from Sunda Land to Sahul Land since the Permian at least. Even

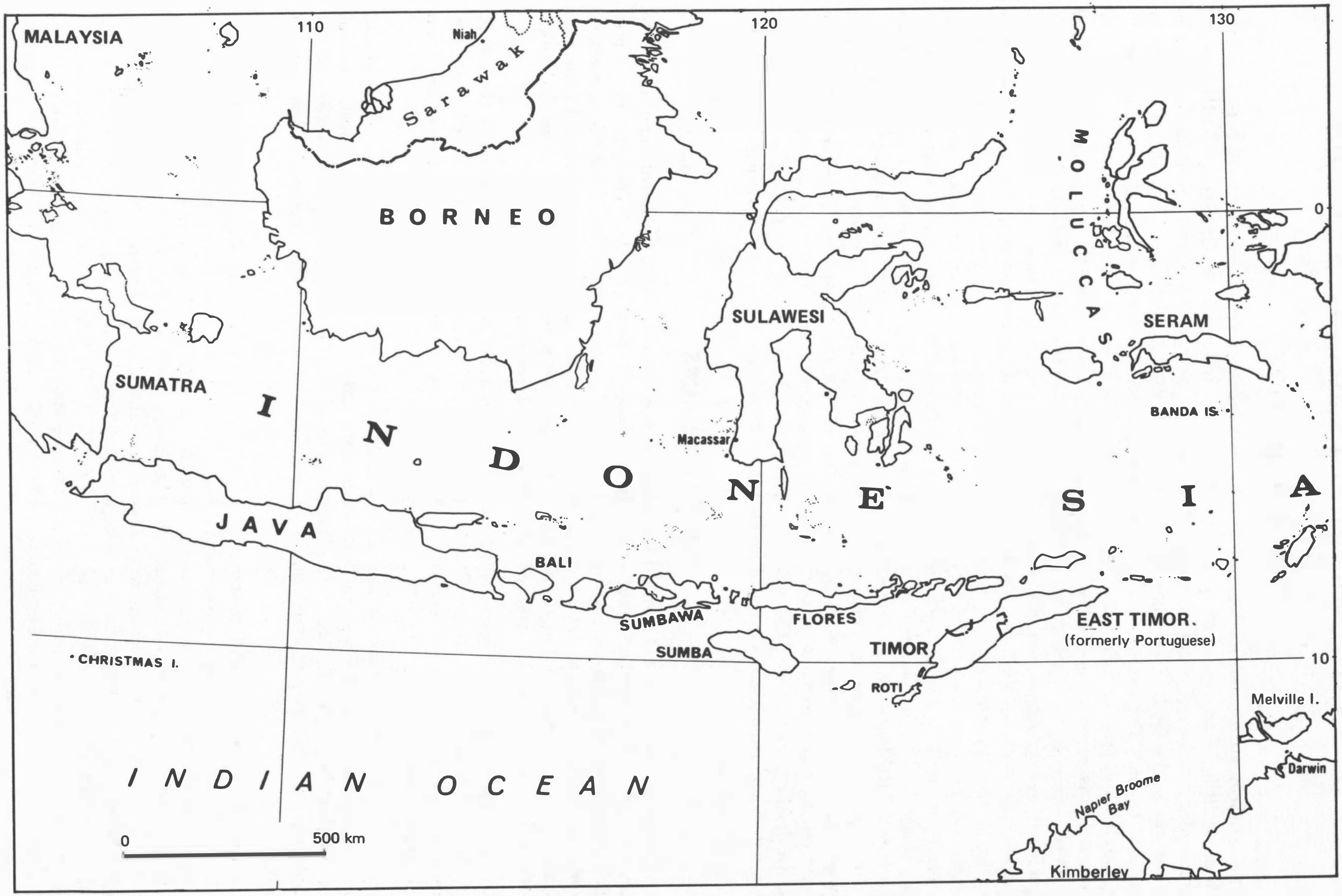


Fig.1 **Island Southeast Asia, excluding the Philippines**

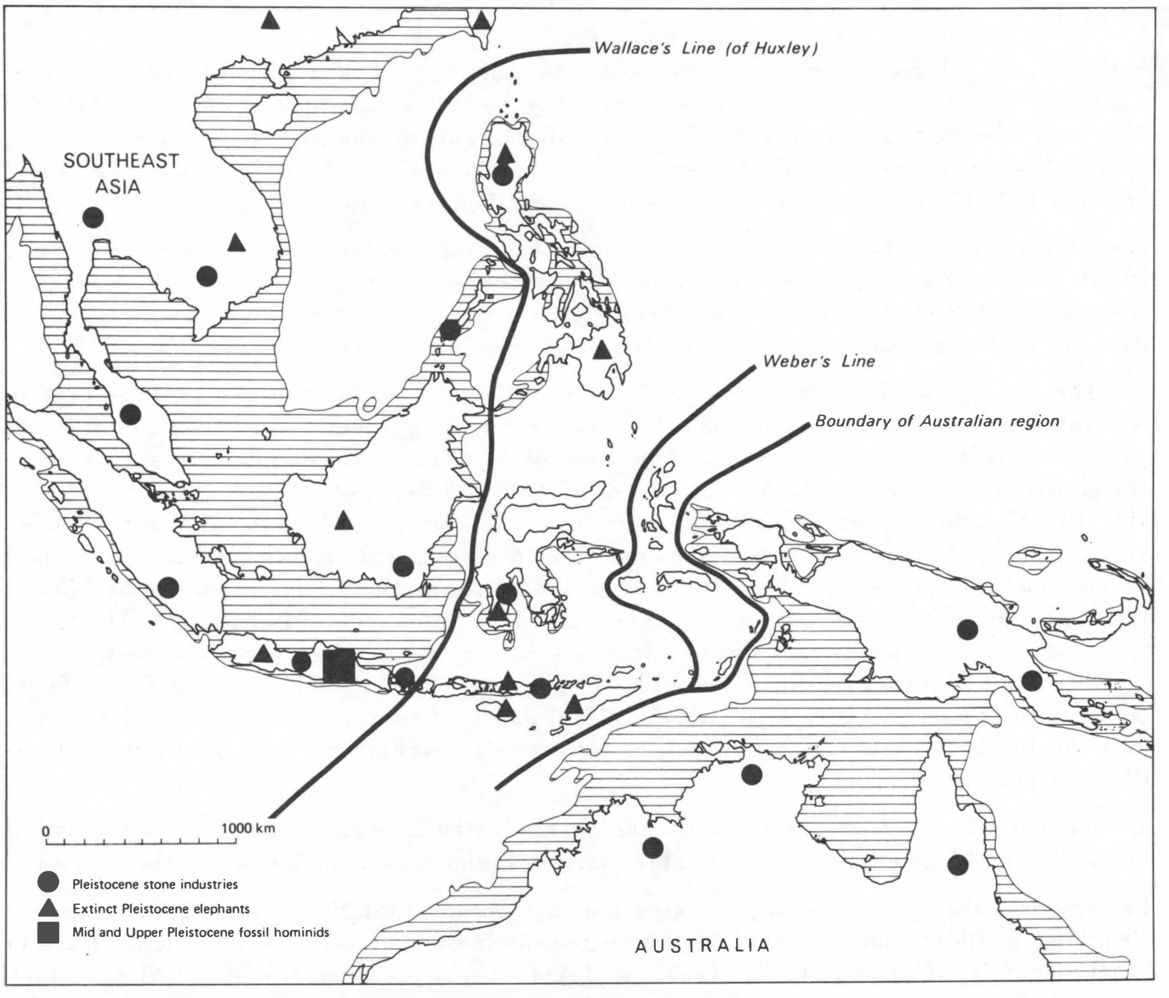


Fig.2 **Island Southeast Asia, showing the probable extent of land exposed during the height of the last glaciation, about 30,000-15,000 years ago. Major faunal breaks occur at the boundaries of the Pleistocene land continents, Sunda Land and Sahul Land, while Weber's Line marks the line of faunal balance (after Mayr 1945). (Compiled jointly with R. Jones)**

the narrow straits separating Bali from Java have been an effective faunal barrier for a very long time, since Bali has only a small fraction of the Javan fish fauna (Darlington 1957:51).

Scrivenor *et al.* (1943), Mayr (1945) and Darlington (1957:462-74) discuss in detail the zoogeographic meaning of Wallacea and the effectiveness of the various water barriers to the passage of animals, and Keesing (1950:103-4) has discussed the implications of the water barriers and land bridges between these regions for the Pleistocene settlement of Sahul Land. Shepard (1961:31) has estimated the sea level to have been some 350-400 ft (107-122 m) lower 15,000 years ago, and recent work on the Sahul shelf (Andel and Veevers 1967:100-2) confirms the view that during the last glacial maximum the Sahul shelf linked Australia and New Guinea and advanced the frontiers of this continent towards, and probably within sight of Timor, the most southerly island in Wallacea. See also Chappell (1976) for a more recent discussion of late Quaternary palaeogeography.

Knowledge of the prehistory of this region (Heekeren 1972:106-32) was not such that problems could be defined narrowly and sites sought to answer them, but it was expected that some light might be thrown on the following problems:

1. The timing of the primary settlement of Australia and the anatomical status of the first migrants.

Today Timor is basically Indonesian in culture and race but the island has often been cited as a possible migration route for Pleistocene man into Australia and Melanesia (Birdsell 1957:60; Mulvaney 1961:62; Macintosh 1963), and a number of anthropometrists have claimed to have found Melanesoid and Australoid characters among the peoples of the interior of the island (Bijlmer 1929:19-20; Nyessen 1945; Keers 1948; Bork-Feltkamp 1951).

Recent finds of fossils in Australia have shown that the continent was settled earlier than 30,000 BP by *Homo sapiens* of a type not markedly different from modern Australian Aborigines (Bowler *et al.* 1970). But about the same time, or perhaps even later, a type (e.g. Kow Swamp) morphologically more primitive was also living in Australia (Thorne 1976).

2. The dating and immediate origin of a series of technical innovations which appear in Australian stone industries about or before 5000 BP and for which there is some evidence to indicate an origin outside Australia. This will not be discussed in detail here as it has been adequately treated by Mulvaney (1961:79-83, 1975:223-31), White and O'Connell (1979, 1982:106-25) and Glover and Presland (1985). The question relates to the fairly sudden appearance in Australia of two new stone tool traditions, the one characterised by small backed blades often called microliths (Glover and Lampert 1969), and the other by bifacial and unifacial points, and perhaps the tula adze type (Mulvaney 1975:233-35). These tool types have markedly different distributions within Australia. Generally similar tools are found in parts of Indonesia; small backed blades in south Sulawesi and west Java and unifacial points in both west and east Java (Glover 1973a) and so there is at least prima facie evidence to indicate more than one movement of men and/or techniques into Australia in post-Pleistocene times.

3. The spread of pottery, horticulture and domesticated animals such as pigs into eastern Indonesia and Melanesia from, presumably, western Indonesia and mainland Southeast Asia.

Prompted by the hypotheses of plant geographers (Vavilov 1951:20-48; Sauer 1952; Anderson 1960; Harris 1967), some workers have been re-examining the development of agriculture in Southeast Asia. Gorman (1969a, 1969b) and Yen (1977) produced the first evidence which has been used to support the suggestion that plant cultivation has a longer history in the region than historians and archaeologists have usually been willing to admit, and that a completely independent evolution of agriculture may have taken place in the region bounded by south China, eastern India and Indonesia, at a time more or less contemporary with the classical 'neolithic revolutions' of Southwest Asia and Meso-America. Such a development would have revolutionary implications for the understanding of Asian history. Although it is not thought that Timor would have been in the nuclear area of Southeast Asian agriculture, an expansion from this core area would have affected Timor and would be observable in the archaeological remains.

4. The dating and more exact definition of the prehistoric culture found in western Timor by Bühler, Willems and Verhoeven (Sarasin 1936; *Oudheidkundig Verslag* 1939:12-13; Verhoeven 1959).

Pioneer archaeology in Timor by Alfred Bühler in 1935 revealed a distinctive flaked stone industry which has been difficult to date, or to relate to material subsequently found in Indonesia. A re-evaluation of Bühler's research has been published separately (Glover 1972c).

5. The composition of the endemic land fauna of Wallacea and the dating of various species of larger mammals. Mammals such as *Macaca fascicularis*, *Cervus timorensis*, *Phalanger orientalis* and *Paradoxurus hermaphroditus* are thought to be introduced by man. Apart from the recent finds of *Stegodon* fossils in Flores, Timor and Sumba (Hooijer 1957, 1967, 1969; Verhoeven 1964), it is widely believed by mammalogists and zoogeographers that the only placental mammals to breach the Wallace Line independently of man were various murid rodents and bats (Laurie and Hill 1954:86; Darlington 1957:322-24, 467).

DEVELOPMENT AND INTERPRETATIONS OF SOUTHEAST ASIAN PREHISTORY

In the 20 years before the Second World War, Southeast Asia was an area of active prehistoric research. Exciting finds of fossil hominids in Java made the region rival Africa in importance for the study of the origin of man. From later periods, widespread similarities were found between Indo-China, Malaya, Java and Sumatra in a series of artifact assemblages which enabled European-oriented archaeologists to reconstruct prehistory on the familiar framework of Palaeolithic, Mesolithic, Neolithic and Bronze Ages. These stages, together with analyses of existing languages and physical types, were used to explain the diverse cultural and racial patterns found in the area, the relationships with China and India and to provide provisional dates for the various phases of cultural development within the region which are generally dependent on correlations or analogies with China and western Asia. The last cultural developments were thought to have been the result of successive waves of migration towards the Indonesian region from vaguely defined areas of south China and mainland Southeast Asia, each brought by a different racial type; melanesoid, proto-Malay, and deutero-Malay, each with distinct languages and cultures. The results of this pre-war archaeology have been published and discussed in numerous books which are well summarised and listed in Heekeren (1958, 1972) and they will not be discussed in detail here.

Since 1945 political and economic disturbances have slowed down the pace of archaeological work which only now is beginning to match that of the pre-war years. From new data being acquired and from more sophisticated methods of excavation, dating and analysis, there has come a realisation that our present understanding of Southeast Asian prehistory depends, in many instances, more upon the cultural preconceptions of European historians and archaeologists than on the archaeological data themselves. Solheim (1967, 1969) was one of the first to recognise this, and has shown how new archaeological data combined with a reappraisal of the old is leading him to a fresh synthesis of the development of culture in Southeast Asia, and its implications for our understanding of Asian history.

The issue, at its simplest level, can be stated thus: was Southeast Asia merely a passive cultural backwater, of interest only because of its position between the great foci of Asian civilisation, India and China? Or was it an area of autochthonous development with its own dynamics, 'contributing much to world culture and in particular, contributing the foundation for north Chinese culture and its later expansion' (Solheim 1969).

The view until recently, as I see it, has been close to the first proposition. J.G.D. Clark, in an influential attempt to write a prehistory of the world, has said:

> one of the main reasons why the mainland of Southeast Asia merits study is that it forms a kind of funnel through which peoples have spread over Indonesia, Melanesia and farther afield. Another is its intermediate position between the two main foci of culture in India and China respectively [1962:201].

In 1968 Clark described Southeast Asia as one of the 'most unenterprising', and 'particularly backward' parts of the late Pleistocene world (Grahame Clark 1968:22, 28). And in the second edition of *World Prehistory* (Clark 1969:233), while admitting that Southeast Asia was the home of rice cultivation, Clark assumed that this was only undertaken under the stimulus of northwest Chinese civilisation. Even the appearance of pottery in a late Hoabinhian context is ascribed to an intrusive neolithic culture (Clark 1969:234); the same interpretation as that given by Mansuy (1925:56) more than 40 years earlier for the presence of edge-ground tools in this culture.

A.H. Christie, less influential, but at least a specialist in Southeast Asian history, has asserted that:

> little appears to have been invented in South East Asia .... Its importance lies in

> the survival of cultural traits and its position between the cultural spheres of China and India ... [Christie 1961:291-92].

Solheim's case, that scholars have been grossly biased by their 'western European, essentially Victorian, upbringing' (Solheim 1967:896) is, I think, a good one and it is interesting to see that in a study of early Chinese civilisation Treistman (1968:853) argued that not only are classical Chinese histories biased towards a north Chinese view of things, but that modern archaeologists, European and Chinese, have accepted this bias and interpreted prehistoric cultural development in east Asia as the result of a series of enlightening waves of north Chinese civilisation.

In late prehistoric and early historic times it is evident that Southeast Asia was profoundly influenced by Indian and Chinese civilisation. The spread of Buddhism to western Indonesia, Thailand, Cambodia, Vietnam and China and the dominance of Chinese cultural forms in North Vietnam during the past 2000 years are obvious examples, but it is unwise to interpret prehistoric cultural developments in terms of the recent past alone.

The detailed examination of dated archaeological sequences from these various regions should provide a better guide for writing cultural history and explaining its processes than an uncritical acceptance of a variant of the *ex oriente lux* theory. Unfortunately, reliably dated archaeological sequences are rare in Asia and those that are starting to appear in China, Japan, Thailand, Taiwan, Australia and Melanesia are at such odds with the previously accepted chronologies for these areas that drastic reinterpretations of the prehistories of these areas are becoming necessary.

THE NEED FOR MORE RELIABLE DATA FROM INDONESIA

Inadequate data and cultural preconceptions have, in the past, led European-trained archaeologists to underestimate the interest and importance of Southeast Asian prehistory. The main problem, until recently, has been the lack of stratified and dated regional sequences and a concentration of the spatial distributions of chance finds of prehistoric objects, items of recent material culture, art styles, languages and racial types as a substitute for them. These are important, but it is essential that regional chronological frameworks are constructed on a sounder basis and that greater attention be paid to the stratigraphy, description of total assemblages, as well as to the ecological aspects of prehistoric sites. In the past few years such work has been undertaken at a number of sites in mainland Southeast Asia, Taiwan, Borneo, the Philippines and Melanesia.

Economic and political conditions in Indonesia since 1945 unfortunately have been such that continuous and detailed archaeological work on prehistoric sites has not been possible. Short of money and trained personnel, the Indonesian National Archaeological Service wisely concentrated on maintaining and repairing the great monuments of the Hindu-Buddhist period. Some work has been done, despite these difficulties, in prehistoric studies, notably by Heekeren in Sulawesi, R.P. Soejono in Java and Bali, Verhoeven in Flores and Timor, Jacob on hominid palaeontology, and more recently by G-J. Bartstra on palaeolithic sites in Java and Sulawesi.

Archaeological interest in Timor and the other islands of eastern Indonesia derives largely from their position, intermediate between Sumatra, Java and Borneo on the Sunda shelf, and Australia and New Guinea, both part of the same continental land mass throughout much of the Pleistocene. The primary settlement of the latter region almost certainly came from Sunda Land via some or all of the intermediate islands, and recent finds of extinct Pleistocene mammals in Flores, Sumba and Timor and an archaic flaked stone industry (Hooijer 1957, 1969; Verhoeven 1964) in these islands lends support to this belief. In mid-Recent times the development of horticultural societies in New Guinea (Brookfield and White 1968; Golson 1976) and the appearance of new traditions in Australian stone industries suggests renewed contacts with island Southeast Asia.

ARCHAEOLOGICAL RESEARCH IN TIMOR

In 1935 Alfred Bühler made a series of excavations in caves in Timor which revealed a culture using flaked stone tools and pottery and apparently with domesticated animals. This was described as 'neolithic' and dated from immediately before the arrival of Europeans in Southeast Asia (Sarasin 1936:32-34; Glover 1972a). In 1938 Willems of the Oudheidkundige Dienst found the same culture in Ulnam Cave in West Timor (*Oudheidkundig Verslag* 1939:12-13), and in 1954 Father Th. Verhoeven excavated two caves with related material from the eastern part of West Timor (Verhoeven 1959).

The Portuguese anthropologists Correa, Almeida and Cinatti have found stone tools on the north coast of East Timor, some of which they claim to be lower and middle Palaeolithic (Correa *et al.* 1956). Almeida has also excavated Lene Hara Cave at the far eastern tip of East Timor which yielded a rather amorphous stone industry, apparently predating the appearance of pottery (Almeida and Zbyszewski 1967:57-58). In addition, Verhoeven (1964) and others have found fossilised bones of an extinct megafauna eroding from gravel terraces near Atambua in central Timor. I have discussed the significance of these finds elsewhere (Glover and Glover 1970; Glover 1973b) and since they are clearly far older than any of the material found during my 1966-67 fieldwork, they will not be discussed further in this monograph.

The situation, then, when I started research in Timor was that a number of casual finds had been made, there had been a few unrecorded or unsystematic excavations, and one relatively orderly program of survey and excavation had been undertaken by Bühler 30 years previously. There was no reliable chronology, few organic remains had been recovered and it was impossible to recognise any patterns of cultural change, innovation or adaptation to the diverse environments of Timor.

II TIMOR: THE PHYSICAL AND SOCIAL ENVIRONMENT

PHYSICAL ENVIRONMENT

Geology and landforms

Timor is the largest island in the non-volcanic Outer Banda Arc, which also includes the islands of Buton, Buru, Savu, Semau, Roti, Leti, Tanimbar, Kai and Seram. Although Timor today is surrounded by deep ocean troughs, the region has been marked by crustal instability since the Cretaceous and the recent finds of Pleistocene megafauna already referred to suggest that the island may have been connected with Flores and Sulawesi at some time in the early Pleistocene. At the same time the geological evidence is against Timor ever having been part of or even in close proximity to the Asian or Australian continents since Permian times (Audley-Charles 1968:1).

The island is characterised by steep relief with many peaks over 2000 m more or less aligned down the centre. Rivers are short and steep and run north and south from the central ranges. Coastal plains are not well formed although somewhat wider on the south coast. The majority of rocks are of sedimentary origin, limestones, clays, shales and gravels with some igneous rocks and crystalline schists from the Tertiary and Permian (Fig.3). The two formations of greatest archaeological interest are the various limestones, mostly Miocene and Pleistocene, and the Pleistocene, Ainaro, gravels. The latter are poorly represented in eastern Timor, except between Maliana and the upper Lois Valley near the border of East and West Timor (Audley-Charles 1968:P1.13), where they form a continuation of the central basin of western Timor. The *Stegodon* fossils and large flake tools previously referred to probably come from this formation. Some smaller but well exposed terraces belonging to the same formation are recorded at Ainaro and at Cribas in the centre of the island south of Manatuto and these might repay examination for similar materials.

Climate

Timor's climate is ruled by its proximity to Australia. It is strongly seasonal and is generally similar to that of the coastal zone of northern Australia from Arnhem Land to the Kimberleys. However, the high mountain spine of Timor lying at right angles to the main wind directions, produces strong local modifications.

In most areas there is a dry season (rainfall of less than 100 mm per month) of 4-6 months during the southeast monsoon (April to October), although the south-facing slopes get some rain then (Soares 1957:Table XVII). Mean annual rainfall ranges from less than 600 mm on the north coast to over 3000 mm in a mountainous region near the south coast of West Timor (Ferreira 1965:Map 39; Ormeling 1956:Fig.5).

Mean daily temperatures range from 23-31°C at sea level to 15-24°C at 1000 m (Ferreira 1965:Map 38) with some seasonal variation. It is usually a little colder and much windier during the dry season when wind speeds of up to 45 km per hour are common.

Soares (1957:111) has produced a simple but useful classification of the climate which does not distort the data too much and in which he divides East Timor into three zones, a north zone, a mountain zone, and a south zone, each marked by different aspects, elevations, rainfall, temperatures and vegetation patterns. These zones roughly correspond to the three main landforms, the north coastal plains and plateaux, the central mountains, and the southern foothills and alluvial plains.

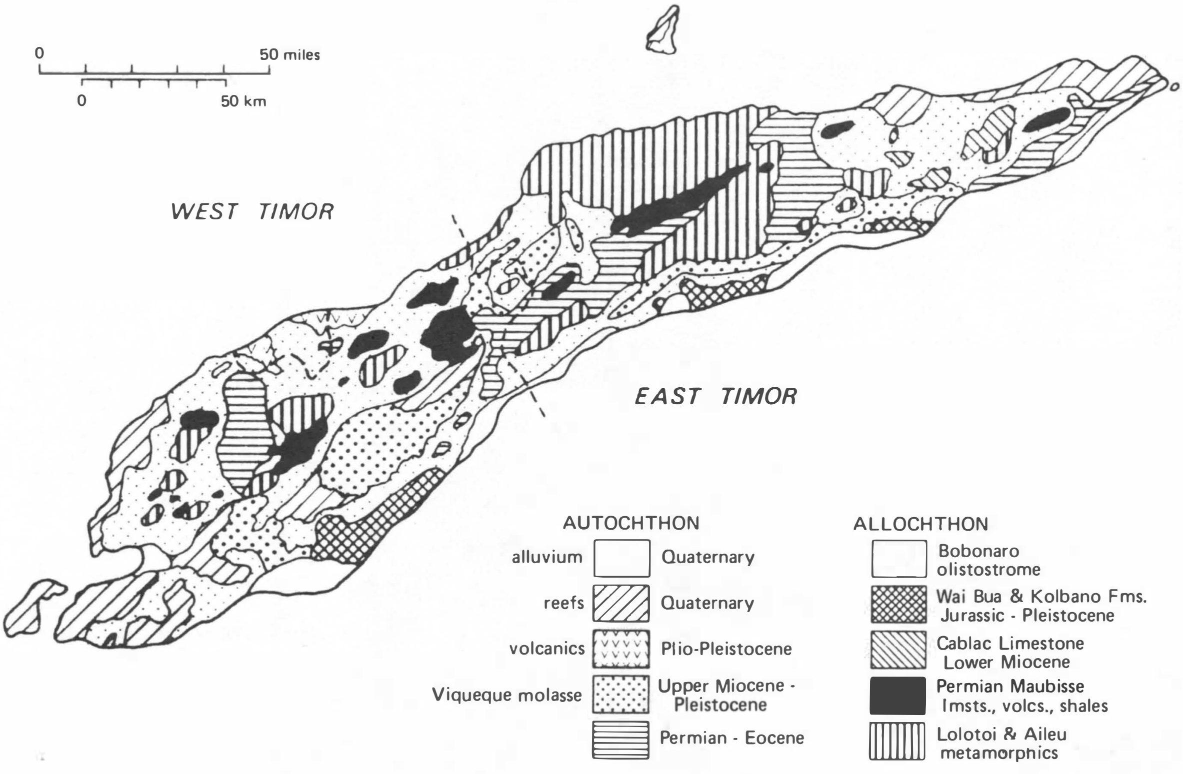


Fig.3a The main geological formations

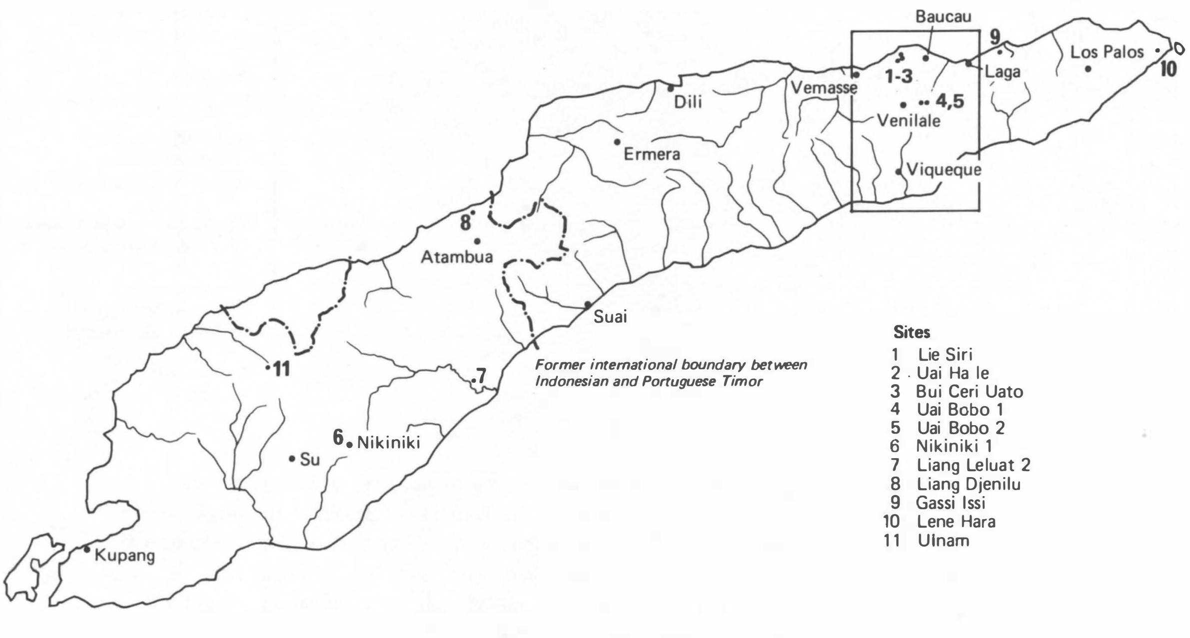
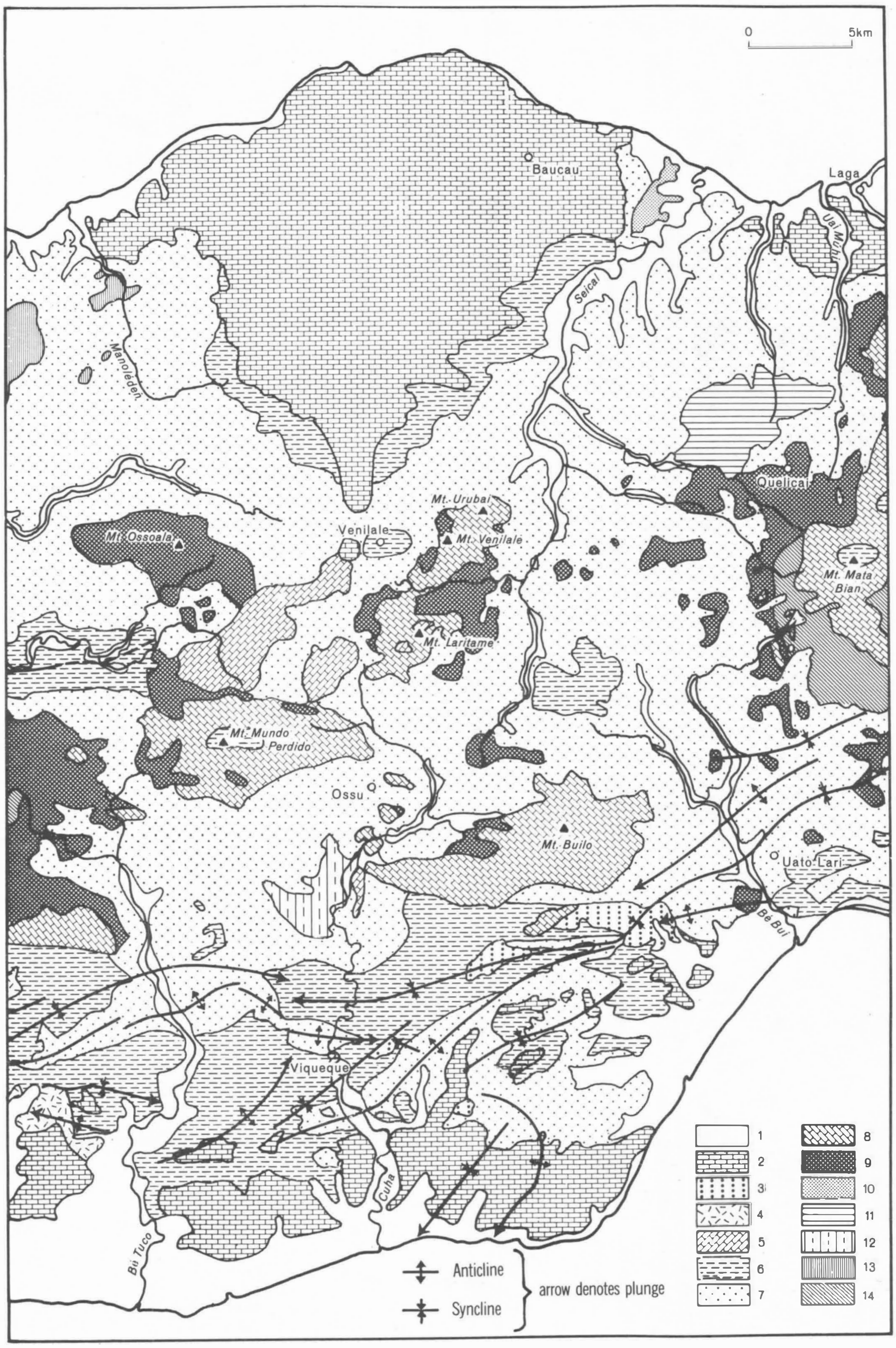


Fig.3b The archaeological sites (1-11), and administrative centres. The boxed area is the Baucau Plateau and Venilale region, enlarged as Fig.3c. Geological details are taken from Audley-Charles 1968, 1986:Fig.5; Carter *et al.* 1976:Fig.7



Pleistocene and Recent
1 Suai formation
2 Baucau limestone

Pliocene
3 Seketo block clay
4 Dilor conglomerate

Upper Miocene
5 Larigutu limestone
6 Viqueque formation

Middle Miocene
7 Bobonaro scaly clay

Lower Miocene
8 Cablac limestone

Oligocene
9 Barique formation

Upper Cretaceous - Lower Eocene
10 Seiçal formation

Middle and Upper Triassic
11 Aitutu formation

Permian
12 Cribas formation
13 Maubisse formation

Pre-Permian
14 Lolotoi complex

Fig.3c **Geological formations of the Baucau Plateau and Venilale region. Metzner's (1977:Fig.11) amendments to Audley-Charles' geological map of Portuguese (East) Timor comprise an extension of the Baucau limestone at the southern tip of the Baucau Plateau, several additional spots of Barique formation in Mundo Perdido and east of Ossu and the Viqueque formation around Venilale. Reproduced with kind permission of J. Metzner, University of Heidelberg**

Vegetation

There is little primary monsoon forest left in Timor except in the extreme southeast and on some of the steeper and more inaccessible mountains in the central ranges, for most of the useful land has been cleared at one time or another for cultivation. In these areas only a few of the useful forest trees survive, such as *Pterocarpus indicus*, *Sterculia* sp., *Aleurites moluccana* and *Tamarindus indicus*.

Below 1000 m repeated clearing and burning at the end of the dry season have generally produced a savanna with little of the original flora. Above that height, where there is a shorter dry season, and on non-calcareous soils, a secondary forest develops where *Eucalyptus urophylla* is a prominent tree species (Ormeling 1956:59; Cinatti 1950:51).

Fauna

Laurie and Hill (1954) list the living wild mammals of Timor as far as they are recorded. However, their list is almost certainly incomplete for rodents and bats (see Appendices 2 and 3).

The domesticated banteng (*Bos sundaicus*) is rare in eastern Timor, but buffaloes, horses, pigs, goats and dogs are numerous (goats and pigs alone outnumber the human population - Agencia Geral 1965:71). Of the larger wild mammals, the Timor or rusa deer (*Cervus timorensis*) is the most common game animal, and monkeys, civet cats (*Paradoxurus hermaphroditus*), and the cuscus (*Phalanger orientalis*) are all plentiful in the better wooded areas, which generally means the mountain zone.

EUROPEAN DISCOVERY, TRADE AND SETTLEMENT

Now a poor and isolated island, Timor was famous in the past as the main source of the finest quality white sandalwood (*Santalum album L.*) which appears to have been traded to western Indonesia and perhaps to India when the first relevant historical records appear in the 2nd or 3rd centuries AD (Wolters 1967:65; Burkill 1935:1954-56). Wheatley lists Timor as a source of sandalwood for China in Sung times (Wheatley 1959:65-66). The earliest known reference to the island in European literature is in *The Summa Oriental of Tomé Pires* written in Malacca about 1515 (Cortesãa 1944:203-4). Tomé Pires notes that before the Portuguese entered the area, trade was in the hands of the Gujerati merchants who sailed south of Sumatra, through the Sunda Strait, on to Timor and the Moluccas 'and came back very rich men' (Cortesãa 1944:46). The Portuguese lost no time entering this profitable trade though they made no settlement in Timor until the end of the 16th century (Castro 1862:470).

The first useful description of the island is given by Pigafetta in 1522 when Magellan's ship, the *Victoria*, called at Timor to refit, probably at the present-day port of Atapupu (Ormeling 1956:39). He recorded the products of Timor as white sandalwood, ginger, buffaloes, pigs, goats, fowls, rice, bananas, sugarcane, oranges, lemons, wax, almonds, beans and gold. Trade goods in demand included red cloth, linen, hatchets, iron and nails (Stanley 1874:151-52). With the addition of guns, this is almost the same list as that provided by George Grey 300 years later for prospective traders to Timor (Grey 1841:283-84). Pigafetta makes no mention of maize, now the most important single crop, nor of horses, which he surely must have seen had they been as common as they are today.

The Portuguese wanted sandalwood principally as an entrance to the rich Chinese market and in the 17th century a flourishing trade developed between Macao, Flores and Timor which enabled the Portuguese to maintain their position against the Dutch in this part of the Indies (Boxer 1948:175-80, 195-96).

In the 18th century trade declined and in 1750 there were reported to be no more than eight

Portuguese on the island apart from a few licentious friars (Boxer 1948:197). The Dutch had by then established themselves in Kupang in the west, and although there was frequent skirmishing between the Dutch, Portuguese and Timorese there was no real attempt to pacify and administer the island until the late 19th century, when it was formally divided between the two colonial powers. Metzner (1977) provides a valuable summary of recent history and colonial administration preceding his analysis of land use, settlement and environmental degradation in the Baucau-Viqueque region.

THE TIMORESE

Physical anthropologists who have worked in Timor all comment on the racial complexity of the population and explain it in terms of varying admixtures of Melanesian, Australoid, Negrito, proto-Malay, deutero-Malay and so on, as well as commenting on the influence of recent immigrants such as Chinese, Arabs, Rotinese, Indian, African, Negro and Europeans (Bijlmer 1929; Nyessen 1945; Keers 1948; Bork-Feltkamp 1951). Correa (1944), on the other hand, sees the variety of physical types as stemming more from the inherent heterogeneity of the populations of eastern Indonesia, than from successive waves of invaders. But all observers agree that the coastal peoples have more Malay characteristics and that the inhabitants of the interior resemble more closely the populations of New Guinea and Melanesia in colour, hair, stature and cranial form, and this should be explained by the later arrival of the Malay groups from the north and west. The distribution of languages lends support to this belief for, as Capell (1944) has shown, the coastal languages generally belong to the eastern Indonesian language family and many languages of the interior do not; these are sometimes called Papuan for want of a better term (Capell 1944:311).

Timor is basically Indonesian in culture and not Melanesian, although it was not directly influenced by the great cultural traditions of western Indonesia, Buddhist, Hindu and Islamic, which have developed there during the past 2000 years. Timorese culture can be distinguished from that of Melanesia by a number of traits such as a developed class system with hereditary chiefs, cattle-keeping, the predominance of cereals including wet rice over root crops, metal working (iron for swords, and gold and silver for ornaments), weaving of cotton, and a partial market economy with the production of goods for sale and export.

The present population of the whole island must be between 1.25 and 1.5 million of which about 650,000 live in the eastern half with a density of about 32 per km^2. Estimates of past populations vary considerably and are difficult to assess (Ormeling 1956:181). Perhaps the most reliable 19th century estimate is Castro's (1862:470) figure of 300,000 for the whole island. Francis (1838:355-60) quite independently calculated a figure of 347,000 for 1831, so it may well be that the present increase only started after colonial pacification ended the flourishing slave trade and the endemic warfare it generated (Ormeling 1956:180). The impact of western introduced diseases must have been felt in the early days of European trade with the island for Pigafetta recording that the 'Portuguese sickness' (venereal disease) was more common in Timor than in any other island of the entire archipelago (Stanley 1874:153).

Apart from towns such as Kupang and Dili, settlement takes the form of scattered house clusters (*cnuas*), representing lineage groups which are organised into 'villages' (*povoaçoes* in East Timor) based on localised patriclans or matriclans (Plates 1 and 2). Six to 10 of these villages make up the largest indigenous political unit (*suco*), under a chief. In the past, shifting alliances between *sucos* threw up kingdoms whose rulers claimed some sort of authority over broad tracts of territory. These states were ephemeral, and depended on the personality and energy of the rulers. In the 16th century, Pigafetta mentions four kings in Timor (Stanley 1874:152); by 1700 there were said to be two empires on the island, Belu in the east and Serviao in the west (Hicks 1968:3), but by the mid-19th century Castro lists 47 kingdoms in the Portuguese half of the island alone (Castro 1862:496). It seems probable that changing patterns of trade in Timor were partly responsible for the growth and decline of these kingdoms. The 16th and 17th centuries were periods of busy trade in sandalwood and

Plate 1 **Fortified house cluster in Beta Nau** ***povoação*****,** ***suco*** **Uma Ana Ico, Venilale** ***posto*****. Uai Ma'a is the main language of the** ***suco*** **although the houses are more typical of the inland Makassai speakers**

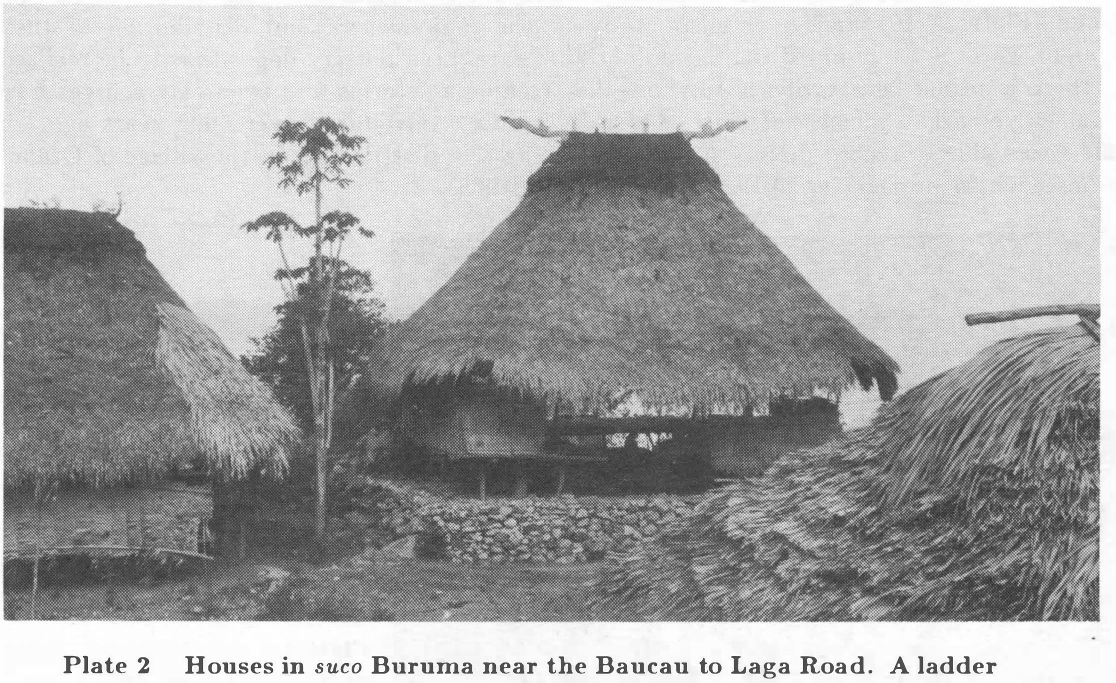


Plate 2 **Houses in** ***suco*** **Buruma near the Baucau to Laga Road. A ladder leads to the main room under the roof which is now used only as an ancestral spirit shrine. Nautilus shells and carved wooden birds decorate the roof-tree**

those chiefs who could organise labour and deliver cut wood to the coast would have gained a near monopoly in the cloth, iron tools and guns traded into the island. Trade declined in the 18th century, the Dutch and Portuguese claimed a greater share of what business there was, and the empires seem to have broken up into petty chiefdoms comprising no more than 3000-4000 people each (Castro 1862:469).

Although Timorese groups share many common features of social and political organisation throughout the island, there are too many variations at the ethnographic level to give more than a brief outline of the aspects of the lifestyle and material culture of the island which are relevant to an archaeological study.

The rhythm of life is dominated by the seasonal needs of swidden agriculture which is practised over much of Timor. Only in a few areas on the coast and in the larger river valleys is *sawah* (ponded rice fields) more than of minor importance, and even there, it is mostly dependent on the strongly seasonal rainfall. Maize, cassava, rice, beans, sorghum, taro, yams, sweet potato and bananas are the staple crops with the *gebang* palm (*Corypha utan*) being an important emergency food in the dry areas when rains fail or come late.

Gardens are cleared and prepared in October and November and planted from November to January at the start of the main rainy season. Maize is harvested from January and dry rice from February when the *sawah* are also prepared for sowing. These are harvested from July to September. August to November is generally a slack period in the gardens and is the time for festivals, travelling and, in the past, for war. Metzner (1977) provides the most detailed and up-to-date study of agriculture in eastern Timor.

A large number of vegetables and tree fruits are grown and local surpluses of these, as well as the staples, are sold or exchanged in the weekly markets held at the administrative posts (Plates 3-6). Pottery, handwoven *ikat* cloths, tobacco, salt, dried fish and hand-made iron tools are also traded at markets which perform important social as well as economic functions.

The pottery is of special interest since it is the most common artifact in archaeological deposits. There are distinct and easily recognisable village pottery styles in present-day Timor (Plates 7-10) and a detailed study of the manufacture and distribution of these different wares is necessary if the full potential of excavated pottery deposits is to be realised, for there is prima facie evidence to show that techniques, forms and even clay sources have remained remarkably constant since the craft was first introduced over 4000 years ago. In 1967 I was able to record details of pottery making and distribution in the village of Oralan, Vemasse on the north coast of East Timor (Glover 1968).

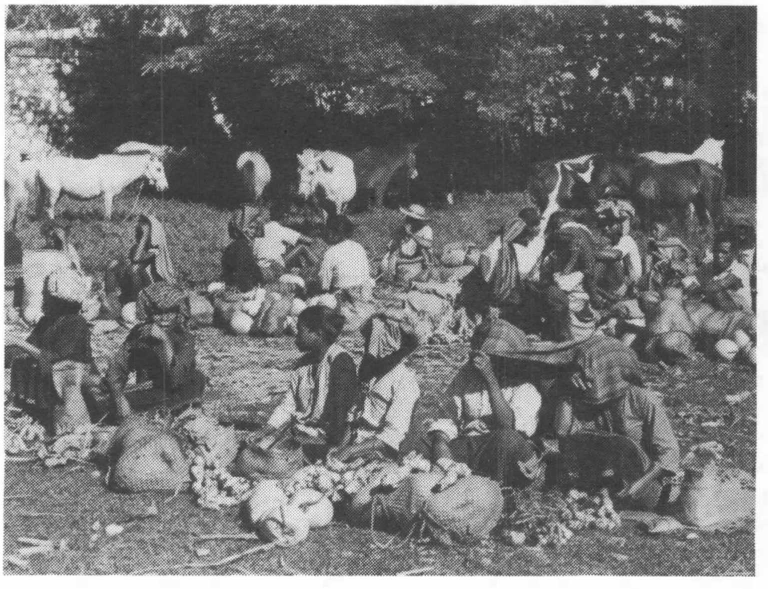


Plate 3

Makassai speakers from the mountains bring citrus fruits, vegetables and root crops to the weekly market in Viqueque, near the south coast

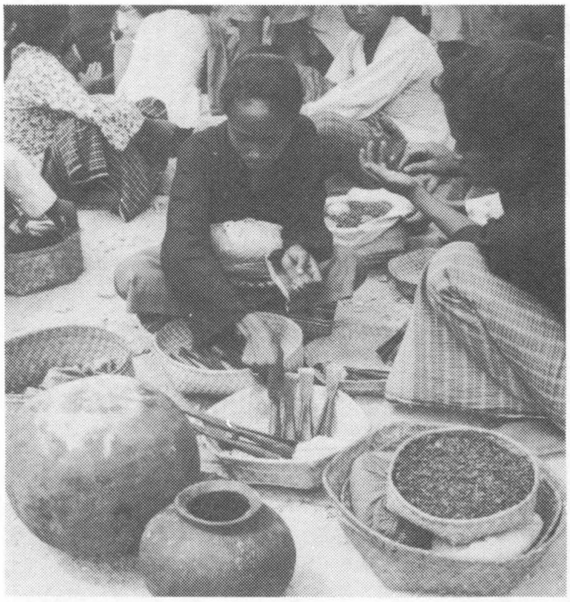


Plate 4 Baucau market: tobacco is being traded for iron digging-stick blades. The pottery is from *suco* Uai Tami, Quelicai

Plate 5 Manatuto: Galoli speakers selling green vegetables in market

Plate 6 Manatuto: market purchases

Overleaf

Plate 7 Manatuto: water jars for sale

Plate 8 Vemasse market: cooking pots from Lor and Raha *povoaçoes*, Oralan *suco*. See Glover 1968

Plate 9 Viqueque: cooking pots from Uma Kik *suco*

Plate 10 Viqueque: pottery from Uato Haco *suco*, near Venilale

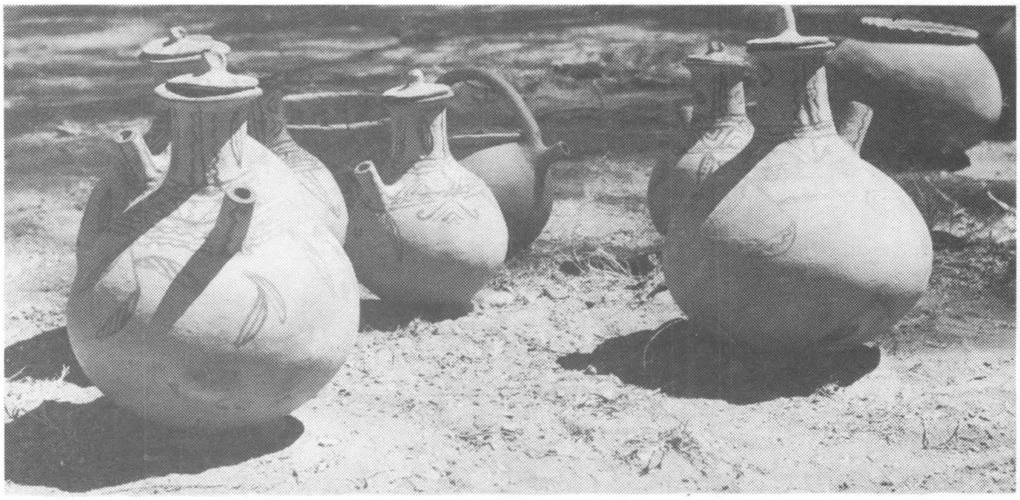


Plate 7

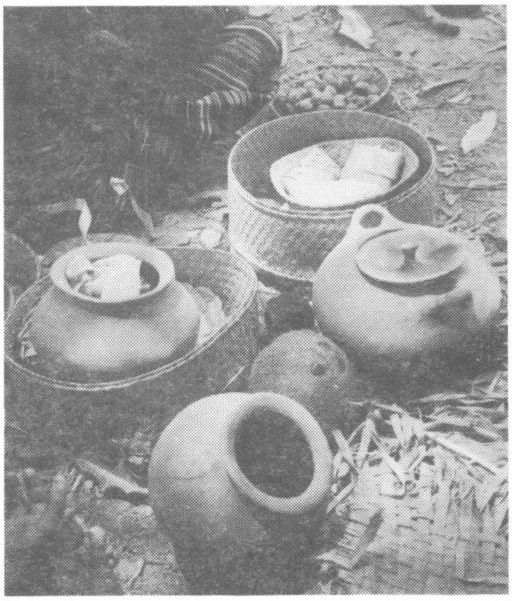


Plate 8

Plate 9

Plate 10

III EXPLORATION AND SITE SURVEYS

It was decided to confine work to the eastern half of Timor because of the ease of access there from Darwin and the better transport available.

The information on archaeological sites in eastern Timor was not great, but promising nevertheless. The geological maps (Fig.3) showed extensive limestone formations and Bühler's excavation at Baguia had demonstrated that caves in these contained prehistoric occupation deposits. The brief reports by Correa *et al.* (1955, 1956, 1964) indicated that stone tools were to be found on the coastal alluvial plains at a number of localities. Mr W.C. Wentworth, MHR, on a visit to Timor in 1965, had seen numerous caves in the Baucau and Los Palos Plateaux and collected struck flakes of flint from Lene Hara Cave near Tutuala.

RECONNAISSANCE, JULY 1966

In July 1966 I went to Timor for two weeks with Professor D.J. Mulvaney to examine the prospects for excavation. We spent four days in Tutuala Village at the eastern tip of the island, three days near Baucau, and three days examining the area from Venilale to Beaço on the south coast.

Tutuala

Three sites were examined in the vicinity of Tutuala; two caves with occupation deposits and one cliff face with rock paintings and wall foundations. The principal cave Lene Hara was the one excavated by Almeida in 1963, and seen by Wentworth. Subsequent to our visit, the excavator published a short report (Almeida and Zbyszweski 1967:57-58). The cave is about 5 km (1-1.5 hours walk) east of Tutuala Village on the left of the track to Jaco islet. It is a solution cave in a limestone cliff about 100 m above sea level. There are two main entrances, the southern one is a fine, open, well-lit chamber some 35 m broad by 20 m deep, with an even deposit of reddish-brown earth and protected by the remains of a rubble-built wall just outside the entrance (a common addition to caves in Timor). Almeida reports that he dug two trenches 2 x 1 m at right angles to each other in this chamber which were still open at the time of our visit (Plates 11, 12).

The northern entrance contained an interesting structure, a forked wooden pole set in a low semi-circle of stones (Plate 12), reminiscent of the spirit shrines of central Timor illustrated by Vroklage (1953:3, P1.L-LIX), but the rocky floor ruled out the possibility of excavation here.

Almeida reports finding marine shells and chert flakes down to 80 cm and some of these have been described and illustrated (Almeida and Zbyszewski 1967:Figs I-IIa), but without adequate analysis and stratigraphic data. None of the distinctive tool types found in the excavations of Bühler, Willems, Verhoeven and myself can be recognised from these illustrations, with the possible exception of a triangular flaked stone adze (Almeida and Zbyszewski 1967:Fig.II, 10). One point of interest in this cave is the absence of pottery except on the surface, which might indicate a considerable antiquity for this deposit, but I am hesitant about dating it by a simple correlation with my own excavations 100 km to the west.

For further details on Lene Hara Cave and the interesting rock paintings near Tutuala see Glover (1972a:40-42) and Almeida and Almeida (1976).

Baucau

Returning from Tutuala, Mulvaney and I spent two days looking at rockshelters in the vicinity of Baucau township, which is situated on the edge of a limestone plateau some 400 km^2 in area and which rises in a series of well-marked reef terraces from present sea level to 500 m (Plate 13; Figs 3, 4, 5). Close to Baucau there are many small shelters eroded into

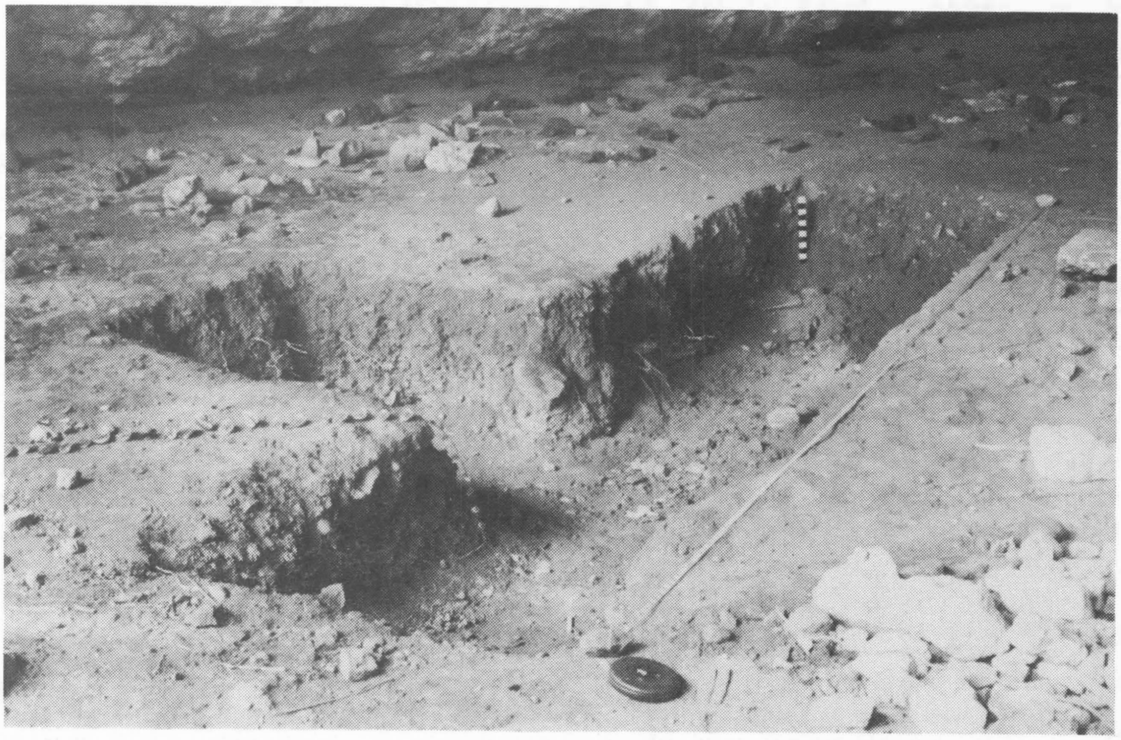


Plate 11 Lene Hara Cave, Tutuala: Almeida's trench

Plate 12 Lene Hara Cave, Tutuala: stone structure

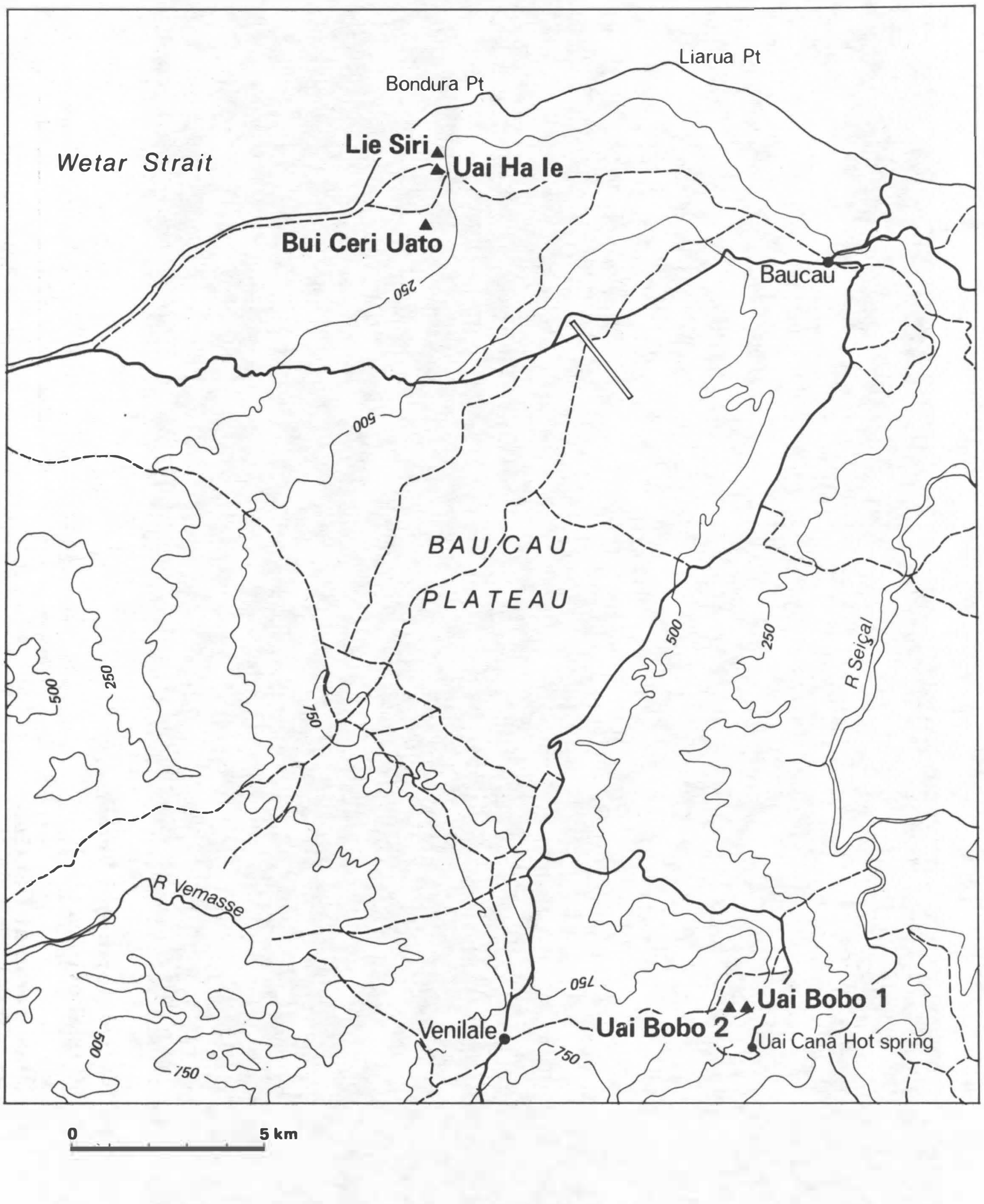


Fig.4 **East Timor: the Baucau Plateau and the Venilale region locating the author's main excavations of 1966-67. Redrawn from *World Archaeology* 1977:Vol.9(1)**

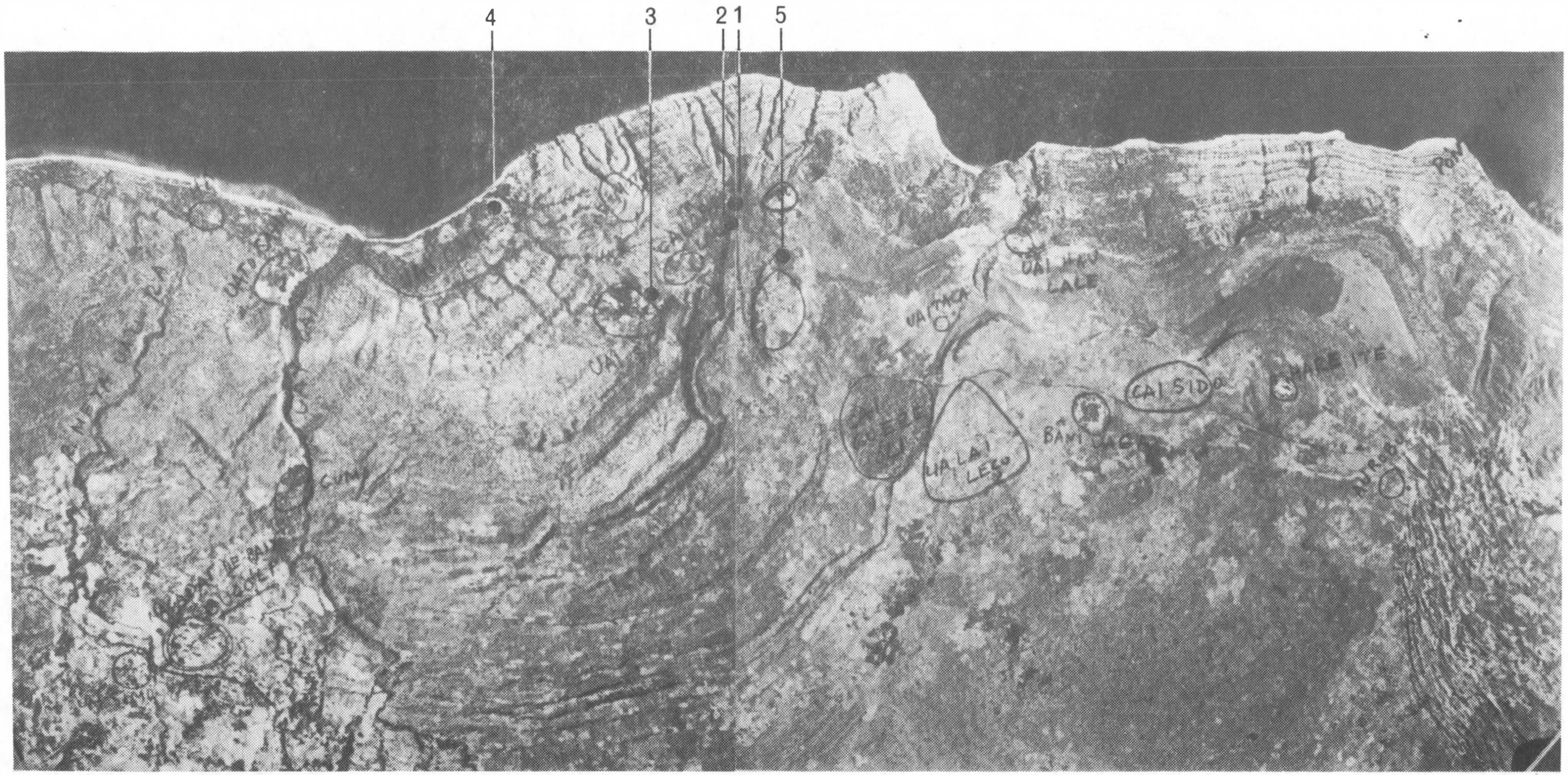


Plate 13 **Baucau Plateau between Baucau town and Vẹmasse. Highest terrace is about 450 m above sea level**

1 Lie Siri
2 Uai Ha Ie
3 Bui Ceri Uato
4 Base camp at Uai Ono
5 Osso Ua burial cave

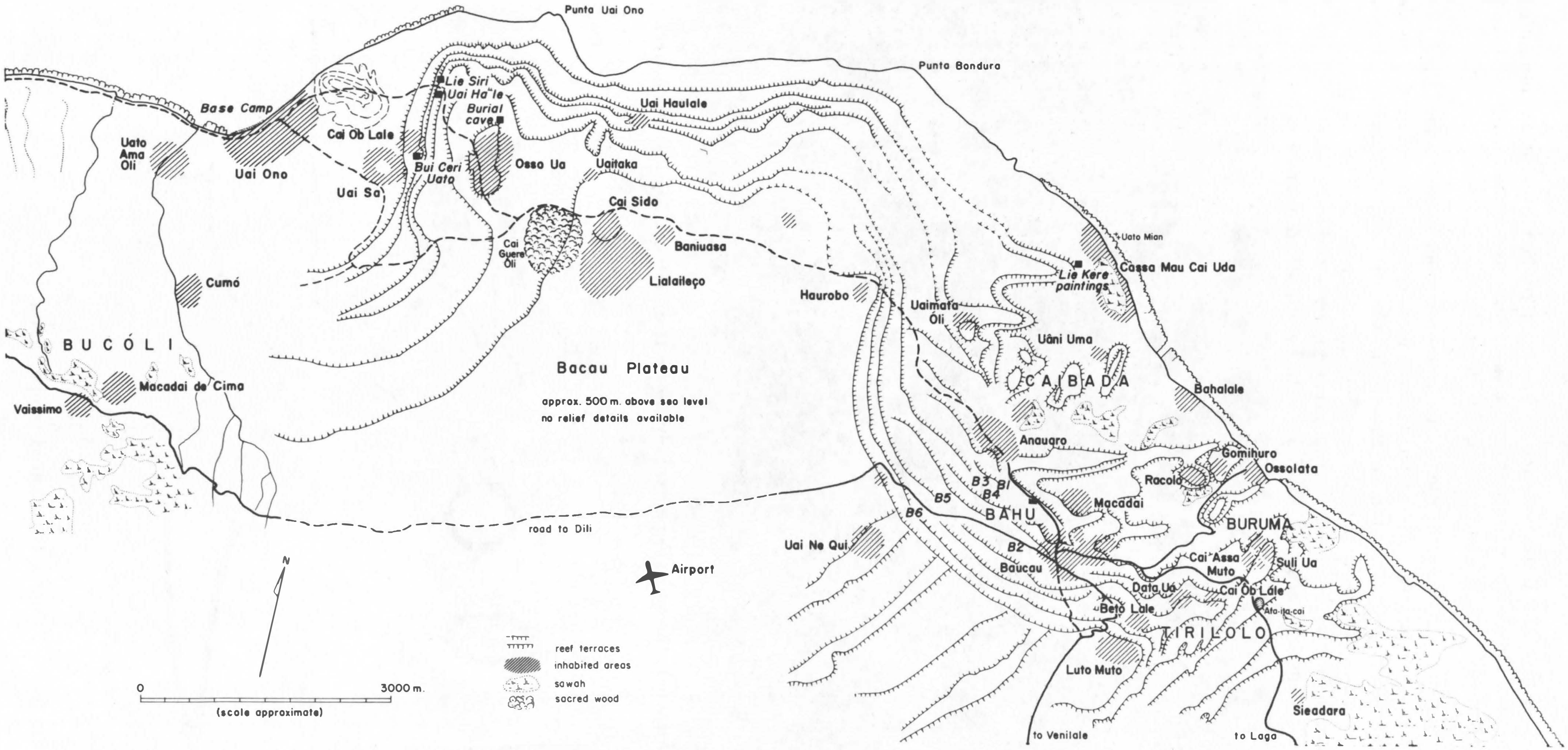


Fig.5 The Baucau Plateau, East Timor: locating the archaeological sites mentioned in the text. Village areas are approximate only as residence is usually scattered in Timor. Drawn by Winifred Mumford from data supplied by the author. For details of test excavations see Glover 1972a

blocks of limestone where the terrace structure has been broken by erosion and subsidence. Many of these shelters show signs of recent occupation, such as bamboo frame structures and broken pottery, with walls and fences blocking the entrances.

In one such cave (Baucau 1) (Plate 14; Fig.5), we found a copper axe, or adze (Fig.6) lying on the surface near a broken modern pot. The axe is of a form common in Indonesia, particularly in west Java, and is usually attributed to the Dong Son or Southeast Asian Bronze Age, although few have been found in datable contexts in Indonesia. This is the first to my knowledge found in Timor, although similar axes have been found in Sulawesi, Salajer, Buton, Banda and Flores. A detailed study of this adze is to be published elsewhere.

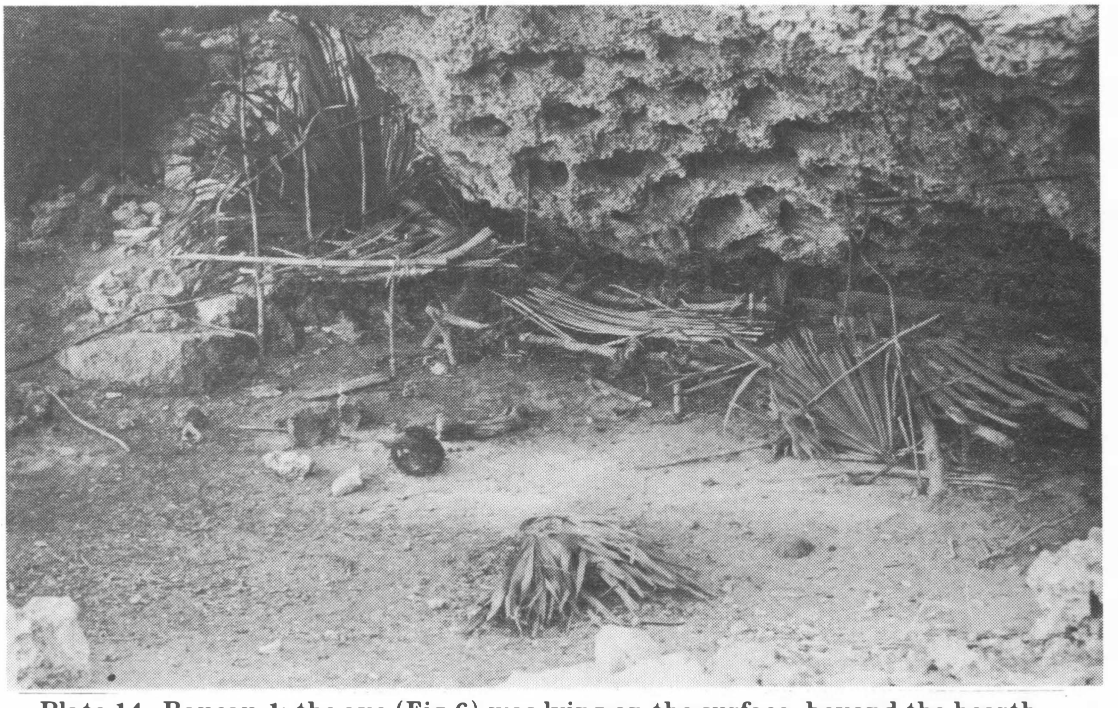


Plate 14 Baucau 1: the axe (Fig.6) was lying on the surface, beyond the hearth

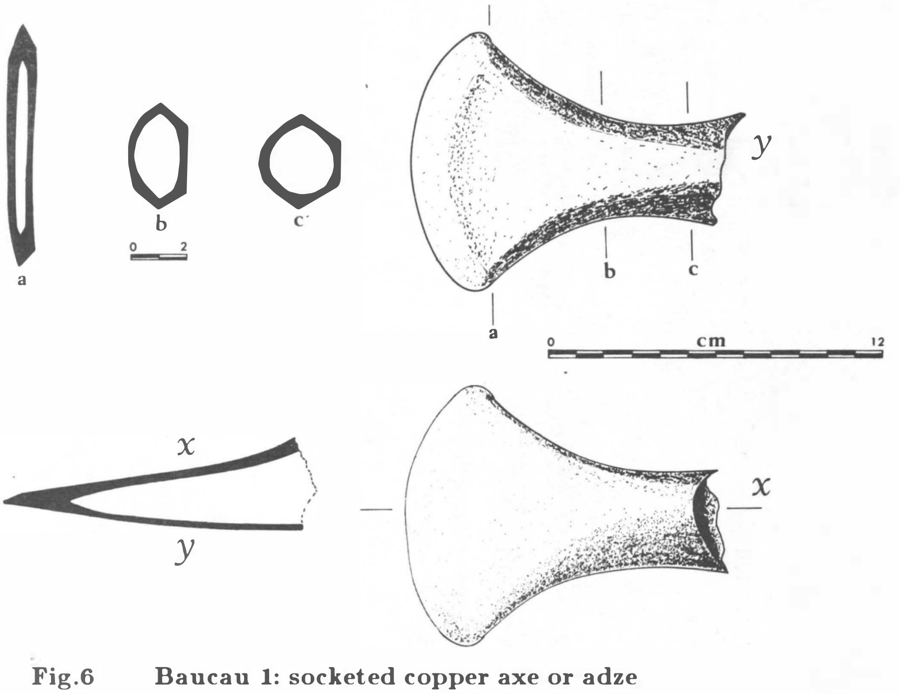


Fig.6 Baucau 1: socketed copper axe or adze

SURVEY AND EXCAVATION, NOVEMBER 1966-JANUARY 1967

The first visit to Timor indicated that the region around Baucau was the most favourable for fieldwork; the Pleistocene reefs of the Baucau Plateau contained numerous caves, the central Miocene mountains seemed promising and were easily accessible, and the Portuguese administrator, Sr Luis Franco Ricardo, was interested and helpful. The plan was to locate and excavate at least one good cave site before the wet season started in December. Three weeks were spent looking for and testing cave and open sites in the neighbourhood of Baucau, Laga and Baguia before a cave was found at Uai Ha le (Fig.4). A test excavation was made on 6 December and more extensive work was undertaken there from late December 1966 to January 1967. The results from this work were disappointing compared with those obtained from later excavations, and although it is hoped to publish Uai Ha le sometime in the future it was not included in my thesis (Glover 1972a), and is omitted from this monograph.

In December 1966, and again in July 1967, a survey was made around the salt lake of Gassi Issi where Portuguese anthropologists had reported finding palaeolithic flake tools (Correa *et al*. 1955, 1956, 1964; Almeida and Zbyszewski 1967). My conclusions (Glover 1972a:44-50) were that the few genuine artifacts found on the gravels around the lake are conformable with the cave industries discussed later in this volume, and need be no older than terminal Pleistocene.

Some small rockshelters examined near Gassi Issi, around the Baucau township, and in the neighbourhoods of Baguia and Venilale did not yield sufficiently interesting results to warrant further discussion here. For details on these surveys and test excavations, see Glover (1972a:51-62). Minor sites in the neighbourhood of Baucau are located on Figure 5.

I returned to Timor in May 1967, and between June and December that year undertook more survey and excavation on the Baucau Plateau and in the central limestone mountain chain east of Venilale. Four cave sites, Lie Siri and Bui Ceri Uato on the plateau, and Uai Bobi 1 and Uai Bobo 2 near Uai Cana on the western slopes of the Seiçal Valley (Fig.4), were selected for more intensive excavation and these are reported in full in Chapters IV-VIII. Some minor sites identified on these surveys are described in Glover (1972a).

IV METHODS OF EXCAVATION AND ANALYSIS

The approach to excavation and analysis was determined by the initial problems set for the fieldwork. Principally, it was hoped to obtain dated assemblages of stone and pottery artifacts so that similarities to industries in Australia, Indonesia, Melanesia, and elsewhere, could be assessed, and to obtain sufficient faunal remains so that the presumed transition from a basically hunting and gathering economy to agriculture could be dated. Excavations were made in two of the three main environmental zones on the island so that wider generalisations could be made about the prehistory of the whole of Timor, and not just one small part of it, and further, to see how the gross environmental differences were reflected in the archaeological record. Given the conditions and time available for fieldwork and analysis it was inevitable that objectives had to be limited and methods closely directed towards them. And at the present stage of archaeological research in Timor it is not possible to undertake the finer points of environmental studies, such as seasonal use of the sites, the reconstruction of local microenvironments and the effects of human activity on them. These are questions to be asked only when the basic historical framework is fairly well understood through the definition of archaeological cultures in space and time and from a general understanding of their economic bases. This is not the case in Timor, nor elsewhere in Southeast Asia at present.

EXCAVATION

There is no single way of excavating a prehistoric site, but rather a wide range of techniques and approaches which can be combined to provide the most satisfactory answers to the archaeological problems with which the excavator starts. The initial problems defining my fieldwork in Timor are set out in Chapter I, the sites to be investigated were all limestone caves, and some limitations on excavation and analytic procedures were set by the isolation of the island and the need to rely entirely upon untrained local labour. Because so little was known about the prehistoric cultures of Timor, emphasis in both excavation and analysis has been placed upon chronicling the main events of Timor's past at the expense of piecing together patterns of social life and ecological adaptation at any one time. Consequently, no attempt was made to expose extensive areas at any one level of cave occupation, which is in any case a dangerous practice unless habitation floors are clearly recognisable (Bordes 1968:16). I chose rather to excavate small areas in several sites so that regular patterns of continuity and change over time could be measured.

The five caves excavated varied considerably in size and availability of living space. The biggest, Lie Siri, had a potential area for excavation of 20 x 15 m, and Uai Bobo 2, only 2 x 3 m at the surface. Subsurface conditions varied too, from the finely stratified ash lenses at the surface of Uai Bobo 2 (Plate 43a) to the almost uniform stony brown earth at Bui Ceri Uato. As inexperienced labour was used for many stages of excavation, methods of digging, sorting and recording had to be standardised and varied only when absolutely necessary to suit special conditions on a site.

The practice in excavation was to lay out a trench 1 m by about 5 m in that part of the cave least encumbered by boulders on or just below the surface which, in practice, generally meant just inside the overhang; below the overhang and on the talus slope excavation was usually difficult because of rock falls. In the larger caves, where extension of the trench in any direction was possible, the squares were numbered according to the distance and direction of one corner from a datum point, e.g. Square N1W4 (Fig.8). This system has great advantages on open sites where irregular structures might be found but I found it too cumbersome to apply in the restricted area of these caves where the position of the entire area to be excavated can usually be decided in advance. For the smaller sites (Uai Bobo 1 and Uai Bobo 2) a simple grid was laid out and the squares called by a single letter.

Because I was using untrained labour no attempt was made to record the precise location of each potsherd, bone or flake in the deposit; rather the earth was trowelled from each 1 m^2 in 10 cm spits or less where changes in colour or texture could be recognised. Features such as concentrations of ash, charcoal, and stones were planned and photographed before the next unit was dug; holes and pits were cleaned out and the finds from these were kept apart from those from undisturbed deposit. The depth of each spit was measured in all corners (and elsewhere if the surface was irregular) using a dumpy level and survey staff, and the readings were recorded as a height below a permanent datum which was engraved on the cave wall.

Cave deposits in Timor were generally dry and rather soft, and definable floors, or even zones of habitation were not found. Whether this is the result of intermittent disturbance of the deposits as they accumulated through 'scuffage and treadage' by later inhabitants, or because of a pattern of regular, brief phases of habitation, I am not able to say on the present evidence.

Most digging was done with bricklayers' trowels and hearth shovels and the deposits carried out of the trench in two gallon plastic buckets to be double-sieved on 6 mm and 3 mm screens. Stone, pottery and bone finds were bagged separately and labelled by site, square and spit, e.g. TL/N4W1(10). Some of the more distinctive finds were washed and labelled on the site so that a watch could be made for major changes in the fauna and artifacts found. All subsequent sorting and analysis was done in Australia. It is realised that some information may have been lost through this, although in caves with soft earth floors, where disturbance of any surface is likely, greater precision may be more apparent than real (Matthews 1964:166-70).

This approach to excavation does not conflict with the traditional requirement to separate each layer of a deposit since spit boundaries will correspond to layer interfaces where these are present and clear enough to be recognised during excavation. But depositional strata in caves do not necessarily have the cultural significance they possess in shell middens or village mounds where the overwhelming bulk of material owes its presence on the site to human activity. McBurney (1968:392) makes this point in his discussion of the Ali Teppeh Cave, Iran, where he argues that less than a fraction of 1% by volume of cave deposit is normally to be attributed to human occupation. Stratigraphic changes in caves reflect predominantly natural events and this must be borne in mind when comparing the cultural material from different layers.

This is not to deny that human activity does affect cave deposits in a number of ways: by contributing artifact and food remains which alter the structure, acidity, phosphate level, and other chemical properties of the natural cave earth; fires alter the colour and structure of the deposit, both through the presence of charcoal and the oxidation of the underlying deposit, and clearing vegetation, and building activities outside, or even within the cave, can alter the rate of deposition. The immediately visible stratigraphic changes in the cave deposits in Timor were generally close to the surface and were produced by ancient firemaking, but below, these changes in texture and colour were almost certainly the result of natural processes.

The method of excavation by spits is undoubtedly second-best to the precise three-dimensional recording of every item in an archaeological deposit, but the latter requires much time spent in the field and a team of trained excavators and recorders such as is now available in many parts of Europe and the USA. On the other hand, excavation by spits has good precedents especially in pioneering excavations (e.g. McBurney 1967:13, 1968:390), McBurney describes with insight the problems faced and compromises adopted in such situations. Since his methods at Ali Teppeh were, in the initial stages at least, very close to those I used, I quote from his description:

> It is well known that cave deposits vary between those at one extreme with stratigraphy so clear that each microlayer can be separated from the rest with confidence during the actual process of digging, to others where great bands of

> deposit offer little or no visible structure. Intermediate between these two extremes is a not inconsiderable class of deposit where the bulk of the layer interfaces, either because of lack of sedimentological contrast or complexity of structure, can only be disentangled in detail after the examination of substantial vertical exposures ... every attempt is made in the first place to extract dug units (or 'spits') which correspond as nearly as possible with the slope and visible irregularities of layer interfaces. *In addition* careful record is kept of the limits below datum of each spit which is individually numbered. These limits are subsequently compared with the limits of the natural layers as confirmed by the three dimensional study of vertical sections. The natural layers are then codified together with the spits, and the two are displayed schematically on an overlap diagram ... [McBurney 1968:390].

Such a procedure was adopted in Timor and is described in detail below.

In the course of the first excavation in Timor, at Uai Ha Ie, baulks were left between squares, and several squares were excavated in rotation. However, this was found to be unsatisfactory because of the difficulties in recognising stratigraphic boundaries when scraping the floors in the poor light of the cave. And because deposits tended to be dry, stratification of the exposed sections was no clearer on immediate exposure as may be the case in damp deposits. In the later four excavations (reported in this volume) squares were usually dug to 50-70 cm before work was started on adjacent squares, digging against the exposed face and without leaving a baulk. The sections thus exposed were drawn or photographed and these records were used to aid in the correlation of layers across the entire trench. This method had the advantage that I could mark the exposed face with skewers and a trowelled line, as a guide to my workmen, just where excavation of any particular unit should stop.

When a sufficient area had been excavated and the trends of the deposit and cultural materials were fairly clear, charcoal samples were collected; the method depending on its availability. Where charcoal was common, or found concentrated in hearth lenses, it was picked directly out of the deposit after cleaning the surface, and placed in a thick plastic bag. In many instances it was necessary to augment this by collecting from both coarse and fine sieves.

The coastal sites contained a large number of marine shells and these only were sampled; the method of sampling and analysis is described later. Otherwise all bone, pottery, vegetable remains and stone, other than limestone fragments, was collected. Soil samples were taken after excavation, generally from the deepest section at intervals of 10-15 cm and their position noted on the drawn sections.

STRATIGRAPHY, SPIT CORRELATION AND UNITS FOR ANALYSIS

As has been explained above the various sites were excavated by combining the separation of stratigraphic units with a system of 10 cm spits to subdivide those layers which were relatively undifferentiated and thick. This provided for each site a large number of small collections of artifacts and bones ranging from 111 at Bui Ceri Uato to 323 at Lie Siri; each collection coming from an area 1 m^2 x 10 cm or less deep. As one of the principle aims of the research was to compare dated artifact and faunal comparisons between sites, some means had to be found of combining these many small collections into useful assemblages, or roughly contemporary and associated sets of finds. The numbers of finished stone tools, diagnostic bones and decorated rim sherds were rather few in all sites and in order to provide sufficiently large samples so that the broad trends of cultural change would be discernible within a site and comparable between them, I decided to combine for analysis, the finds from adjacent squares over the extent of the excavated trenches provided these units did not cut across recognised stratigraphic boundaries. Thus, for instance, all the finds from Spit 1 at Bui Ceri Uato (Table 37), have been combined, and this includes material from the top goat dung layer only (Fig.19c). Before artifacts were combined, of course, the finds from each square were sorted and all retouched or utilised flaked stone, all rim or decorated potsherds, and all of the rarer finds, such as grindstones, were catalogued according to their square and spit of origin. The numbers and weight of waste flakes and plain body sherds from each square and spit were recorded (but not catalogued) and these were then bagged separately, so that any future worker can restore the finds to the minimum recorded location (1 m^2 by about 10 cm deep) if a different analytical approach is adopted.

In some cases layers were continuous over the entire trench but were excavated in more than one spit in some squares. Thus, for instance, the surface layer at Lie Siri was excavated in two spits where it was deeper, and in only one spit where it was rather shallow, in Areas E and F of the trench. The way in which these spits were combined into a single unit is shown in Table 2 and Figure 11. Deeper in the deposits the layers were generally thicker and relatively homogeneous and to put all the material from a single thick layer together for analysis would have been unreasonable and unprofitable for two reasons.

1. Usually only four or five layers could be seen in the sections (more at Uai Bobo 2) and these varied enormously in depth, extent, and presumably in the period of time they represented. Combining all the material from a single layer would obviously not provide groups of finds that were in any way comparable, and the number of assemblages in any site would be too few to provide a reliable picture of cultural change and development over time.

2. In cave deposits, as I have already pointed out, depositional changes, which are largely the result of natural processes, do not necessarily correspond to cultural changes. Although this might seem self-evident, it is only in recent years that excavators of European palaeolithic caves (e.g. Bordes 1968:19; Lumley 1969:13-14) have systematically tried to distinguish between the two. In most of the classic cave excavations (i.e. most of those reviewed by Sonneville-Bordes 1960) cultural materials are classified according to the strata in which they occur; a process which leads to an irrefutable, but probably erroneous conclusion, that each depositional layer has its characteristic facies.

The procedure adopted here was that where layers were relatively shallow and extensive, finds from all the spits within such a layer were combined and treated as a separate assemblage. Where a thicker layer could be subdivided over all or most of the trench into two or more spits, the horizontally adjacent spits were correlated and the finds combined to yield several assemblages from a single layer. Thus, in Uai Bobo 1 (Fig.32) the dark grey layer, (Munsell 10 YR 4/1), fourth from the surface, was divided into three assemblages for analysis. These horizontally combined spits I have called Horizons (or subdivisions of Horizons). Thus, the fourth layer in Uai Bobo 1 comprises three horizons, IIIa, b and c whereas the top two layers each comprise one horizon, VIII and VII. Horizons have been numbered from the base of the deposit, using Roman numerals to avoid confusion with spits.

The term horizon was used to clarify the distinction between: (a) the excavation unit or spit; (b) the basically natural depositional layers; and (c) the units found most convenient for analysis. But in retrospect, it was perhaps not a good term to use because of the possibility of confusion with the use of horizon in American archaeological terminology to designate the rapid and broad spread of various cultural traits or assemblages (Willey and Phillips 1958:33).

It should be emphasised that the combination of spits into horizons has been done by aggregating excavation units on a single, more or less horizontal, plane across the trenches, and vertically adjacent spits have only occasionally been combined unless they were contained within a single thin layer. Thus at Lie Siri, a maximum of 16 vertical excavation units have been reduced to 12 horizons (including subdivisions) and so most horizons are only one spit deep.

The presentation of the horizons in relation to the stratigraphic sections shown, also requires some explanation since it is more schematic than might be thought, and the illustrations occasionally suggest that depositional layers were quite arbitrarily ignored when spits were combined. This was not the case, as the previous explanation should make clear.

As already mentioned, the base levels of spits were recorded in several places and these were commonly irregular and sloping. But the lines marking the horizon boundaries in the figures represent the average depth of the horizon projected on to a vertical plane, rather than the exact position where the interfaces touch the section shown. They were drawn schematically in the hopeful, but perhaps vain attempt to gain in clarity, since I wanted to avoid the sort of confusing precision represented by sections such as those of Haua Fteah (McBurney 1967:7, Fig.I). At the same time it must be admitted that spits were sometimes dug too deeply and horizons may include a little material from more than one stratigraphic unit. Gradual colour and soil changes in a soil profile are difficult to isolate with absolute precision during excavation, and in subsequent recording of a soil section it is easy to see that an earlier identification of a layer boundary was, in fact, wrong. Sections drawn for publication are interpretative, and what are, in the field, subtle distinctions of colour and texture, have been exaggerated in the drawn sections. Reference here to a particular instance might help to clear up this point. Figure 19b shows the stratigraphy on the south section of Squares N7E2, N6E2 and N5E2 in Bui Ceri Uato Cave, and Figure 19c illustrates how the 13 spits which were dug in these squares have been consolidated into 10 horizons. The stratigraphic sequence, which is more fully described in Chapter VI, Description and Excavation; consists, from the surface, of seven visible layers:

1. goat dung (10 YR 4/3);
2. white ash (7.5 YR 8/0);
3. dark grey charcoal (10 YR 4/1);
4. pale brown oxidised soil (10 YR 6/3);
5. brown (10 YR 5/3);
6. light brownish-grey (10 YR 6/2); and
7. yellowish-red (5 YR 4/6).

However, Layers 2 and 3 are really part of the same event, an extensive fire on a buried surface which I have tentatively suggested was produced by corn parching. Layer 4 is no more than the surface of Layer 5 which has been oxidised by this fire, and structurally belongs with Layer 5. Below this, the layers are thicker and, except in the southwest corner of Square N5E2 where a roof drip had moistened the soil, these layers were relatively easy to separate during excavation.

Layer 1 was dug as Spit 1, and after the various pits were cleared, Layers 2 and 3 were dug as Spit 2, for I realised that the two layers were part of the same extensive hearth. Spit 3 consisted of Layer 4 and the surface of Layer 5, Spits 4 and 5 the middle of Layer 4 and Spit 6, the lower part of Layer 4. For analysis, the spits were correlated and consolidated into horizons as shown below. Where alternatives are shown, this reflects the differences between squares; fuller details are given in Table 37.

Spit	Layer	Horizon
1	1	X
2 or 2-3	2-3	IX
3 or 3-4	4, top 5	VIII
4-5 or 5-6	Mid 5	VII
6, 6-7 or 7-8	Lower 5	VI
7, 7-8 or 8-9	6	V
8, 9 or 10	Top 7	IV
9, 10 or 11	Mid 7	III
10, 11 or 12-13	Lower 7	II
12 or 13-14	Base 7	I

In order to make comparisons between horizons more meaningful, the volume of each horizon has been calculated so that quantitative comparisons can be made in terms of a standard unit of volume, i.e. 1 m^3. These were calculated by a combination of two methods. Firstly by measuring the area and average depth of each spit; large rocks were measured and excluded from these calculations. Secondly the number of buckets from each spit was counted. This worked out fairly consistently at all sites to between 12 and 15 for 1 m^2 x 10 cm deep, i.e. 120-150 per m^3.

When nearing the bottom of most trenches where rocks made the calculation of volume by measurement difficult, then bucket count was relied on, at an average figure of 130 per m^3.

It is recognised that both methods are not very accurate, and their reliability is difficult to assess, but at least the use of the two methods of recording volume avoids gross errors due to differential soil compaction, and I believe that a broad measure of occupational density is valuable and should not be abandoned because it is not precise. Most such measures used by archaeologists are approximate but found valuable nonetheless, whether they are to show the age structure of prehistoric animal herds, populations of settlements or the age of deposits.

Radiocarbon dates and chronology

Seventeen samples were submitted to the Radiocarbon Dating Laboratory, ANU, from five excavated sites. The ages, which are based on the standard half-life of 5568 ± 30 years are listed in Table 1, together with the location of the samples, and a description of the material dated.

Not all the samples have provided satisfactory results, but at Lie Siri, Uai Bobo 1 and Uai Bobo 2, enough consistent dates have been obtained to provide a basic framework for dating the excavated sequences. A chronology for each site is put forward in the respective chapters, and the dated sequences are correlated in Chapter IX where the implications of the results for the initial problems are considered. In this section, only the use of the radiocarbon dates is discussed and it is explained why some results have been rejected as unacceptable.

The samples provide a few fixed points for the chronology of a site but do not, in themselves, permit all the excavated material to be dated. To achieve this, a relationship has to be established between the depth of deposit and the time period over which it has accumulated. With only a few dates from each site this can only be done in a tentative and provisional way. None of the sites show a perfect positive correlation between depth and age. Uai Bobo 2 comes closest to this, but at Lie Siri and Uai Bobo 1 the rate of deposition has obviously varied considerably over time (Fig.48). To calculate the best possible depth/age relationships, the location of each dated sample is plotted on a graph, on which the vertical axis represents the depth in the deposit, and the horizontal axis the dates. To get the best possible age in calendar years, the procedures recommended by Polach and Golson (1966:22) were followed. The laboratory dates in Table 1 have, for this purpose, been increased by 3% to adjust them to the accepted best half-life for C14 of 5730 ± 40 years. They are then rounded to 100 years, and the errors given as a minimum of 200 years for two standard deviations. The results have not been recalibrated against any tree ring curves. On the graph, the dates are plotted as a diamond figure, of which the height indicates the depth of deposit from which the sample was collected, and the width represents two standard deviations. The outside of these diamonds are joined to give a range within which the age of the deposit at any depth can be calculated.

In order to analyse the artifact and faunal sequences, the deposit at each site has been divided into a number of horizons as previously described and all the finds from each horizon are treated as separate assemblages. To calculate the age of these horizons, dotted lines, representing the mean depth of the horizon boundaries, are projected from the vertical axis. Where these intersect the lines joining the dated samples, maximum and minimum dates for that point can be read off on the horizontal axis. Since the dates are plotted to two standard deviations, and the localisation of the sample is also shown, there is a good probability that the real date lies within this range. The mid-point of the age range, rounded down to 100 years, has been used as a convenient and single reference date for the horizon boundaries. It

Site	Sample nos	Age BP	Horizon	Location	Source and material dated
Lie Siri	ANU-173	2660 ± 110	VIb	N1W9 (2)	Scattered charcoal 10-15 cm below surface
Lie Siri	ANU-172	3545 ± 120	VIb	N1W10 (2)	Scattered charcoal 10-20 cm below surface
Lie Siri	ANU-324	1030 ± 70	VIa	N5W9 (3)	Scattered charcoal 10-15 cm below surface
Lie Siri	ANU-235	3530 ± 90	VIa	N4W11 (4)	Discrete hearth 20 cm below surface, charcoal
Lie Siri	ANU-171	6635 ± 140	Vb	S0W4 (6)	Discrete hearth 40 cm above bedrock, charcoal
Lie Siri	ANU-236	7270 ± 160	I-III	N4W9 (13) and 6 adjacent squares	Scattered charcoal from 7 1 m squares 10-20 cm above bedrock
Bui Ceri Uato	ANU-327	220 ± 80	VI	N7E1 (6)	Concentrated charcoal and ash 50 cm below surface
Bui Ceri Uato	ANU-325	modern	I	N6E1 (15)	Scattered charcoal near bed-rock, 1.4 m below surface
Uai Ha Ie	ANU-174	240 ± 76	-	S25W1 (2)	Scattered charcoal 10 cm below surface
Uai Bobo 1	ANU-332	350 ± 60	V	C (4)	Scattered charcoal 30-40 cm below surface
Uai Bobo 1	ANU-237	2190 ± 80	IIIc	D (6)	Concentrated charcoal lens 50 cm below surface
Uai Bobo 1	ANU-326	2450 ± 95	IIIb	K (8)	Scattered charcoal, 60 cm below surface
Uai Bobo 1	ANU-414	3470 ± 110	IIIa	K (9)	Scattered charcoal, 70 cm below surface
Uai Bobo 2	ANU-239	3740 ± 90	IX	A (13)	Charcoal from hearth 1 m below surface
Uai Bobo 2	ANU-187	5520 ± 60	VII	A (19)	Charcoal from hearth 1.6 m below surface
Uai Bobo 2	ANU-328	7010 ± 125	IV	A (30)	Charcoal from hearth 2.6 m below surface
Uai Bobo 2	ANU-238	13,400 ± 520	I	Ik(9)	Charcoal from hearth 20 cm above bedrock, and seed cases scattered throughout Horizon I

Table 1 Radiocarbon dates from the excavations in Timor. Figure 48 shows how these dates are related to horizon boundaries. These dates are calculated on the basis of a half-life of 5568 ± 30 years and are uncorrected

must always be remembered that this is only the approximate mid-point of a range, and not a calendar year to be equated with the Christian calendar. It is quite unrealistic, given the continuing disturbance which takes place as many archaeological deposits accumulate, to expect precise dates for most features, or for all the excavated artifact assemblages. As Polach and Golson (1966:20-23) point out, a radiocarbon date is not the same as a date in calendar years but is a statistical expression of the probable age of the sample submitted. Further, the refinements of modern dating techniques allows a greater precision in expressing this probability, than the association between artifacts and charcoal usually warrants. There are of course, occasions, some cremation burials for instance, when single short-term events are preserved intact and undisturbed and the archaeologist can be confident that artifacts, bones and charcoal are all exactly contemporary. However, this is not the case for these cave deposits in Timor, where considerable scuffage and treadage and some modern disturbance can be demonstrated.

At Uai Bobo 1 and Uai Bobo 2 the method outlined above has been used with some confidence for the stratification at both sites is nearly horizontal and the samples were taken directly from one above another at Uai Bobo 2, and close to one another at Uai Bobo 1.

At Lie Siri, samples ANU-172, 173 and 236 are taken from one area of the trench, ANU-324 and 235 from some distance away, and ANU-171 from several metres away, in the opposite direction. Although the stratification (Fig.9) at this site is close to horizontal over much of the trench, the base rock slopes steeply and the rate of accumulation has been much faster in the northeast part of the cave. A simple depth/age correlation is not possible here. In this case, the mean depth of the various horizons from which the samples have been taken, has been calculated, and the dates related to these are shown in Figure 48.

Although most of the dates are mutually consistent both within, and between sites, there are some which cannot be related to these without postulating very considerable variations, at any one time, in the cultural patterns and economic bases of the groups occupying the sites. This is possible, but I find it easier to believe that some of the dates reflect modern disturbances not noticed during excavation, and that they are not reliable guides to the age of most of the material found within the levels from which the samples were collected. The samples in question are ANU-324 from Lie Siri, ANU-325 and 327 from Bui Ceri Uato and ANU-332 from Uai Bobo 1. The main basis for rejecting these dates is the similarity in the archaeological sequences from all the sites. Artifactual differences between sites of the coast and inland, which are not more than 24 km apart, are minor and the evidence suggests that in the past, as today, cultural similarities were strong between these zones, at least in this part of Timor. Changes in the occupation density at all sites show a similar pattern and the replacement of wild by imported and domesticated animals as basic food sources can be correlated at most sites, with, I believe, acceptable precision. Although one might expect a time lag between coast and inland in terms of imported styles, artifacts and animals there is no evidence for this; the differences appear to be greater in this respect between the two sites within each of the two altitudinal and environmental zones. Of the four samples thought to be contaminated, two, ANU-324 and 332, were both taken from rather scattered charcoal close to the surface of the respective sites, which would be very susceptible to contamination by modern charcoal derived from the surface. But, of course, not all samples collected from close to the surface have given modern dates. In the case of ANU-324, other dated samples from the same horizon and from the one above, at Lie Siri, have given dates of 2660 ± 110 (ANU-173), 3530 ± 90 (ANU-235) and 3545 ± 120 (ANU-172) BP. The associated materials can be better correlated with those in other sites if these old dates are accepted. The evidence suggests a very slow recent rate of deposition in the site, and the virtual abandonment of the cave for habitation about 2000 years ago.

The two modern dates obtained from Bui Ceri Uato (ANU-325 and ANU-327) present a problem which at present defies satisfactory explanation; it is discussed in detail in Chapter VI. Chemical contamination seemed a possibility, but after careful pre-treatment by Polach, ANU-327 again gave a modern date. ANU-325 was consumed during the first dating process and could not be checked. It looks as if ANU-327 is, in fact, modern charcoal, and yet the archaeological evidence supports the integrity of the deposit. The hearth from which ANU-327 was taken is extensive and, I believe, *in situ*. Without further excavation it is not possible to resolve the problem.

MEASUREMENT

Metric scales were used for recording excavations and for measuring artifacts. Horizontal measurements on excavations are accurate for the most part to 1%, or to 1 cm in the metre, and vertical measurements of excavated units were taken to 0.5 cm and recorded to 1 cm, using a Wild engineers dumpy level and a lightweight surveying staff of my own design graduated in 1 cm intervals.

Linear measurements of artifacts were made with metric scale dial calipers to 0.5 mm and recorded to 1.0 mm unless otherwise mentioned.

The length of stone artifacts was measured as the maximum length, irrespective of the angle to the striking platform since the precise direction of flaking could be determined only on a small percentage of implements with secondary working. The difference between this measurement and one taken at right angles to the striking platform, need not be too great. The lengths of a sample of 96 backed blades from an Australian excavation were measured in both ways, and the two measures showed a positive correlation of .97. The breadth and thickness of stone artifacts were measured at right angles to length.

Potsherd thickness was recorded to 0.5 mm, because the range within any assemblage was too small (about 2-9 mm) to give a useful distribution with 1 mm intervals. The thickness of a single sherd may vary more than the class interval and so the maximum thickness on any sherd was recorded.

Weights were measured to 0.5 gm and recorded to 1 gm except where specifically mentioned.

ANALYSIS OF FLAKED STONE TOOLS

Aims and approach

Flaked stone tools often comprise the majority of all artifacts recovered during the excavation of prehistoric sites and their description and classification occupies a proportionate amount of the archaeologists' work. The questions asked in the present analysis of flaked stone tools are fairly common ones basic to most archaeological work of this sort: (a) are there changes over time in the number, form and variety and technique of manufacture of the artifacts? (b) are these correlated with other features? (c) what are the differences between sites and within sites? (d) are there similarities with other regions and so on? The interpretation of the answers goes towards writing the history, but to get the answers it is necessary to start with an analysis of the various observable and measurable properties of the artifacts which can be used to describe the form, size, techniques, etc. These properties depend on the general nature of the tools, and very often on the archaeologist's understanding of their past function.

The recognition of repeated patterns of similarity between individual artifacts is the starting point of the analysis. Although flaked stone tools from Timor are not very elaborate, there are four distinct and easily recognisable basic categories and within one of these, flakes with secondary working, different artifact types have been identified by what is perhaps best described as 'intuitive recognition'. The criteria defining these groups are few and quite easy to describe. Within the types, attributes have been measured and analysed to reveal patterns of variation and change within and between the different sites. Changes over time in the proportions of different types in assemblages and the comparison of assemblages between and within sites is also one of the main objectives of the analysis, for which simple descriptive statistics have been used.

Preliminary examination of the excavated material showed marked changes in the composition of the faunal remains at all the sites, and this appeared to be correlated in time with the introduction of pottery, indicating a possible change in the economic base of prehistoric Timorese society. However, no marked change at this time could be seen in the flaked stone industry. This apparent technological continuity has been examined from several points of view: (a) typological; (b) attribute distribution; and (c) functional and stone working technology.

Sorting and labelling

The finds from each excavated unit were washed and sorted into four primary categories:

1. Waste flakes; that is flakes and broken pieces of flint showing no trace of use or of secondary modification.
2. Cores and core trimming flakes.

3. Flakes which have been utilised but without secondary working.
4. Flakes which show any secondary working.

Categories 2, 3 and 4 were labelled specifying the site and excavation unit, e.g. TB/N4W1(10). Serial catalogue numbers were also given so that individual artifacts could be identified and attributes correlated on individual artifacts. Site code numbers are given in the respective chapters, and catalogue numbers are listed in Glover (1972a) but not in this monograph.

Waste flakes

The material from each excavated unit was sorted a second time, counted and then the waste flakes from all units in the same horizon were put together and weighed. The density of waste flakes per m^3 was calculated for each horizon and, together with the density of retouched and utilised stone tools and pottery, has been used to indicate the relative frequency of occupation of the cave.

Waste flakes have not been measured, but the weight in each horizon has been divided by the number to see if any changes in the average size can be recognised.

Cores and trimming flakes

These were examined in conjunction with the waste flakes, from the point of view of core preparation and flaking technique. The ratios between cores, hammer stones and the other primary categories of flaked stone, were calculated to see if there were changes in the use of sites as workshops, and also to measure differences between sites in this regard. Details of the number and positions of the striking platforms were recorded.

Utilised flakes

It is realised that many of the so-called waste flakes may have been used but only those which show regular patterns of edge breakage, polish or gloss can be treated.

Two forms of utilisation were recognised:

1. flakes with small patches or streaks of gloss on the edges but with little or no edge fracturing; and
2. flakes with lengths of small negative scars on one or more margins. The individual flake scars are seldom more than 1-2 mm long.

Flakes with occasional and irregularly distributed scars on the margins were assumed to be waste flakes accidentally damaged. Proportions and densities of all these tools were calculated, and length, breadth and thickness of both groups were measured for comparison with the secondarily worked flakes. The flakes with the glossy, utilised edges were examined to determine whether any ideas about the form of utilisation could be obtained. Some examples were examined under a binocular microscope to see whether different forms of gloss could be distinguished, and the number, position, and length of these polished edges were recorded. Thin sections were made in an attempt to examine the structure of the glossy surface, and microphotographs were taken of some tools (Plate 47) for comparison with polish and gloss on stone tools from other sites and areas.

Flakes with secondary working

The distinction between edge modification due to utilisation, to secondary flaking prior to use, and to retouching or resharpening after use, is always subjective and often difficult to make. The function of the artifact has to be considered as well as the pattern, position and form of the flake scars, for secondary flaking on tools designed for scraping or light cutting may be indistinguishable from the combination of utilisation and retouch found on some chopping tools. The shape, size and weight of the tool must be considered as well as the angle, length, shape and position of the edges, and the sort of edge flaking.

For this analysis it has been assumed that flakes with regular lengths of scars which individually are greater than 1-2 mm long have been secondarily worked and/or retouched. A few basic characteristics of these tools should be noted here:

1. Working is nearly always unifacial, on a single plane and from the bulbar face of a flake.
2. Working is generally steep with a high proportion of step flaking.
3. Many tools have notched margins and working tends to be steeper in the notches.

Among the flakes with secondary working, two basically different categories of artifact can be recognised, and these require different approaches for analysis. The first category includes those tools which have been made to a predetermined form and size before use. Most varieties of hafted tools belong in this category, including spear and arrowheads, barbs and sometimes knives and scrapers. Resharpening may change the edge characteristics of these tools but, in general, it can be assumed that they are originally made to a preconceived shape and size, which can be recognised by analysis of dimensions, proportions, the position of working, and so on. The second category includes those artifacts whose shape and size are determined by the process of use. These are mostly chopping tools, on which edges are blunted and resharpened many times altering the original flake beyond recognition. The analysis of size and form which is appropriate for, say projectile points, is not so valuable for the second category of artifact, and instead other attributes have to be found to identify, describe and discriminate between different types of chopping tools.

White has discussed the problem of analysing assemblages of tools of this sort (White 1969) and the approach used here owes much to his work. Tools in the class I call Timor side scrapers have much in common with the 'miscellaneous chunky scrapers' of the New Guinea Highlands, especially in the fact that the final shape and size of a tool owes more to the history of its utilisation than to the intention of its manufacturer. They differ in that the majority are made from regularly proportioned struck flakes and that the working is usually confined to a single plane which is the bulbar surface. For these reasons they are rather easier to analyse typologically and by measured attributes. Although I have called these artifacts 'scrapers' this is a purely conventional term. Some may have been used for scraping but it is thought that the majority were percussion cutting, or chopping tools. Attributes which appear to be useful for identifying such tools are the angle of the cutting edge to the (usually) bulbar surface of the flake and the height of this edge in relation to its length, size, and proportion of the flake.

In Timor, it has been noticed that such tools are regularly worked back in the centre of cutting edges to form notches, and the width and depth of these are important characteristics which might serve to distinguish different functional varieties of chopping tools.

For purely descriptive and record purposes, also, the main dimensions of these (and other secondarily worked artifacts) have been recorded. They are useful for comparing between horizons within sites, and between the different broad categories of stone tools.

To cope with the questions just raised, artifacts which show signs of secondary working and/or retouch have been divided into the following categories:

1. tanged points;
2. side scrapers;
3. other scrapers;
4. flaked adzes;
5. burins; and
6. miscellaneous, including broken edges and other rare tool types.

It is not difficult to sort the artifacts from Timorese caves into these six categories. Side scrapers normally have steep working on edges which are usually thick, concave, or only slightly convex. Exclusively end scrapers, nosed scrapers or round scrapers are rare, but it must be admitted that some ambiguity between these scraper categories is inevitable, since stone tools are rarely standardised to the extent a classifier would like.

Tanged points, burins, backed blades and gun flints are not sufficiently common to justify detailed metrical or typological analysis. However, the tanged points from Timor constitute the most distinctive stone artifacts so far found on the island, and they have been frequently commented on in discussions of the interrelationships of post-Pleistocene cultures of Southeast Asia (Sarasin 1936:20-21; Heine-Geldern 1945:131; Heekeren 1972:125-26) and it has seemed worthwhile recording their attributes in some detail, both for present description and possible future analysis, should they ever be recovered in greater quantities.

At the level of intuitive recognition, the side scraper category was deliberately made broad and inclusive. It could contain a number of distinct types or comprise artifacts which vary considerably but not systematically from one another. The principal identifying criteria were that secondary working was mostly confined to the middle of one or both sides of the blade or flake, and while the secondary working varied from light invasive to steep step flaking, the latter where it occurred was generally associated with notches on the margins. This was thought to be the result of the process of use and resharpening. The tool may have been an unmodified flake when first used, or flaked lightly to strengthen a thin edge, and the more it was used, the steeper the retouched edge became.

It seems most probable that these artifacts were woodworking tools. The fact that so many are notched suggests that they were used more for small, cylindrical objects such as digging sticks, bows, spears or blow guns rather than for hollowing out bowls, canoes and so on. It is difficult to be certain whether they were hafted or not. Some (Fig.46) seem too small to be much use unhafted, whereas others (Figs 17, 42) could well be used in the hand alone. The average length (52.7 mm at Uai Bobo 1) is greater than for the Australian hafted tula adze which must have served much the same function (Glover 1967:421), and I would think that only the smaller artifacts were in fact hafted.

Artifacts with secondary working which only rarely occur, such as nosed scrapers, thumbnail scrapers, burins and gun flints, are described individually and most of them are illustrated.

ANALYSIS OF POTTERY

All of the sites excavated in Timor have yielded reasonably large quantities of pottery giving a total of over 14,000 sherds; a number which might be thought sufficient for sophisticated analysis. Nevertheless, the usefulness of this material for the normal archaeological procedures of typological and metrical analysis is reduced by the degree of breakage of the pots, the restricted range of vessel forms, the extreme rarity of surface decoration, and the conservatism over time in respect of those features which can be measured or recorded.

All of the sites excavated were caves and although these have an advantage that occupation is localised over time, there is the disadvantage that intermittent occupation by man and animals reduces the pottery to small fragments. This is especially noticeable in the centre of cave floors where the sherds are generally smaller than towards the walls. Timorese pottery, prehistoric and modern, is generally thin-walled and readily breaks into small fragments.

Caves, too, frequently produce a rather narrow range of pot types and unless the caves are used for burials or offering sites, most of the pottery will be simple utilitarian vessels. In Timor today, these are mostly globular pots, restricted into a neck with a short everted rim (Plates 6-9). At the pottery making village of Oralan (Glover 1968) near Vemasse on the north coast, vessels of this type comprised nearly 90% of all pots offered for sale at the weekly markets. There is some evidence that in the recent past a greater variety of pottery objects were made in Timor than at present. Jardim (1903) mentions a few clay drums, drinking vessels with lids, and square boxes, from villages where these forms are not made today. But these, perhaps always rare forms, have not been found in the cave deposits.

In many parts of eastern Timor modern pottery is painted with red, white and black mineral colours and in a variety of angular and curvilinear designs (Plates 7, 15), which are often specific to the village of manufacture. Jardim (1903) mentions such decoration 70 years ago but the custom must be of fairly recent introduction in East Timor because only a few sherds of painted ware were found in caves and these in the most recent levels.

Another method of finishing, or decorating, the surface of common wares is by burnishing when the clay is leather hard. Even light stroke-burnishing survives on pottery in the deposits and this does permit some stylistic changes to be observed. Some prehistoric pottery, for instance, in the Venilale region was burnished but the habit seems to have died out in that area today. But burnishing is of limited use in making detailed and specific comparisons between levels, sites, areas and cultures.

As far as I am aware, decoration by incision, impression or relief except for occasional modern flower pots, is unknown today in eastern Timor. Decoration is found, however, on less than 1% of the total number of excavated sherds. Incised ware is found at all sites and appears to be restricted to a period between 1500-3500 years ago. Decorated pottery provides valuable means for correlating various levels between sites, and the designs permit some simple comparisons to be made with traditions outside Timor.

The final character of Timorese pottery, which makes it unamenable to normal archaeological procedures, lies in its conservatism. Continuity of style is less easy to argue from, than evolution or radical changes. There are some changes in Timor pottery traditions since the 3rd millennium BC, when pottery first appeared in the sites, but they are small, slow and not very obvious. Apart from the recent painted decoration and the few incised sherds, it is virtually impossible to say whether any one sherd or rim form is modern or 4000 years old, whether it comes from the coast or from the mountains. In time, it may be possible to isolate certain characters or combinations of them which distinguish Timorese pottery from that of the surrounding islands, and the modern from the ancient. But with the present lack of available comparative material, it is difficult to see in proper perspective the archaeological value of the differences and similarities within the body of excavated pottery.

The emphasis in the treatment of pottery in this monograph therefore is descriptive rather than analytical. Many of the attributes recorded have little immediate value for the analysis and interpretation of the material beyond demonstrating the continuity of tradition. But when more is known about the pottery from other regions of the island and from outside it, some of the data recorded here may prove archaeologically useful.

Descriptive terms

Descriptive terms for vessel shape and for parts of vessels are based on those used by Shepard (1965:225-49). Most sherds in all the excavated collections come from vessels which are in Shepard's category of independent restricted forms and most of them are necked. Plates 7-10 and Plate 15c, d show the typical shape and proportion of these pots. There are also a few simple unrestricted vessels or bowls in the collections; a fairly typical modern one is illustrated in Plate 15b. There are also a few sherds from Lie Siri, of vessels with more complex contours which are difficult to reconstruct and these are described separately.

Terms such as rim, lip, mouth, neck, shoulder, base, etc. are used in the commonly accepted senses and they are not always exclusive nor with definable limits. Thus, one can say that the lip is part of the rim without having to say exactly where it begins. The rim is thought of as the area from the neck to the lip, and the neck merely as the point of maximum constriction below the mouth. It usually coincides with a point of vertical tangency (Shepard 1965:Fig.18).

Most of the vessels have, as far as one can tell, only one end point, the lip, as most bases are

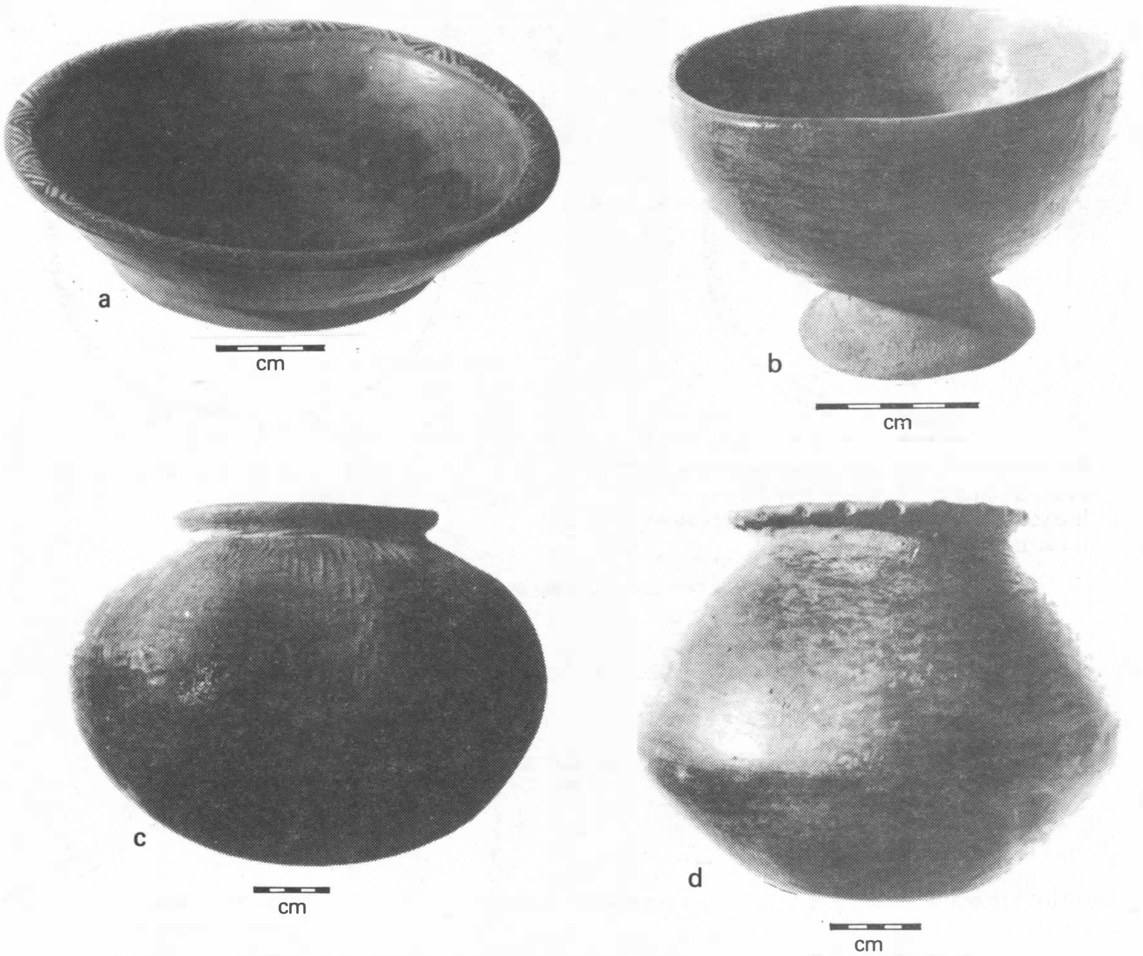


Plate 15 Typical forms of modern pottery from the north coast of East Timor

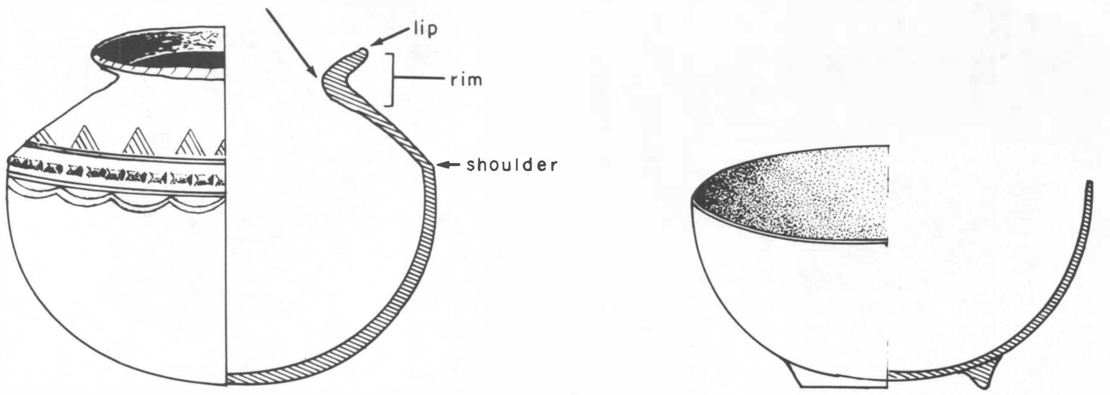
- **a Ring-base bowl, burnished red slip and painted red and black on rim. Bought in Baguia market, probably made in *suco* Tekinamata**
- **b Pedestal bowl, burnished red slip. Bought in Liquica market, north coast west of Dili**
- **c Cooking pot with paddle-stamped surface from *suco* Uai Tami, Quelicai bought in Baucau market**
- **d *Lum* - water pot from *suco* Oralan, Vemasse made by Clara Freitas. The manufacture of these vessels is described in Glover 1968**

rounded. A shoulder, which is rare in Timorese pottery, is an angular change in contour, or corner point. Where it occurs, it lies at or above the major point, or point of greatest diameter on the body. The use of these terms is illustrated in Figure 7.

For ease of reference, I call the necked, independent restricted forms without shoulders and without base modifications, globular or spherical, since below the rim, they generally approximate to this shape. But because most of the pottery comprises small undecorated sherds it has not been possible to achieve much in the way of vessel reconstruction and the pottery has been divided into two main categories, rim sherds and body sherds, which are described and analysed independently.

Measurement of pottery frequency

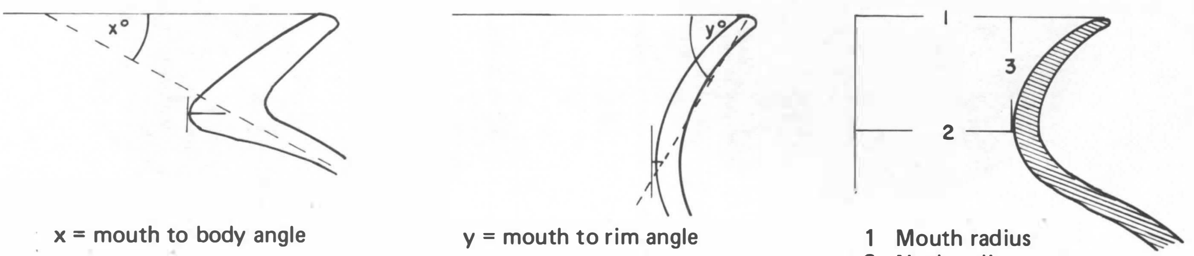
Solheim (1960), has suggested that sherd weight should be considered together with sherd



Round-based vessel with restricted form, everted rim and an angular shoulder line. Incised and relief decoration, where present, is usually placed at the shoulder.

Bowl with unrestricted form, direct rim and a ring base.

The drawings are not based on any individual vessels



x = mouth to body angle

y = mouth to rim angle

1 Mouth radius
2 Neck radius
3 Rim height

Fig.7 Pottery forms and rim attributes

count when assessing the quantity of pottery in various levels of a site, or between sites. But it can be argued that, as a single measure, the surface area of pottery present, would serve just as well, and be easier to handle than ratios between two or more measures. On the other hand, it is a waste of time to make several measures, or a difficult one such as area, if they are going to yield essentially the same results. To see if the latter would be the case, an experiment was made with the excavated collection from Uai Bobo 2. (See also Chapter VIII where the full analysis of the pottery from this site is presented.)

Within each horizon all of the pottery was counted, weighed, and the surface area estimated by crowding the sherds together into rectangles leaving the minimum possible free space between sherds. The area of the rectangle was taken to equal the surface area of pottery. This is a rough measure but if done in the same way for each sample, errors are likely to be consistent. A measure for surface area has the advantage that it can be related to the numbers of vessels present if their sizes are known or can be calculated. Rim sherds were also counted separately to see if rim sherds alone would give a reliable measure of the relative frequency of pottery.

Details of the test are omitted here and can be found in Glover (1972a:93-96). It was apparent that all four measures for pottery frequency show very considerable agreement and that any one would be quite adequate as a measure of pottery frequency.

Since it was useful for simple descriptive reasons to have sherd numbers, these alone have been used to measure pottery frequency for sites other than Uai Bobo 2.

Rim sherds

Rim sherds are analysed by pots rather than by separate sherds. Thus all rim sherds recognised to be from one vessel will be joined if possible and treated as one rim. Where there is doubt whether two rims come from the same vessel they are assumed to come from different vessels. A preliminary examination of the rims showed two main forms to be present:

1. Direct rims, with no change in direction, contour or thickness of the wall before the lip. Body shape of these vessels is generally, and perhaps always, unrestricted.
2. Everted rims, where the body wall changes direction below the lip. Body shapes are always restricted.

Everted rims are by far the most numerous in all sites in Timor and exhibit considerable variation. Most of the rims are small and a descriptive code has been designed to record data on as many as possible. On the larger and more complete sherds, some potentially useful information has been ignored because it could only be recorded on very few sherds. Analysis of the recorded data has been made to see if there are any consistent changes over time or between sites for the various attributes recorded. No multivariate analysis has been made for significant clusters of attributes nor for changes in the pattern of relationships between attributes, because of the small samples involved.

Descriptive code for rim sherds

1. *Rim form*
   Direct
   Everted A, with marked thickening at neck
   Everted B, with no marked thickening at neck.

2. *Lip form*
   Rounded
   Angular
   Decorated (incised, impressed, grooved etc.).

3. *Angle between upper part of body and mouth of vessel*
   The greater the restriction of the upper body, the more acute this angle will be (Fig.7). The angle has been recorded to the nearest 5°.

4. *Angle between rim and mouth*
   The more flaring and flatter the rim, the more acute this angle will be. It has been recorded to 5°.

5. *Height of rim*
   This is the distance between the plane of the vessel mouth and point of vertical tangency, as in Figure 7.

6. *Radius of circle formed by lip*
   With the mouth plane horizontal the sherd was tested for goodness of fit against a series of concentric circles with intervals of 1 cm.

7. *Radius of circle formed by neck*

8. *Percentage of whole vessel represented by the rim sherds*
   This is measured as a percentage of rim circumference in intervals of 5% to estimate what proportion of the pottery is missing from the sample.

9. *Surface texture*
   The preliminary examination showed that some of the pottery was burnished, either over the entire outer surface or in a series of more or less parallel and purely decorative lines (stroke-burnishing); some was slipped, and also usually burnished. But the majority of sherds appear to have been merely wiped smooth while wet. This last finishing technique can be recognised by horizontal striations caused by coarse granular inclusions from the clay which have been dragged across the surface. Sherds decorated by incision, impression, painting and so on are all illustrated and discussed separately.

A more detailed analysis of rim form (e.g. Shepard 1965:245ff.), and associated attributes is not warranted because of the small size of the collections and the narrow range of rims present. It must be remembered that all the pottery is hand-made, not wheel turned, and considerable variation exists in form, angle, proportions etc. at different points on a single vessel and in the production of one potter or within one local tradition.

Body sherds

Body sherds comprise about 97% of all the pottery. They have not been catalogued individually, but the following data has been recorded where it was appropriate:

1. number of decorated sherds, shoulders and bases;
2. maximum thickness;
3. surface finish;
4. frequency of shell or other easily recognisable fillers; and
5. indications as to technique of manufacture; coil building, paddle and anvil shaping etc..

To see if there had been any progressive change in average body wall thickness, sherds in each horizon at two sites, were measured to 0.5 mm, the means, standard deviations, and the significance of mean differences were calculated. Where the number of sherds in any one horizon was small, horizons were grouped, and where large, samples were taken by quartering.

Decoration

Sherds decorated with incision, impression, application and painting were so few that no real analysis was possible. All the decorated sherds are illustrated, compared between sites and with designs from elsewhere in Southeast Asia and Melanesia.

Physical properties

At this present stage of research it has not seemed worthwhile to spend much time on analysis of strength, porosity, mineralogy and so on, of the excavated pottery. Thin sections were made of samples of pottery from various levels in some sites, to provide a basic description of mineralogy, and to compare the prehistoric ware with modern pottery of known place of origin. One or two sherds which, on stylistic grounds, it was felt were exotic, were examined and compared with the indigenous ware. This work was started by Mr C. Key, Department of Prehistory, ANU, at that time but was not completed. Preliminary results are included in the respective chapters.

It was not thought that anything could be gained by recording the colour of sherds, because it was evident from the modern Timorese pottery that there were very great colour differences on a single pot, as one would expect to be the case with open fired wares. And further, subsequent use for cooking, or random refiring of broken sherds in cave hearths would disguise any systematic variations in colour originally possessed by that pottery.

OTHER STONE ARTIFACTS

A small number of stone artifacts, other than flaked stone, were found. These are too few for detailed analysis, but some are of interest because of their rarity. The largest number comprises oval stone pebbles, probably pounders, since many are pitted on the ends or sides (Plate 28). The occurrence of these has been correlated with that of cores and waste flakes to see whether their identification as anvils and hammer stones can be supported. Many are likely to be multi-purpose pounders for nuts (e.g. *Aleurites*, *Areca*), seeds and so on. Some of these and the more unusual of the other stone artifacts have been described and illustrated.

SHELL ARTIFACTS

In most sites small numbers of shell ornaments were found, mainly pierced discs of *Nautilus* shell, and olive and arc shells some of which appear to have been pierced for threading. These have been identified as closely as possible by Emily Glover in consultation with Mr G. Buik, University of Papua and New Guinea, Port Moresby, and are illustrated. Over 60 pierced discs were found and the external diameters of these have been measured both for descriptive purposes and to look for possible functions for the discs.

At Bui Ceri Uato Cave, one polished *Tridacna* shell adze and one possible broken stone axe/adze were recovered. The former conforms closely to the size and form of the few polished stone adzes so far known from Timor. One complete and one broken shell fish-hook were also found at the same site.

MOLLUSCA

The sites of the Baucau Plateau all contained numbers of marine and other shells, and samples were collected from Lie Siri and Bui Ceri Uato. The density in these sites was not so great that adequate samples could be obtained from one or more small vertical columns through the deposit and other means of sampling them had to be found.

It was decided to collect all the shells from a number of buckets taken from spits at various positions in the excavation, in such a way that there would be an adequate sample from each level and that horizontal variations in the number and proportions of shells would be evened out. As the number of buckets could be related to the excavated volume of deposit, changes in the density of shells over time could be calculated.

Shells from Bui Ceri Uato were identified by Emily Glover in 1969 in consultation with Mr G. Buik, and using the then standard reference work on Indo-Pacific shells (Kira 1962). The analysis of the mollusca from Lie Siri was undertaken with the cooperation of the Australian Museum, Sydney, which now holds all the collections. The shells were examined and sorted in Sydney in 1981 and representative types of all the species were taken to London for final identification. The British Museum of Natural History generously allowed the use of their collection and library and in particular I must thank Dr J.D. Taylor and Mr F. Naggs for their help and advice. There are always difficulties with the determinations of archaeological molluscan specimens; shells are frequently degraded, broken or burnt, but in the case of Lie Siri molluscs most of the shells were in reasonable condition, some remarkably fresh-looking and most of the identifications are fairly secure and are better substantiated than those from Bui Ceri Uato. It therefore seemed worthwhile to develop the analysis of the material from Lie Siri beyond that possible for Bui Ceri Uato. With this better data it has been possible to look in more detail at the cultural and ecological implications and to make comparisons with those few other coastal sites in Southeast Asia for which any data exists.

Unfortunately, little work could be done in the field collecting information on the ecology of the various shell species found in the caves, nor on the classification, preferences and uses made of shells by present-day Timorese, so that cultural and environmental information obtained from analysis of the mollusca is very limited.

PLANT REMAINS

Plant remains found in the excavations comprised, for the most part, nuts and seed cases, together with wood fragments, leaves and animal dung near the surface of some sites. Most common, and easily identifiable, were the broken and often partly burnt shells of the candlenut tree (*Aleurites moluccana*), known as *kami* in Timor (*kemiri* in Indonesian). They are commonly used on the island to produce lamp and cosmetic oil, and soot for tattooing, and they may have been eaten, as they still are in parts of western Indonesia. Samples of these and other plant remains were sent to Dr D.E. Yen, Bernice P. Bishop Museum, Honolulu; now Department of Prehistory, RSPacS, ANU, for identification and his report is contained in Appendix 4.

Soil samples were collected which might contain microplant remains. Four of these samples from near the surface of sites Lie Siri, Bui Ceri Uato, Uai Bobo 1 and Uai Bobo 2, were examined for pollen by Dr J.M. Powell, The Herbarium, Royal Botanic Gardens, Sydney, New South Wales. However, alkaline limestone cave deposits do not favour the preservation of pollen and too little was found to make further investigation worthwhile except possibly in Uai Bobo 1.

Results were as follows:

Lie Siri, Horizon VIb, 10-15 cm below surface: several grains of Pteridae (ferns), two grains of Poaceae (grasses), two ?Chenopodiaceae, one grain of ?Moracae (figs), one of ?Euphorbiacae, and a few unidentifiable grains.

Bui Ceri Uato, Horizon IX, 10-15 cm below surface: a few fungal spores present but no pollen.

Uai Bobo 1, Horizon VIII, 5-10 cm: pollens were quite plentiful although not well preserved. Those recognised included several Pteridae, Cyperacae (sedges), and Poaceae, Umbelliferae and *Casuarina* sp. Some unidentifiable pollen and fungal spores were also found, one large grain, tentatively identified as a cereal.

Uai Bobo 2, Horizon XII, 40-50 cm below surface: very little pollen was recognised and that poorly preserved. Only Pteridae and Poaceae could be recognised, and fungal spores were present.

Dr Powell comments that grasses and fern pollens are the most resistant to alkaline erosion and the absence of other species probably reflects this. She suggests that it would be worth looking at more samples from Uai Bobo 1 and perhaps Lie Siri, using liquid flotation methods. It is interesting to note that *Casuarina* sp., recorded only at Uai Bobo 1, is one of the most common tree species near the site growing widely on the clay deposits below the limestone cliffs; it is not found near the coastal sites and grows only in river valleys at lower altitudes.

SOIL SAMPLES

The analysis and interpretation of soil samples presents great difficulties to the archaeologist not trained in geomorphological techniques. This is especially the case in an area such as Timor, where only the broad outlines of geology are known, and where the effects of the world-wide climatic changes since the late Pleistocene are not all understood. Many of the techniques and inferences developed for the interpretation of cave deposits in temperate latitudes (Schmid 1963) have not yet been shown adequate for dealing with material from the tropics (Jennings and Frank 1967:LXVI-III and pers. comm.). Nevertheless it was felt that some attempt should be made to analyse samples of the cave deposits to investigate the nature of the problems involved and to provide a basic description of them.

Soil samples were collected from the cleaned sections of all sites, at vertical intervals of approximately 10-15 cm, and where possible from the front, middle and rear of the caves. The samples were in the order of 1-2 kg when collected, of which moisture comprised 2-11% by weight.

After discussion with Dr Jennings, Department of Biogeography and Geomorphology, ANU, it was decided that Mr K. Fitchett of the same department, would examine seven samples, each of about 70 gm, from Uai Bobo 2 to see whether meaningful results were obtainable before an analysis was attempted of samples from all sites. He was asked to test the samples for: (a) pH values; (b) the proportion by weight of carbonised and non-carbonised organic material; (c) particle size; and (d) carbonate content.

pH values had been measured in the field with Johnson's papers. All levels in all sites were within the range of 7-9, with a very slight tendency to increase with depth.

Carbonised organic material is thought to represent, for the most part, wood charcoal resulting from human occupation, and the determination of the proportions of charcoal present at various levels should give some index of the frequency of occupation which is independent of the artifacts.

The non-carbonised organic material is thought to include fine roots in the lower levels, and roots, goat dung and decayed vegetable material in the upper levels where it might comprise a significant proportion of the deposit in volume. Artifact densities have been calculated for the deposit *in situ* and these could be affected by the amount of non-carbonised organic matter in the upper levels.

It was thought that the bulk of the deposit had been derived from chemical weathering of the cave walls and roof, with perhaps small proportions contributed by slope-wash, deposition of sediment by percolating water through the roof, and wind-blown soil. Analyses for particle size and carbonate content are required to determine whether there have been any marked changes in the proportions contributed by these sources over time. It seemed possible that the introduction of agriculture to the island resulted in increased erosion on the steep hill slopes resulting in a greater proportion of the cave deposit being derived from this source in recent times.

Mr Fitchett found that it was not practicable to distinguish between carbonised and non-carbonised organic matter, nor to analyse the particle size distribution of non-carbonate minerals, since the overwhelming bulk of the deposit consisted of soluble carbonate.

An attempt was made to eliminate all carbonate from one sample of 54.3 gm from Uai Bobo 2 Horizon V, but after boiling the sample for 240 hours in 36 HCl (dil.), microscopic examination of the small amount of residue revealed an absence of non-carbonate minerals. Since this one sample required over five winchesters of concentrated HCl, further attempts did not seem to be justified. Measurement of pH and organic material proved to be more successful, and the results for Uai Bobo 2 are given in Chapter VIII. The organic content was obtained by reaction with hydrogen peroxide.

FAUNAL REMAINS

The alkaline soil aided the preservation of bone and good collections were made at most sites. It was intended to collect all bones, and by careful screening in coarse and fine sieves, good recovery was achieved, including the majority of diagnostic bones. A problem was the large number of rodent bones in the lower levels of many caves; Uai Bobo 2, Horizon II for instance, contained 1348 mandibles of small rodents and an estimated 18,300 bones, complete or broken.

The sorting and analysis of the smaller bones was by horizons and not by spits and squares. Although some information will have been lost on the horizontal distribution of bone at each level, the additional time required to sort each spit separately seemed unjustified. Preliminary sorting was made into the following categories:

1. large rodents, dentition and cranial fragments;
2. small rodents, dentition and cranial fragments;
3. larger mammals, dentition and cranial fragments;

4. larger mammals, postcranial bones;
5. bats, dentition and cranial;
6. reptiles, dentition and cranial;
7. birds, all identifiable bones;
8. fish, all identifiable bones; and
9. unidentifiable postcranial bones, (mostly small rodents).

The bones from each horizon were sorted twice by different workers, all of whom had had some previous experience with identifying faunal remains.

The dentition and postcranial material of the larger mammals were identified as far as possible to generic level. The animals thus provisionally identified included pig, goat, dog, buffalo, monkey, civet cat and cuscus. After this preliminary sorting, the identifiable faunal remains were sent to the following experts whose help is gratefully acknowledged:

Rodents	Mr J. Mahoney, Late of the Department of Geology and Geophysics, University of Sydney
Human bones	Dr A.G. Thorne, Department of Prehistory, ANU
Bats	Mr J.L. McKean, Division of Wildlife Research, CSIRO
Marsupials	Mr J. Calaby, Division of Wildlife Research, CSIRO
Other mammals	Professor C.F.W. Higham, Department of Anthropology, University of Otago

Very few diagnostic fish bones were recovered and it has not been possible so far to have identifications made of these, the reptiles, or the few insectivores which were found.

The reports by Higham, Mahoney and McKean are contained in Appendices 1-3. Remains of humans and marsupials, and identified bird remains, were too few to warrant separate appendices, and the data on these is incorporated in the respective site reports.

V EXCAVATIONS ON THE BAUCAU PLATEAU: LIE SIRI

DESCRIPTION AND EXCAVATION

During the excavation of the cave at Uai Ha Ie in June 1967 I had the opportunity to explore the surrounding plateau terraces for archaeologically more productive sites. Only 200 m to the north I found a large, open and well-lit cave (Plate 16) with a usable floor area of about 20 x 30 m. The cave, called Lie Siri and designated as Site TL, was situated at 240 m above sea level, facing northwest and close to the track from Osso Ua *povoação* to Uai Ono (Fig.4). Most of the back of the cave was occupied by sloping sheets of flowstone which was covered in places by goat dung. At the front, and in the northeast corner there was a level area of earth, again covered with hard-packed goat dung, where excavation was possible. The front of the cave was closed by a carefully built rubble wall which overlay a mound of earth and large boulders fallen from the roof. Behind the wall at the western end, were two wood and bamboo racks, about 1.5 m high by 1-2 m square (Plate 17). A broken pot, empty corn husks, and a large wooden pestle were lying on one of the frames. Such racks are common in caves in Timor, and their function is discussed in the next chapter. A rotten post, probably from another such frame, was found in Square N5W9, during the excavation of the cave. In front of the cave, a gently sloping walled garden contained the dried stalks of the previous season's corn crop.

Six weeks were spent excavating at Lie Siri in July and August 1967, plus a few days in November.

A permanent datum mark was carved on a stalagmite pillar near the western end of the cave at 1.98 m above the floor at that point. This was recorded as 11.98 m above an assumed zero, and all readings made with the dumpy level and surveying staff were subtracted from 11.98 m to give the height above zero. Thus the surface at the northwest corner of the trench was 1.30 m below the marked datum, and 10.68 m above zero. An east-west trench, 8 x 2 m was laid out between the stalagmite pillar and the smaller of the two wooden frames. This was subsequently extended to the north and west so that 34 one metre squares were excavated. They are numbered in Figure 8. The irregular shape was determined by the need to avoid as many large boulders as possible, and the fact that the base rock sloped towards the northwest where a maximum depth of 2.05 m was reached at the northern side of Square N5W11. For the purposes of analysis, the trench has been divided into six areas, A-F, which are shown on the main plan.

The stratigraphic sections on Figures 9 and 11 show the south faces of Squares SOW3-10, the west face of Squares SOW10-N3W10, and the south and west faces of Square N4W11. All the other principal sections were recorded, and the drawings were used in order to interpret the sequence, and to correlate the layers and excavated spits across the trench.

Excavation was carried out along the lines discussed earlier and the 312 excavated units were correlated first within each area then across the entire trench, into 12 horizons (including subdivisions) which are shown projected onto the stratigraphic sections. Correlation over such a large area was not always easy because of the uneven slope of the surface and rocky floor, and the varying depths in different parts of the trench. In Area A, and at the south side of Areas B and C, base rock lay at between 20 cm and 1.10 m below the surface and the sequence in the lower part of this area was compressed. In the top 40 cm this did not appear to be the case, for the goat dung was thicker there than elsewhere. The deepest pottery was found at about 40 cm below the surface in all parts of the trench which suggested that excavated units at the same depth from the surface, could be correlated with reasonable confidence for the top part of the deposit at least. About this level there was a marked colour change, from greyish-brown to pale brown, or light grey containing less charcoal (Plate 18). This stratigraphic break has been correlated over the site as the start of Horizon Vc. Just

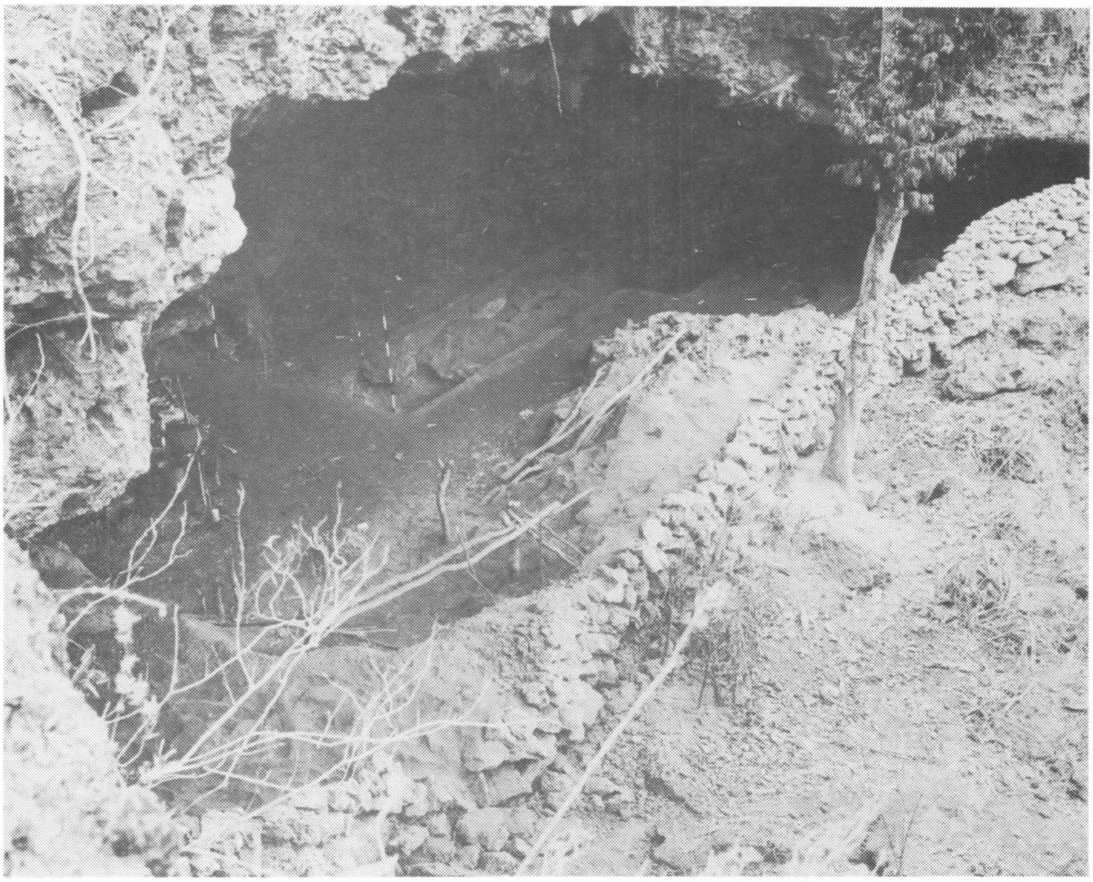


Plate 16 Lie Siri: northern end

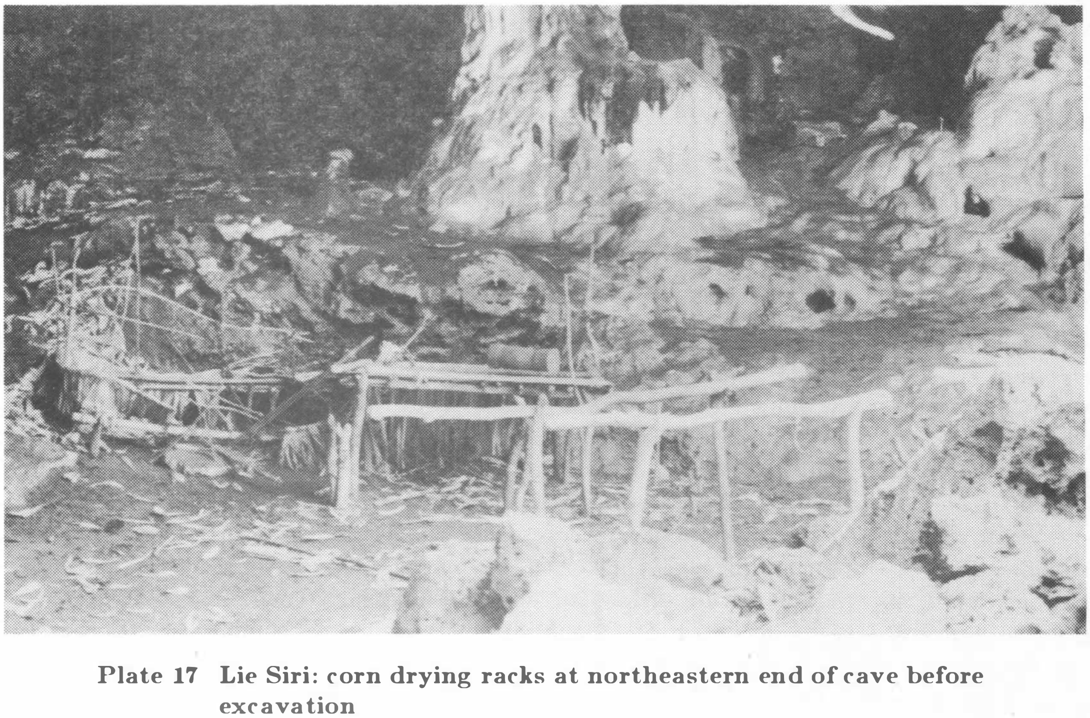
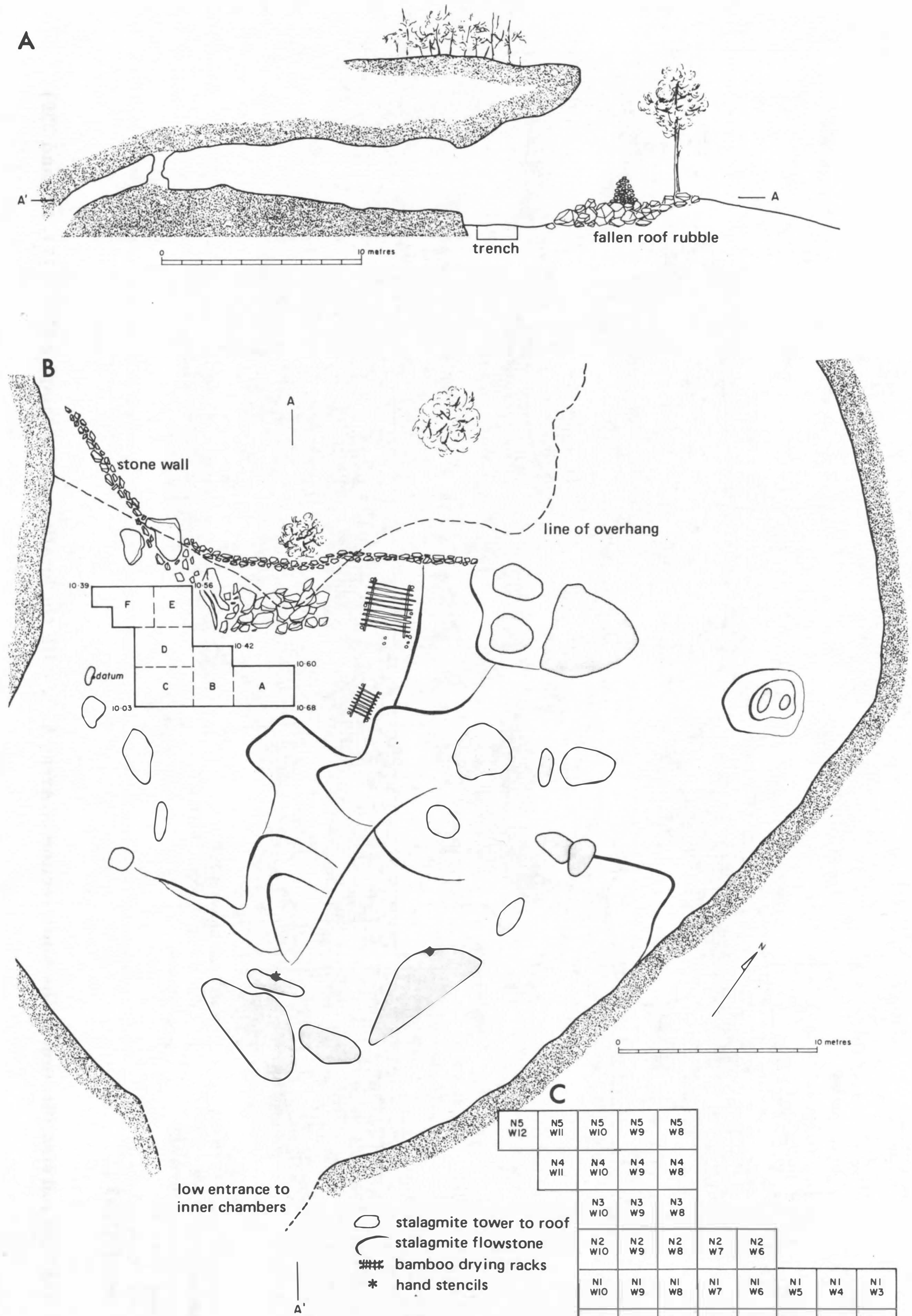


Plate 17 Lie Siri: corn drying racks at northeastern end of cave before excavation



A Section through the cave at A – A[1]

B Plan with the location of trench

C Excavated squares

Fig.8 Lie Siri: plan and section through the cave

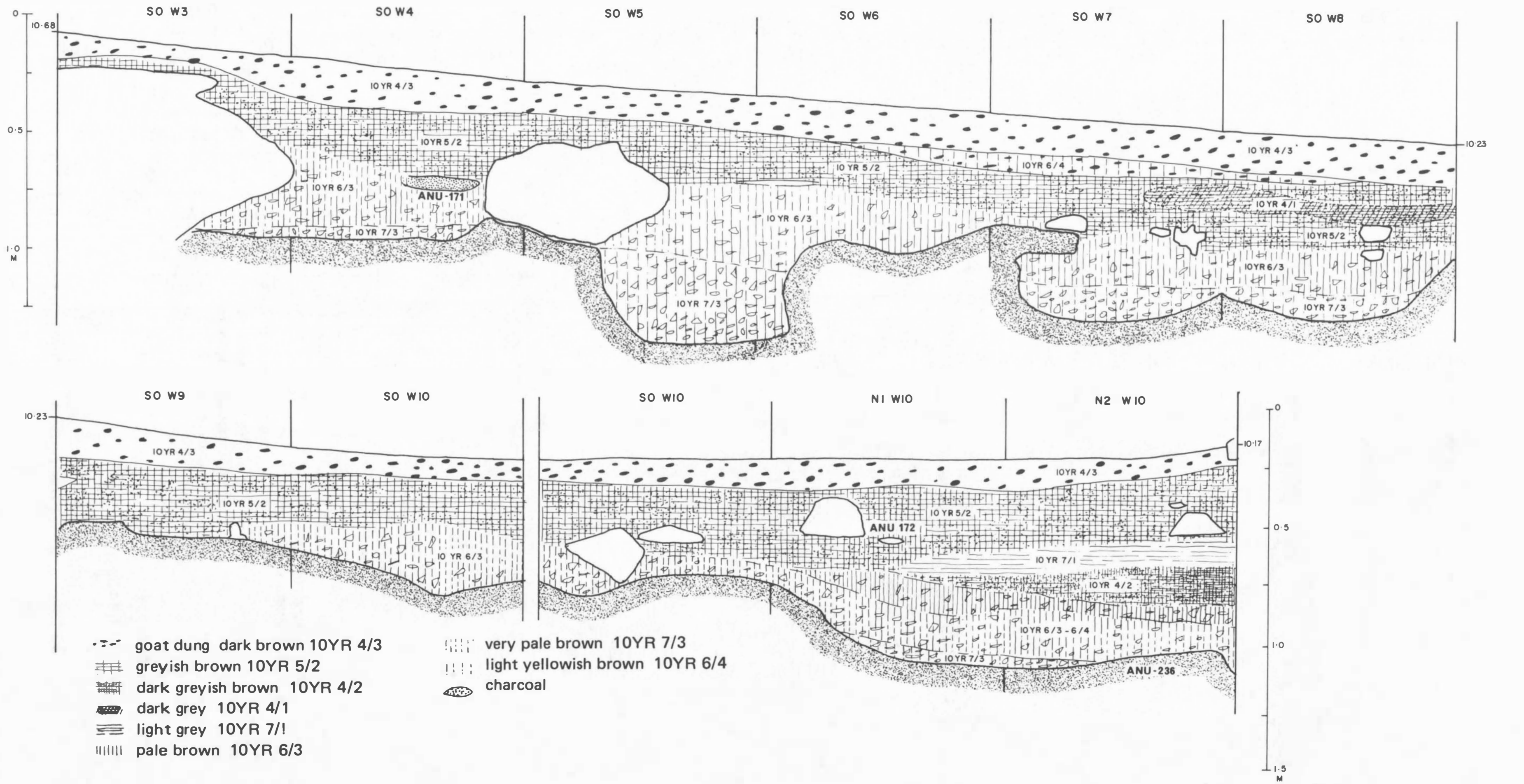


Fig.9 Lie Siri: soil stratification in the south section of Areas A-C, with the location of C14 samples (ANU-171, 172 and 236)

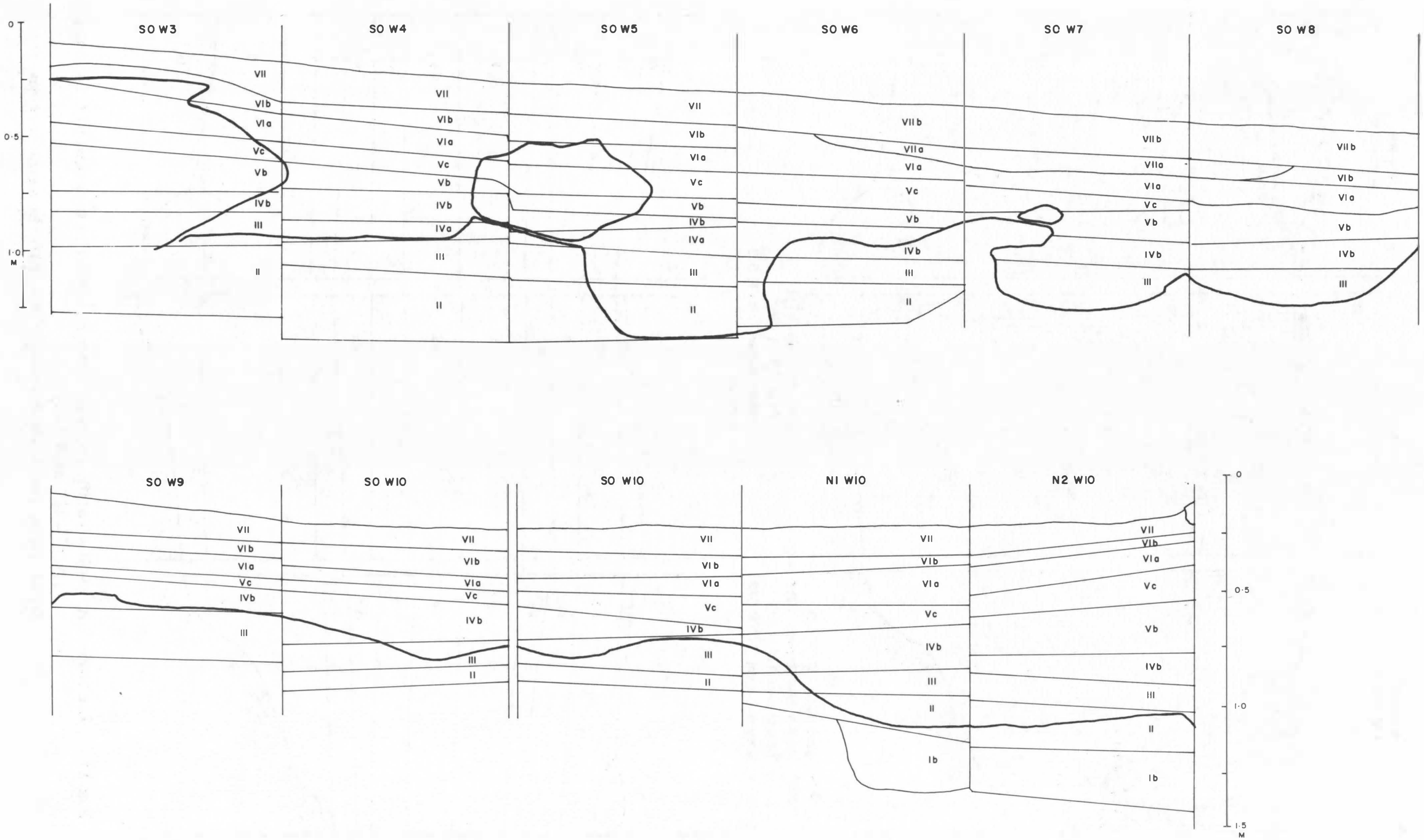


Fig.10 **Lie Siri: horizon correlations in Areas A-C projected onto the section shown in Figure 9**

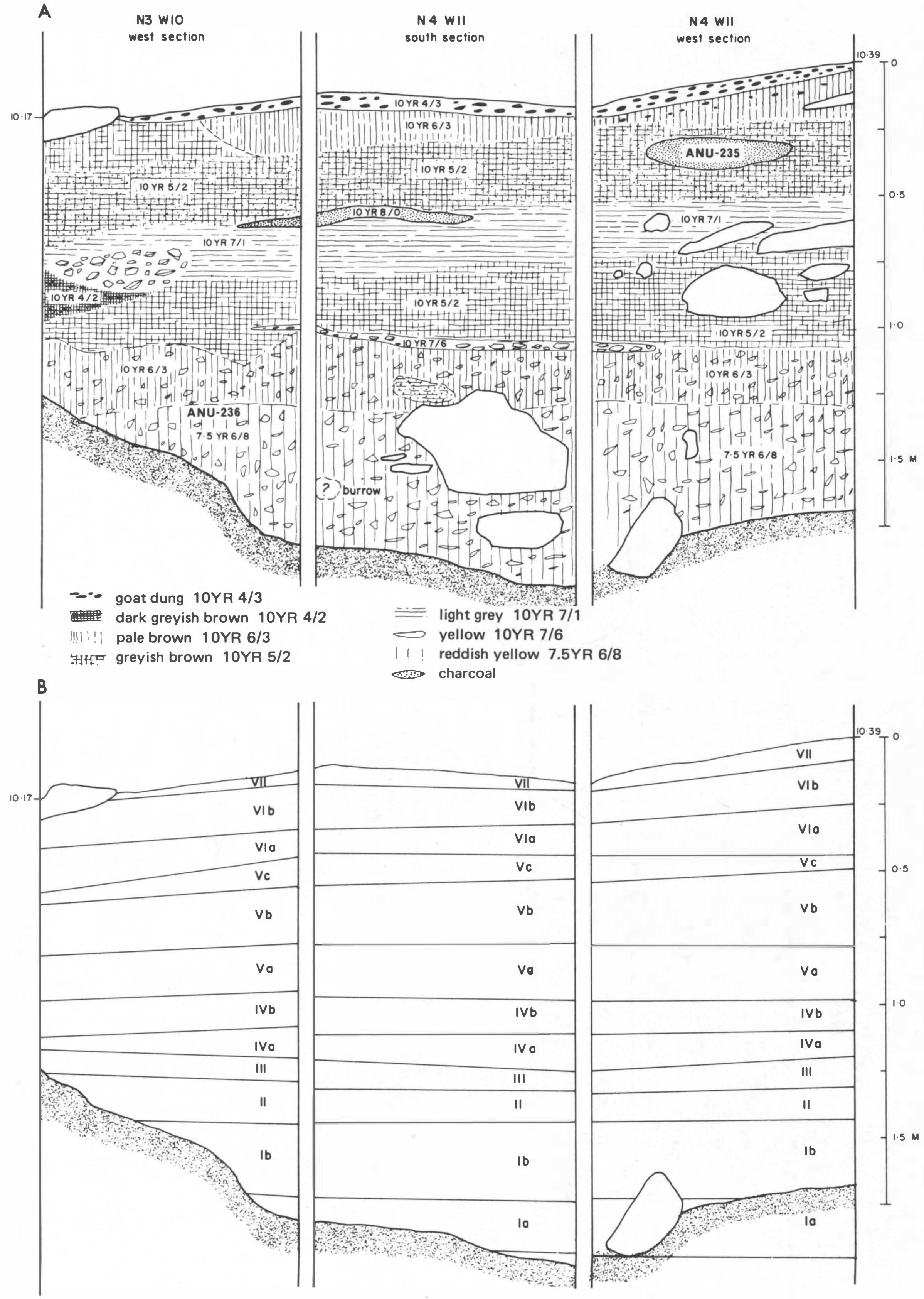


Fig.11 Lie Siri: A Soil stratification in Area F, with the location of C14 samples (ANU-235 and 236)
B. Horizon correlations projected onto the same section

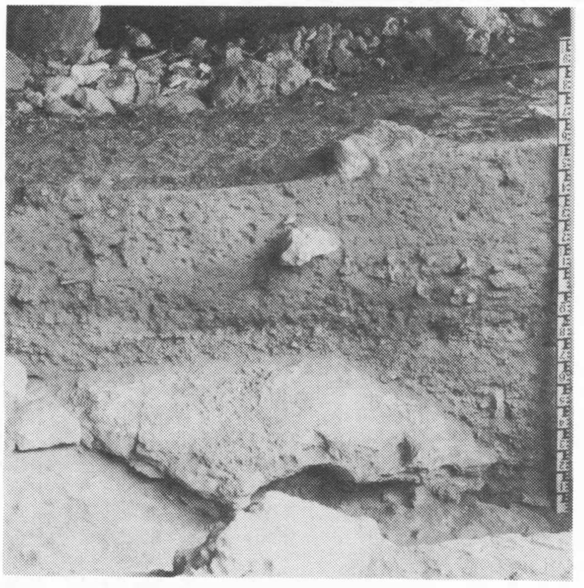


Plate 18 Lie Siri: stratification in the west section of Squares N1W10-N3W10

above base rock in Areas A-C, and 30-50 cm above the rock Areas D-F, there is a further change to a very pale brown, or reddish-yellow earth, with increasing quantities of rocks and fine rubble, which has also been broadly correlated.

Not all of the deposit was excavated down to base rock; in Squares N2W6-N2W8, and N3W8-N5W8, only the top 50 cm of deposit was removed in an attempt to increase the pottery sample, and in particular, to find more of the decorated ware which was found in Areas D-F.

Excavation was generally by 10 cm units following the surface slope where no stratigraphic boundaries could be seen. In Squares N5W8-N5W11 the top 50 cm was dug in 4-5 cm units in an attempt to fix more precisely the level of the decorated pottery which was found in the top 20 cm or so of cave earth below the goat dung. This was abandoned later when I realised that such precision was more apparent than real for the material within any 10 cm unit was quite well churned up. In any case, few of the decorated sherds were found in these squares. In Squares SOW6 and SOW7 a lens of light yellowish-brown goat dung was clearly stratified under the hard crust. This was excavated separately and has been called Horizon VIIa on the section in Figure 10.

I believe that the deepest deposit in Areas D-F, is older than any levels in Areas A and B, and so Horizons Ia and Ib are not represented there, where Horizons II and III comprise the lowest deposit. The rate of accumulation appears to have been rather more rapid in the deeper parts of Areas D-F, and the strata, which here dip towards the northwest in the lower part of the deposit, become more nearly horizontal towards the surface. Horizons IV and V have been subdivided in the areas of deeper deposit to take this into account. The correlations between excavated spits and these horizons are listed in Table 2.

The horizon numbers, I-VII were assigned when the excavated units were correlated with the stratigraphy (Table 4) and before the artifactual material was processed. These subdivisions do not fall very conveniently for the analysis of cultural change within the site. Thus, pottery first appears in Horizon Vc, which is the end of Horizon V, although this is obviously a major cultural break.

The volume of each excavated spit was calculated in the manner outlined previously. The volumes thus obtained for each area and horizon separately are given in Table 3.

Table 2 Lie Siri: correlation of excavation units

Horizon	Area A	Area B	Area C	Area D	Area E	Area F
VII	SOW5 1	SOW7 1	SOW10 1	N2W10 1	N4W9 1	N4W11 1
	SOW5 2	SOW6 1	SOW9 1	N2W10 2	N4W8 1	N4W10 1
	SOW4 1	N1W7 1	SOW8 1	N2W9 1	N5W9 1	N5W12 1
	SOW4 2	N1W6 1	N1W10 1	N2W8 1	N5W8 1	N5W12 2
	SOW3 1	N2W7 1	N1W9 1	N3W10 1	-	N5W11 1
	SOW3 2	N2W6 1	N1W8 1	N3W9 1	-	N5W10 1
	N1W5 1	-	-	N3W8 1	-	-
	N1W5 2	-	-	-	-	-
	N1W4 1	-	-	-	-	-
	N1W4 2	-	-	-	-	-
	N1W3 1	-	-	-	-	-
	N1W3 2	-	-	-	-	-
VIb	SOW5 3	SOW7 2	SOW10 2	N2W10 3	N4W9 2	N4W11 2
	SOW4 3	SOW6 2	SOW9 2	N2W9 2	N4W8 2	N4W11 3
	SOW3 3	N1W7 2	SOW8 2	N2W8 2	N5W9 2	N4W10 2
	N1W5 3	N1W6 2	N1W10 2	N3W10 2	N5W9 3	N5W12 3
	N1W4 3	N2W7 2	N1W9 2	N3W9 2	N5W9 4	N5W12 4
	N1W3 3	N2W6 2	N1W8 2	N3W8 2	N5W8 2	N5W12 5
	-	-	-	-	N5W8 3	N5W11 2
	-	-	-	-	N5W8 4	N5W11 3
	-	-	-	-	N5W8 5	N5W11 4
	-	-	-	-	-	N5W10 2
	-	-	-	-	-	N5W10 3
	-	-	-	-	-	N5W10 4
VIa	SOW5 4	SOW7 3	SOW9 3	N2W10 4	N4W9 3	N4W11 4
	SOW4 4	SOW6 3	SOW8 3	N2W9 3	N4W8 3	N4W10 3
	SOW3 4	N1W7 3	N1W10 3	N2W8 3	N5W9 5	N5W12 6
	N1W5 4	N1W6 3	N1W9 3	N3W10 3	N5W9 6	N5W12 7
	N1W4 4	N2W7 3	N1W8 3	N3W9 3	N5W8 6	N5W11 5
	N1W3 4	N2W6 3	-	N3W8 3	N5W8 7	N5W11 6
	-	-	-	-	-	N5W10 5
	-	-	-	-	-	N5W10 6
Vc	SOW5 5	SOW7 4	SOW10 3	N2W10 5	N4W9 4	N4W11 5
	SOW4 5	SOW6 4	SOW9 4	N2W9 4	N4W8 4	N4W10 4
	SOW3 5	N1W6 4	SOW8 4	N2W8 4	N5W9 7	N5W12 8
	N1W5 5	N2W7 4	N1W10 4	N3W10 4	N5W9 8	N5W11 7
	N1W4 5	N2W6 4	N1W9 4	N3W8 4	N5W8 8	N5W11 8
	N1W3 5	-	N1W8 4	-	N5W8 9	N5W10 7
	-	-	-	-	-	N5W10 8
Vb	SOW5 6	SOW7 5	N1W9 5	N2W10 6	N4W9 5	N4W11 6
	SOW4 6	SOW6 5	N1W8 5	N2W10 7	N4W9 6	N4W11 7
	SOW3 6	N1W7 4	-	N2W9 5	N4W8 5	N4W10 5
	N1W5 6	N1W7 5	-	N2W8 5	N5W8 10	N4W10 6
	N1W4 6	N1W6 5	-	N3W10 5	N5W8 11	-
	N1W3 6	N1W6 6	-	N3W10 6	N5W8 12	-
	-	N2W7 5	-	N3W9 4	-	-
	-	N2W6 5	-	N3W9 5	-	-
	-	-	-	N3W8 5	-	-
Va	-	-	-	N2W9 6	N4W9 7	N4W11 8
	-	-	-	N2W9 7	N4W9 8	N4W11 9
	-	-	-	N3W10 7	N4W9 9	N4W10 7
	-	-	-	N3W9 6	-	N4W10 8
	-	-	-	N3W9 7	-	N4W10 9
	-	-	-	N3W9 8	-	-
IVb	SOW5 7	SOW7 6	SOW10 4	N2W10 8	N4W9 10	N4W11 10
	SOW4 7	SOW6 6	SOW9 5	N2W9 8	-	N4W10 10
	SOW3 7	N1W7 6	SOW8 5	N3W10 8	-	-
	N1W5 7	N1W6 7	N1W10 5	N3W9 9	-	-
	N1W4 7	-	N1W9 6	-	-	-
	N1W3 7	-	N1W8 6	-	-	-

Table 2 continued

Horizon	Area A	Area B	Area C	Area D	Area E	Area F
IVa	S0W5 8	-	-	N2W9 9	N4W9 11	N4W11 11
	S0W4 8	-	-	N3W10 9	-	N4W10 11
	S0W3 8	-	-	N3W9 10	-	-
	N1W5 8	-	-	-	-	-
	N1W4 8	-	-	-	-	-
	N1W3 8	-	-	-	-	-
III	S0W5 9	S0W7 7	S0W10 5	N2W10 9	N4W9 12	N4W11 12
	S0W4 9	S0W6 6	S0W9 6	N2W9 10	-	N4W10 12
	N1W5 9	N1W7 6	S0W8 6	N3W10 10	-	N5W11 10
	N1W4 9	N1W6 7	N1W10 6	N3W9 11	-	N5W10 10
	-	-	N1W9 7	-	-	-
	-	-	N1W8 7	-	-	-
	-	-	N1W8 8	-	-	-
II	S0W5 10	S0W6 8	S0W10 6	N2W10 10	N4W9 13	N4W11 13
	S0W5 11	N1W7 8	N1W10 7	N2W9 11	-	N4W10 13
	S0W4 10	N1W6 9	N1W9 8	N3W10 11	-	N5W11 11
	S0W3 9	-	N1W8 9	N3W10 12	-	N5W10 11
	N1W5 10	-	-	N3W9 12	-	-
	N1W5 11	-	-	-	-	-
	N1W4 10	-	-	-	-	-
	N1W3 9	-	-	-	-	-
Ib	-	-	-	N2W10 11	N4W9 14	N4W11 14
	-	-	-	N2W10 12	N4W9 15	N4W11 15
	-	-	-	N2W9 12	-	N4W10 14
	-	-	-	N3W10 13	-	N4W10 15
	-	-	-	N3W10 14	-	N5W11 12
	-	-	-	N3W9 13	-	N5W11 13
	-	-	-	N3W9 14	-	N5W10 12
	-	-	-	-	-	N5W10 13
Ia	-	-	-	-	-	N4W11 16
	-	-	-	-	-	N4W10 16
	-	-	-	-	-	N5W10 14
	-	-	-	-	-	N5W10 15
	-	-	-	-	-	N5W10 16

Horizon	Area A	Area B	Area C	Area D	Area E	Area F	Total
VII	0.59	0.73	0.74	0.27	0.11	0.22	2.66
VIb	0.71	0.78	0.53	0.64	0.61	0.91	4.18
VIa	0.47	0.67	0.58	0.58	0.43	0.47	3.20
Vc	0.40	0.51	0.74	0.64	0.44	0.58	3.31
Vb	0.33	1.01	0.23	1.12	0.50	0.44	3.63
Va	-	-	-	0.71	0.33	0.60	1.64
IVb	0.36	0.42	0.74	0.41	0.11	0.25	2.29
IVa	0.43	-	-	0.28	0.10	0.24	1.05
III	0.21	0.43	0.63	0.48	0.14	0.45	2.34
II	0.85	0.33	0.24	0.67	0.17	0.53	2.79
Ib	-	-	-	0.59	0.16	0.94	1.69
Ia	-	-	-	-	-	0.52	0.52
Total	4.35	4.88	4.43	6.39	3.10	6.15	29.30

These horizons can be correlated with the main stratigraphic units as shown in Table 4

Table 3 Lie Siri: horizon volumes

Horizon	Area A	Area B	Area C	Area D	Area E	Area F
VII	Dark brown goat dung 10 YR 4/3	Dark brown goat dung 10 YR 4/3	Dark brown goat dung 10 YR 4/3	Dark brown goat dung 10 YR 4/3	Dark brown goat dung 10 YR 4/3	Dark brown goat dung 10 YR 4/3
VIb	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2
VIa	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown and dark grey lens 10 YR 4/1	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2
Vc	Transition to pale brown	Transition to pale brown	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2
Vb	Pale brown 10 YR 6/3	Pale brown 10 YR 6/3	Greyish-brown 10 YR 5/2	Light grey 10 YR 7/1 dark greyish-brown 10 YR 4/2	Light grey 10 YR 7/1 to greyish-brown	Light grey 10 YR 7/1 to greyish-brown
Va	-	-	-	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2	Greyish-brown 10 YR 5/2
IVb	Pale brown 10 YR 6/3	Pale brown 10 YR 6/3	Grey 10 YR 7/1 10 YR 4/2 to pale brown	Pale brown 10 YR 6/3	Transition to pale brown	Transition to pale brown
IVa	-	-	-	Pale brown 10 YR 6/3	Pale brown 10 YR 6/3	Pale brown 10 YR 6/3
III	Very pale brown 10 YR 7/3	Very pale brown 10 YR 7/3	Transition to very pale brown	Transition to light yellowish-brown 10 YR 6/4	Transition to reddish-yellow	Transition to reddish-yellow
II	Very pale brown 10 YR 7/3	Very pale brown 10 YR 7/3	Very pale brown to light yellowish-brown 10 YR 6/4	Light yellowish-brown	Reddish-yellow 7.5 YR 6/8	Reddish-yellow 7.5 YR 6/8
Ib	-	-	-	Light yellowish-brown	Reddish-yellow 7.5 YR 6/8	Reddish-yellow 7.5 YR 6/8
Ia	-	-	-	-	-	Reddish-yellow 7.5 YR 6/8

[1] Colour references according to Munsell Soil Charts

Table 4 Lie Siri: horizon correlations with stratigraphic layers

RADIOCARBON DATES AND CHRONOLOGY

Six samples from Lie Siri were submitted to the Radiocarbon Dating Laboratory, ANU. The dates, based on the standard half-life of 5568 ± 30 years are:

2660 ± 110 BP	ANU-173	Square N1W9(2), Horizon VIb
3545 ± 120 BP	ANU-172	Square N1W10(2), Horizon VIb
1030 ± 70 BP	ANU-324	Square N5W9(3), Horizon VIa
3530 ± 90 BP	ANU-235	Square N4W11(4), Horizon VIa
6635 ± 140 BP	ANU-171	Square SOW4(6), Horizon Vb
7270 ± 160 BP	ANU-236	Square N4W9(13) and 6 adjacent squares, Horizons I-III

In Chapter IV I have discussed how the C14 dates have been used to provide a chronological framework which can be used for interpreting the changes recognised in the sequence of faunal and artifact remains. The proposed chronology is illustrated in Figure 48, and is summarised in Table 5. With the exception of ANU-324 (1030 ± 70 BP) the dates are relatively consistent with each other and provide a reasonable chronological framework for the site. ANU-324 was collected close to the surface and was probably contaminated by charcoal from a recent fire.

Horizon	Horizon boundaries, range in years BP Minimum	Maximum	Rounded mid-point in years BP
	modern		
VII	?	?2000	?
VIa,b	3000	4300	3700
Vc	5000	6000	5500
Va,b	6500	7000	6700
IVa,b	6900	7300	7000
III	7200	7600	7400
II,Ia,b	?8000	?10,000	?9000

Least secure dates are indicated by a question mark

Table 5 Lie Siri: proposed chronology

ANU-172 from Horizon VIb and ANU-235 from Horizon VIa were each obtained from charcoal scattered over an area 1 m^2 x 10 cm deep. They gave identical dates, and taking into account the thinness of these two horizons, and the fact that some sherds from the same vessels were found in both, I have not attempted to distinguish between them chronologically. There is no doubt that most of the material in Horizon VIb is later than most in Horizon VIa, but there is obviously much mixing within this layer. However, the greatest number of artifacts are found at this level and for some of the analysis the material has been divided.

ANU-171 was collected from a hearth in Square SOW4(6), approximately 50 cm below the surface and 40 cm above bedrock. The hearth was at the base of the greyish-brown and dark greyish-brown layer, within which there is a marked increase in the density of stone tools. The date is related to the transition from Horizons IV-V.

ANU-236 comprised scattered fragments of charcoal collected from between 10 and 30 cm above bedrock. The sample provides an average age for the deposit between the top of Horizons I and III, with most of the charcoal coming from Horizon II. In Area F the deposit continued below this level and the earliest occupation at the site must be 1000-2000 years older.

The chronology is summarised in Table 5 where the probable range of dates for the horizon boundaries is derived from Figure 48.

No samples were dated from the goat dung layer which comprises Horizon VII. Goats are still stabled in the cave in the wet season and the surface is certainly modern. I have tentatively indicated the base as about 2000 years old; on the other hand, there may be a break between the final deposition of cave earth and the goat dung. No modern objects were found embedded in the goat dung, and elsewhere, I argue that goats have been established in Timor for at least 3500 years. If this is so, there is no reason why the base of the layer may not be of comparable age.

ANALYSIS OF FLAKED STONE

After Bui Ceri Uato (Chapter VI) Lie Siri produced the largest collection of flaked stone of the four caves excavated - nearly 16,000 pieces. Because of the extensive area of the trench at Lie Siri, differences in the horizontal distribution of artifacts were greater than at other sites, and data on this for some of the principal categories of flaked stone, is presented in the following tables.

The stone used for flaking comprised for the most part, fine, non-crystalline flint obtained from water-worn beach pebbles, and from flint nodules which can be found in the extensive clay deposits which are, in many places, adjacent to the Baucau reef plateau. Flint was, in the 1960s, still occasionally mined by the Timorese for the manufacture of strike-a-lights. The quality of the flint does vary, but not enough to affect its flaking properties, and for the moment, no differentiation has been made between varieties of flint used for the manufacture of the stone tools. The only exception to this is obsidian, small quantities of which (<1%) occur throughout all the sites. The obsidian is found as small pebbles on the edges of the volcanic rock which underlie the limestone reef terraces on the western edge of the Baucau Plateau. The quality is poor for the obsidian is vesicular and containing many flaws. Flakes larger than 1 cm^2 were exceptional, and none show any signs of secondary working or even of extensive utilisation.

The numbers and densities of waste flakes only are given in Tables 6 and 7. Stone is rare in the goat dung which comprises Horizon VII, although pottery shows that the cave was still used by man as well as by the goats. The maximum density of stone occurs in Horizon VIa, just below the greatest concentration of pottery.

An interesting shift in the distribution of the waste material has taken place as the deposit accumulated. In the lower levels most of the stone is found in Areas C-F, but from Horizons Vc-VIb, the greatest concentration occurs in Areas A-C. To some extent this may be explained by the greater compression of the layers at the northeast end of the trench. But the shift may also have been caused by the extensive rock falls at the mouth of the cave (Plate 16) which severely curtailed the available living space.

The waste flakes were weighed but not measured. The average weight of the flakes in each

	Area						
Horizon	A	B	C	D	E	F	Total
VII	19	27	72	2	-	8	128
VIb	923	928	878	177	38	118	3062
VIa	876	901	915	346	98	324	3460
Vc	319	455	1110	359	74	287	2604
Vb	116	580	148	448	199	372	1863
Va	-	-	-	311	246	296	853
IVb	92	125	396	176	41	74	904
IVa	55	-	-	106	44	68	273
III	19	131	282	204	10	111	757
II	17	47	78	141	53	186	522
Ib	-	-	-	105	58	367	530
Ia	-	-	-	-	-	72	72
Total	2436	3194	3879	2375	861	2283	15,028

Table 6 Lie Siri: waste flake numbers

Horizon	Area A	B	C	D	E	F	Combined areas	% per m^3
VII	32	37	97	7	-	36	48	1
VIb	1300	1190	1657	277	62	130	733	14
VIa	1864	1345	1578	597	228	689	1081	20
Vc	798	892	1500	561	168	495	787	15
Vb	352	574	643	400	398	845	513	10
Va	-	-	-	438	745	493	520	10
IVb	256	298	535	429	373	296	395	7
IVa	128	-	-	379	440	283	260	5
III	90	305	448	425	71	247	324	6
II	20	142	325	210	312	351	187	3
Ib	-	-	-	152	363	390	314	6
Ia	-	-	-	-	-	138	138	3
Total	4840	4783	6783	3875	3160	4393	5300	100

Table 7 Lie Siri: waste flake densities, number per m^3

Horizon	Nos	Weight (gm)
VII	128	1.3
VIb	3062	1.2
VIa	3460	1.4
Vc	2604	1.2
Vb	1863	1.1
Va	853	1.2
IVa,b	1177	1.4
III	757	1.5
II	522	1.3
Ia,b	602	1.4

Table 8 Lie Siri: waste flake mean weights

Horizon	Waste flakes	Cores and trimming flakes	Utilised flakes	Flakes with gloss	Secondary working	Total
VII	128	-	-	-	-	128
VIb	3062	61	28	8	92	3251
VIa	3460	70	30	9	132	3701
Vc	2604	38	19	8	115	2784
Vb	1863	12	12	3	47	1937
Va	853	14	6	3	16	892
IVa,b	1177	15	14	1	21	1228
III	757	10	7	3	22	799
II	522	12	7	-	9	550
Ia,b	602	17	4	-	5	628
Total	15,028	249	127	35	459	15,898

Table 9 Lie Siri: numbers of the main classes of flaked stone

Horizon	Waste flakes as % of all stone	Worked and utilised stone only: Cores and trimming flakes %	Utilised flakes %	Flakes with gloss %	Secondary working %	Nos
VII	100	-	-	-	-	-
VIb	94	32	15	4	49	189
VIa	93	29	12	4	55	241
Vc	94	21	11	4	64	180
Vb	96	16	16	4	64	74
Va-IVa	96	32	22	5	41	90
III	95	24	17	7	52	42
II-Ia	96	54	20	-	26	45
All horizons	95	29	14	4	53	861

Table 10 Lie Siri: percentages of the main classes of flaked stone

horizon has been calculated (Table 8) to see if there was any change in the size of the waste material during the occupation of the site. At Bui Ceri Uato there was a marked and regular reduction in waste flake size but this is not apparent at Lie Siri, nor at the Uai Bobo sites.

The numbers and percentages of the main classes of flaked stone are listed in Tables 9 and 10. In Horizon VII only 128 waste flakes were found; below this, waste material comprises about 95% of all stone, which is between 2-3% higher than at other excavated sites. And at both the coastal sites there is a consistently higher proportion of cores to flakes with secondary working or utilisation than at the inland sites. The relative proportions of these at the four sites are illustrated in Figure 50 and the meaning of the differences for the interpretation of site use is discussed in Chapter IX.

Cores (Fig.12)

Table 11 gives the distribution of cores throughout the site. The distribution closely matches that of waste flakes and of the other worked and utilised tools. Although some localised concentrations of flakes were found during excavation it was not possible to identify stone-working areas with cores, flakes, and hammers and anvils in their original positions. Rather, the material left after one phase of occupation appears to have been scattered in subsequent visits. From the distribution of waste flakes alone I have suggested that the main area of occupation moved from Area F in the earliest period, to Areas A-C in later times. This seems to be borne out by the distribution of cores.

Cores with multiple platforms in different planes, and at varying angles to each other (Fig.12f, g) comprised over 80% of the sample. Although variable in shape and size, such cores tend to have the proportions of a cube or sphere. Disc cores with alternate bifacial flaking off the same edge (Fig.12b, d) were present in small numbers throughout the site and a few scalar cores, and cores with parallel, opposed platforms were also recognised. The latter two forms are so rare, however, that they are probably accidental. Tables 11-15 give the distribution of core types, the number of platforms on each core, the average maximum diameter of all cores not obviously broken, and the ratios of cores to waste.

	Area						Total	Trimming
Horizon	A	B	C	D	E	F	cores	flakes
VII	-	-	-	-	-	-	-	-
VIb	15	18	13	5	3	1	55	6
VIa	12	17	21	8	3	2	63	7
Vc	3	1	14	8	3	6	35	3
Vb	1	3	-	-	1	5	10	2
Va	-	-	6	3	1	4	14	-
IVb	2	2	3	5	-	-	12	1
IVa	1	-	-	-	-	-	1	1
III	-	-	2	2	1	2	7	3
II	1	1	1	2	2	3	10	2
Ib	-	-	-	2	-	12	14	1
Ia	-	-	-	-	-	2	2	-
Total	35	42	60	35	14	37	223	26

Table 11 Lie Siri: distribution of cores and trimming flakes

Horizon	Multi-platform	Disc	Fabricator	Opposed platforms	Total
VIb	44	8	2	1	55
VIa	46	15	1	1	63
Vc	33	2	-	-	35
Vb,a	22	2	-	-	24
IV,III	19	1	-	-	20
II,I	23	2	1	-	26
Total	187	30	4	2	223

Table 12 Lie Siri: core types

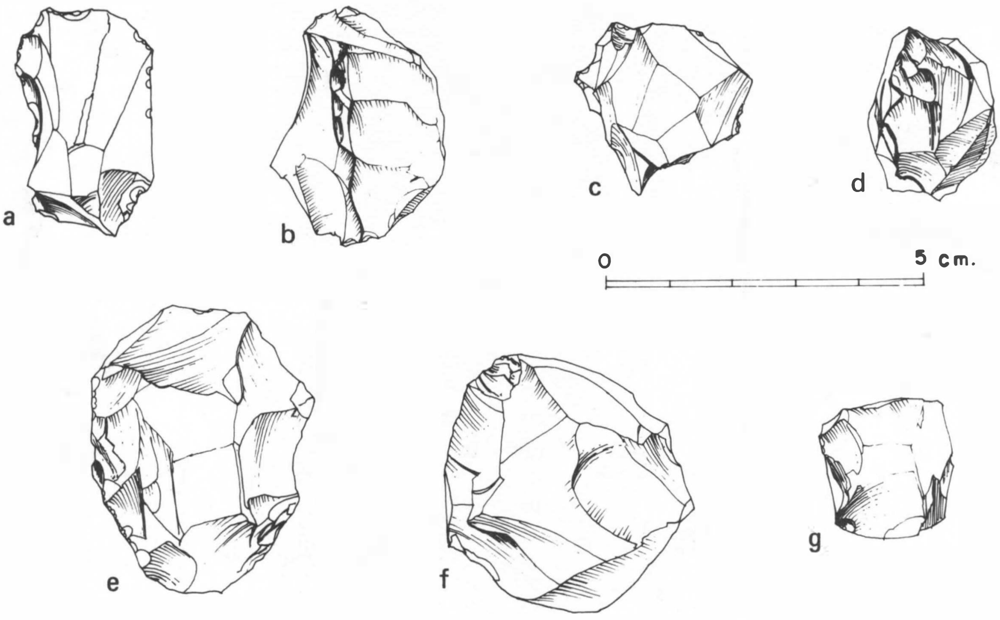


Fig.12 Lie Siri: flake cores

a 7556, core, pyramidal, single platform, Square S0W6(2), Horizon VIb
b 7132, core type 2 (disc), Square N1W4(4), Horizon VIa
c 7493, core/scraper, single platform, Square S0W9(5), Horizon IVb
d 7479, core type 2 (disc), Square N1W8(6), Horizon IVb
e 7862, core type 2 (disc), Square N3W10(4), Horizon Vc
f 7316, core type 1 (multi-platform), Square N4W11(14), Horizon Ib
g 7303, core type 1 (multi-platform), Square N4W11(16), Horizon Ia

Horizon	1	2	3	4+	Total
VIb	7	25	21	2	55
VIa	6	34	21	2	63
Vc	6	20	9	-	35
Vb,a	1	11	10	2	24
IV,III	5	12	3	-	20
II,I	7	17	2	-	26
Total	32	119	66	6	223

Table 13 Lie Siri: number of platforms on each core

Horizon	$\bar{x}$	s	Nos
VIb	27.4	6.7	52
VIa	27.9	5.8	61
Vc	30.0	6.9	32
Vb,a	36.3	8.6	24
IV-I	34.2	9.2	43
Total nos	-	-	212

Table 14 Lie Siri: core diameters, measurements in mm

Horizon	Ratio
VIb	1: 55
VIa	1: 55
Vc	1: 74
Vb,a	1:113
IV,III	1: 97
II,I	1: 43

Table 15 Lie Siri: ratio of cores to waste flakes

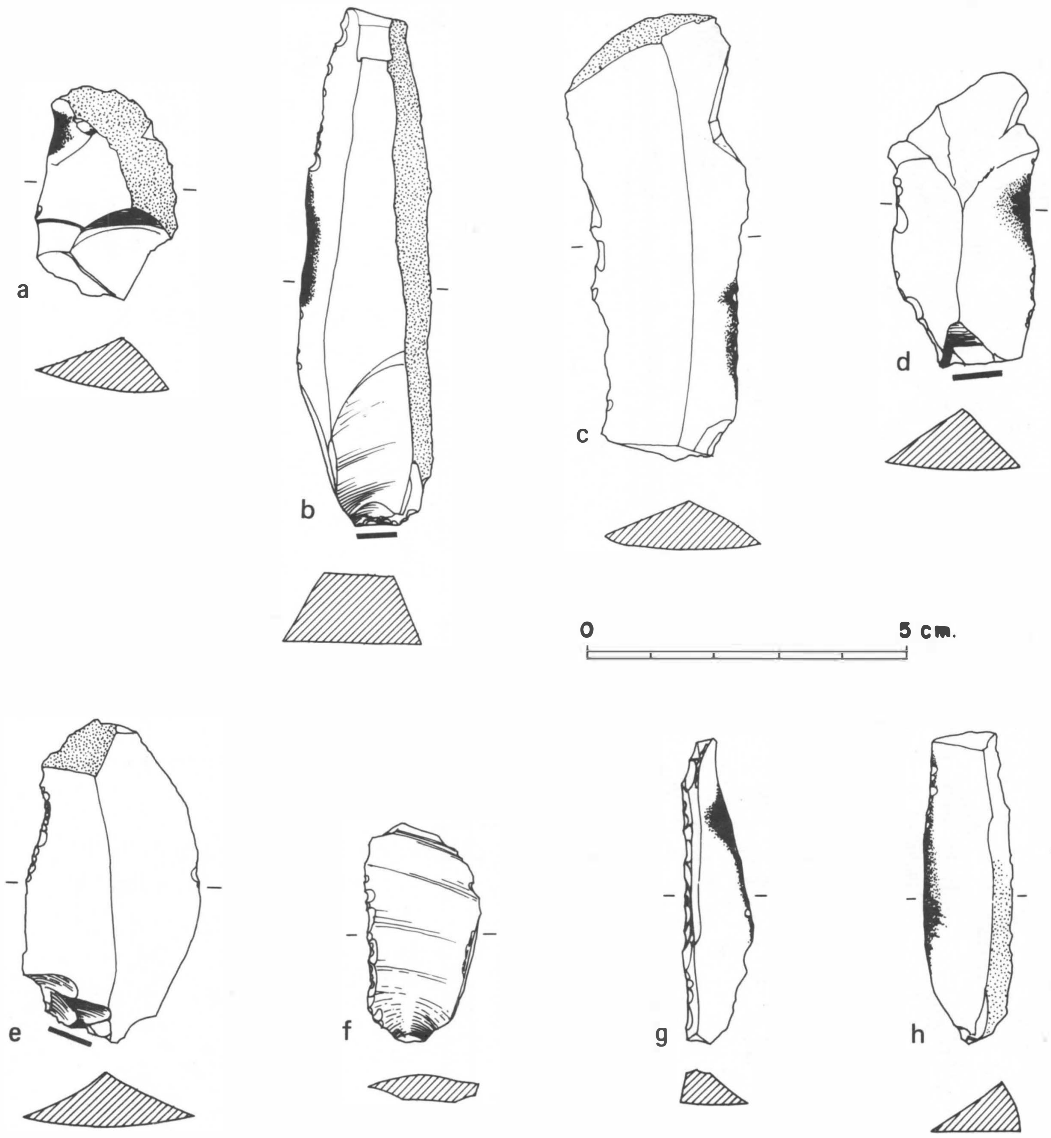


Fig.13 Lie Siri: flaked stone tools
Mt Carmel, Israel: sickle blades

a 7543, flake with silica gloss in notch, Square N1W6(2), Horizon VIb
b 7168, blade with silica gloss, Square N1W4(3), Horizon VIb
c 7683, blade with silica gloss, Square N2W9(7), Horizon Va
d 7217, flake with silica gloss, Square N4W11(6), Horizon Vb
e 7007, utilised flake, Square N4W9(12), Horizon III
f 7762, utilised flake, Square S0W8(3), Horizon VIa
g Backed sickle blade with silica gloss from El Kebara, Mt Carmel
h Sickle blade with silica gloss from El Kebara, Mt Carmel

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

Utilised flakes

As in all sites, two forms of utilised flakes were recognised - those with very fine flake scars, and those with glossy edges. The numbers of both are given in Table 9. They occurred on all areas of the site, with the largest concentrations in Area C. Of the 127 simple utilised pieces 50 were broken flakes, or pieces of flint, and the principal dimensions of the other 77 are given in Table 16.

The percentage of flakes with a length/breadth ratio of 2:1 or greater is given, but not all these are true blades, struck off prepared blade cores.

Of the 33 flakes with gloss, 20 were complete flakes, and only these were measured (Table 17). Because of the small number, flakes from all horizons have been combined. Some of these tools are illustrated in Figure 13.

Horizon	Length x̄	Length s	Breadth x̄	Breadth s	l/b ratio >2:1 %	Nos
VIa,b	35.2	9.0	25.1	4.5	17	36
V-I	39.4	12.0	25.0	7.0	19	41
Total nos	-	-	-	-	-	77

Table 16 Lie Siri: size and proportions of simple utilised flakes, measurements in mm

	Length x̄	Length s	Breadth x̄	Breadth s	Length of glossy edge x̄	Length of glossy edge s	Nos	Gloss on both surfaces	Secondary working	Nos
All horizons	37.7	16.7	20.4	6.5	8.8	3.7	20	27	3	33

Table 17 Lie Siri: flakes with gloss utilisation, measurements in mm

Scrapers

Table 18 shows a typological breakdown of flakes with secondary working. As in other sites, scrapers, and particularly side scrapers, dominate assemblages in all horizons. Although the numbers of scrapers in the various areas of the trench are not shown separately in Table 18, the distribution was examined to see if it varied from the pattern shown by the waste flakes and cores. No important difference was found; most of the scrapers in the lowest levels occurred in Areas D-F, and in Areas A-C in Horizons V and VI.

Horizon	Scrapers Side	End	Round	Small	Burins	Misc retouched	Broken edges	Total
VII	-		-	-	-	-	-	-
VIb	57	6	3	-	-	14	12	92
VIa	78	4	6	2	-	31	11	132
Vc	66	7	2	7	1	20	12	115
Vb	24	1	-	-	-	16	6	47
Va	11	-	1	-	-	2	2	16
IVb	8	1	-	1	-	7	2	19
IVa	-	-	-	1	-	-	1	2
III	13	1	-	-	-	7	1	22
II	6	-	-	-	1	2	-	9
Ib	1	-	-	-	-	2	1	4
Ia	1	-	-	-	-	-	-	1
Total	265	20	12	11	2	101	48	459

Table 18 Lie Siri: typological breakdown of flaked stone with secondary working

The general characteristics of the scrapers have been mentioned in Chapter IV and the few differences which can be seen between sites, and over time are discussed in Chapter IX. Characteristic artifacts from most horizons are illustrated in Figures 14-17. The most common form of scraper was a flake about 40 mm long x 25 mm wide x 12 mm thick, and with steep secondary working on one, or both sides. About 40% of the edges of these tools were worked back to form notches with steep, overhanging, step-flaked sides. A few flakes which were worked only on the distal end have been listed separately as end scrapers, but the few tools with working on both sides and end have been included with the side scrapers since the main working edge is always the side. Horizons IV, Vc and VIa also contain a few small, delicately worked scrapers which are listed separately, and one is illustrated in Figure 15f. One or two of these small scrapers are similar to the 'thumbnail scrapers' of southern Africa and Australia, but they are neither so common nor distinctive to be described as such. The principal dimensions and edge attributes of side and end scrapers are listed in Tables 19-21. About 40% of all scrapers were broken and the dimensions of complete implements only were measured. Edge-height, angle and shape, however, were recorded on all specimens, broken or not, which were large enough to give a reliable figure. One very large concave-edge scraper (Fig.14c) from Horizon III, Area C has not been included in the measurements of size since, at 113 x 61 mm, it is quite outside the range of all other scrapers in the site. In all sites one or two such large tools were found, sharing the same shape and edge characteristics as the smaller side scrapers.

Other retouched flaked stone tools

Two possible burins, one each in Horizons Vc and II are the only tools other than scrapers which can be classified by their properties of form and technique of manufacture. The specimen from Horizon Vc (7387) is not illustrated, and is a single-blow burin, with a spall struck from the broken edge of a flake. The specimen from Horizon II (Fig.14f) cannot be an accidental form, for two spalls have been removed, at 55° to each other; the one across the top of the flake, and the other down the side.

Horizon	Length $\bar{x}$	Length s	Breadth $\bar{x}$	Breadth s	Thickness $\bar{x}$	Thickness s	Nos
VIb	34.5	6.8	23.9	5.7	12.3	1.6	22
VIa	37.4	5.5	24.3	4.5	12.0	3.2	30
Vc	41.8	12.8	25.9	4.8	13.2	3.5	20
Vb-IVa	37.5	9.0	26.2	7.5	13.3	3.8	23
III-I	39.3	13.2	24.5	5.5	12.5	4.0	10
Total nos	-	-	-	-	-	-	105

Table 19 Lie Siri: side scraper measurements, in mm

Horizon	Edge-height $\bar{x}$	Edge-height s	Edge-angle $\bar{x}$	Edge-angle s	Concave %	Straight %	Convex %	Nos
VIb	4.8	1.6	85°	10	68	21	6	57
VIa	4.5	1.5	84°	9	60	30	8	78
Vc	4.3	1.6	86°	12	58	20	15	66
Vb-IVa	4.4	1.1	85°	13	63	21	7	43
III-I	4.6	1.7	80°	11	71	24	1	21
Total nos	-	-	-	-	-	-	-	265

Table 20 Lie Siri: side scraper edge attributes, measurements in mm

Horizon	Length $\bar{x}$	Length s	Breadth $\bar{x}$	Breadth s	Thickness $\bar{x}$	Thickness s	Edge-height $\bar{x}$	Edge-height s	Edge-angle $\bar{x}$	Edge-angle s	Nos
VIb-Vc	32.2	7.2	26.1	5.7	9.5	2.1	5.6	2.5	79°	12	17

Table 21 Lie Siri: end scrapers, measurements in mm

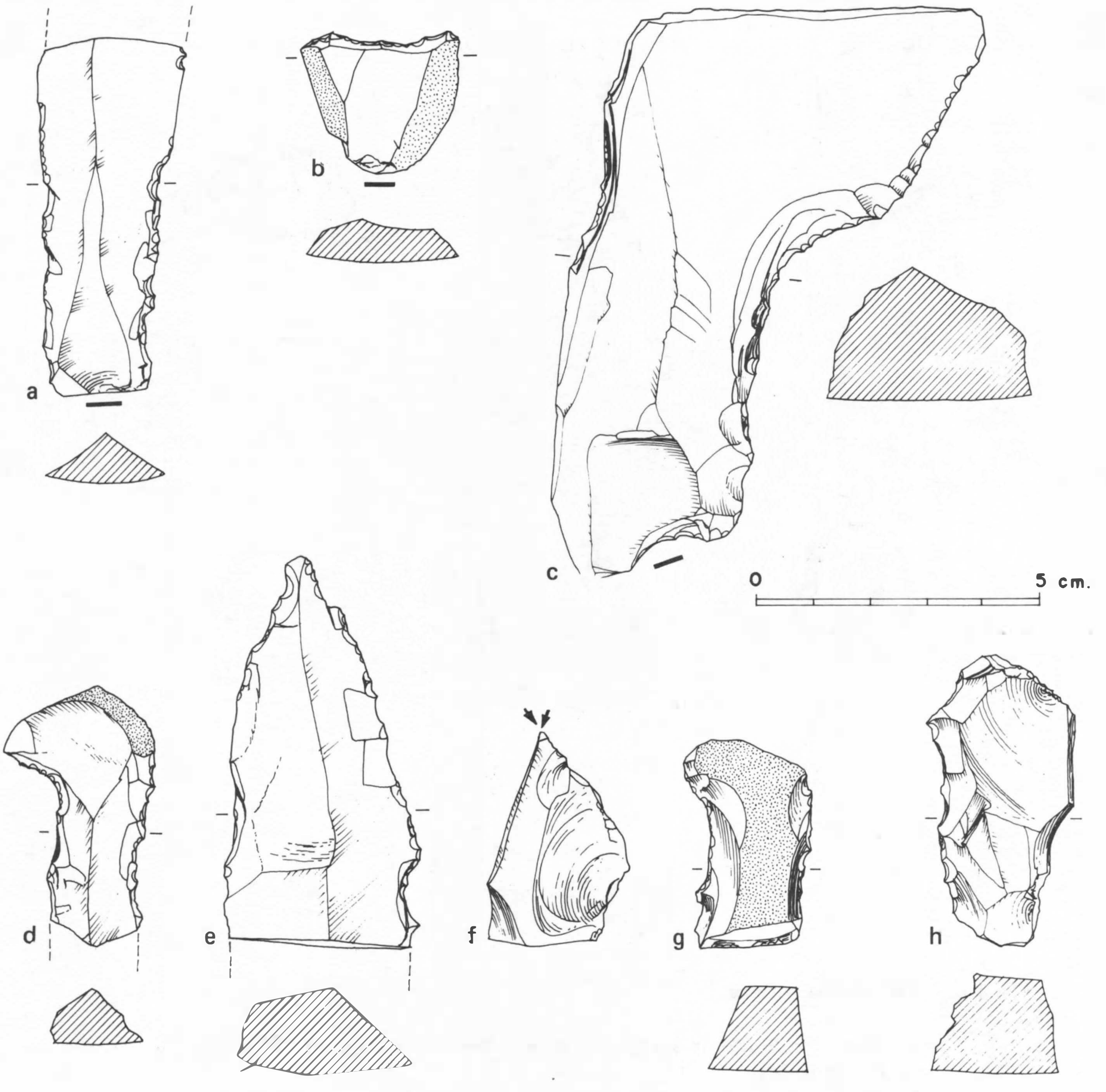


Fig.14 Lie Siri: flaked stone tools

a 7658, broken side scraper, two worked edges, Square N2W9(10), Horizon III
b 7655, end scraper, Square N3W9(11), Horizon III
c 7415, large side scraper, two worked edges, Square N1W8(8), Horizon III
d 7410, broken side scraper, two worked edges, Square N1W9(7), Horizon III
e 7344, bifacial point, broken, Square N1W7(7), Horizon III
f 7779, burin, Square N3W10(12), Horizon II
g 7302, side and end scraper, three worked edges, Square N5W10(15), Horizon Ia
h 7310, side scraper, two worked edges, Square N5W11(13), Horizon Ib

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

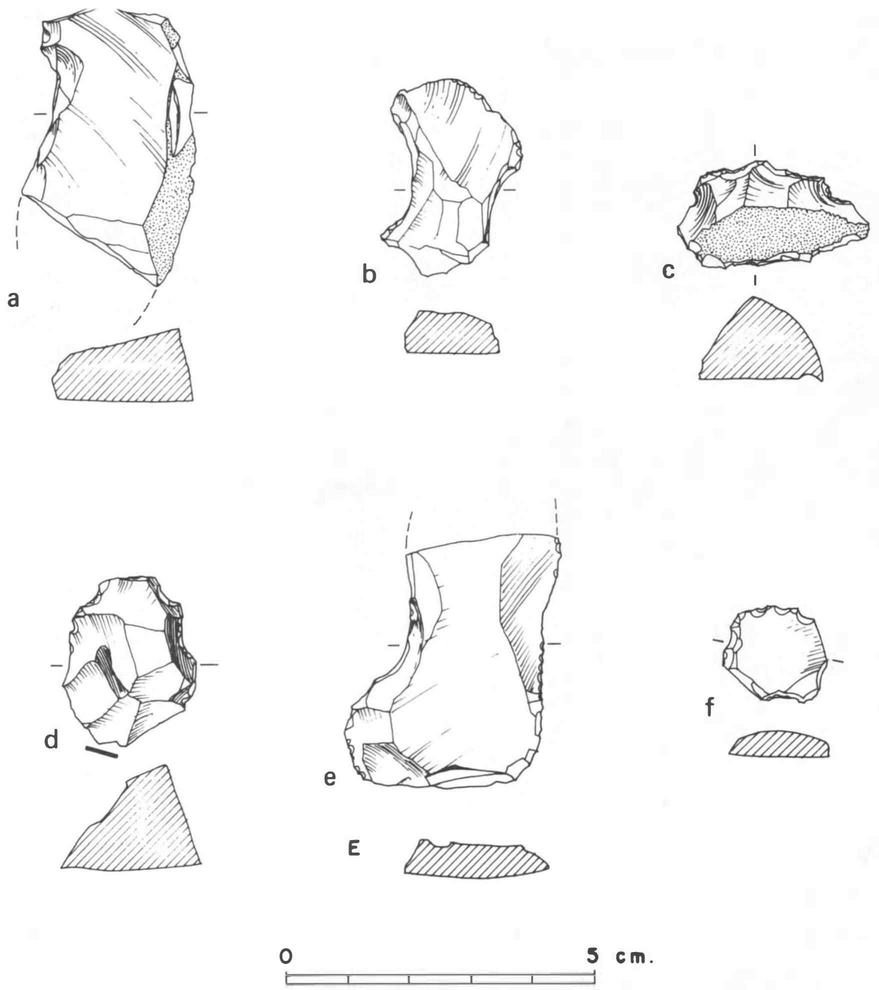


Fig.15 Lie Siri: scrapers

a 7046, broken side scraper, one worked edge, Square N4W9(5), Horizon Vb
b 7213, small side scraper, two worked edges, Square N4W10(5), Horizon Vb
c 7080, small side scraper, two worked edges, Square N1W4(6), Horizon Vb
d 7019, high-backed round scraper, Square N4W9(7), Table Va
e 7077, broken side scraper, one worked edge, Square N1W3(7), Horizon IVb
f 7246, thumbnail scraper, Square N4W11(11), Horizon IVa

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

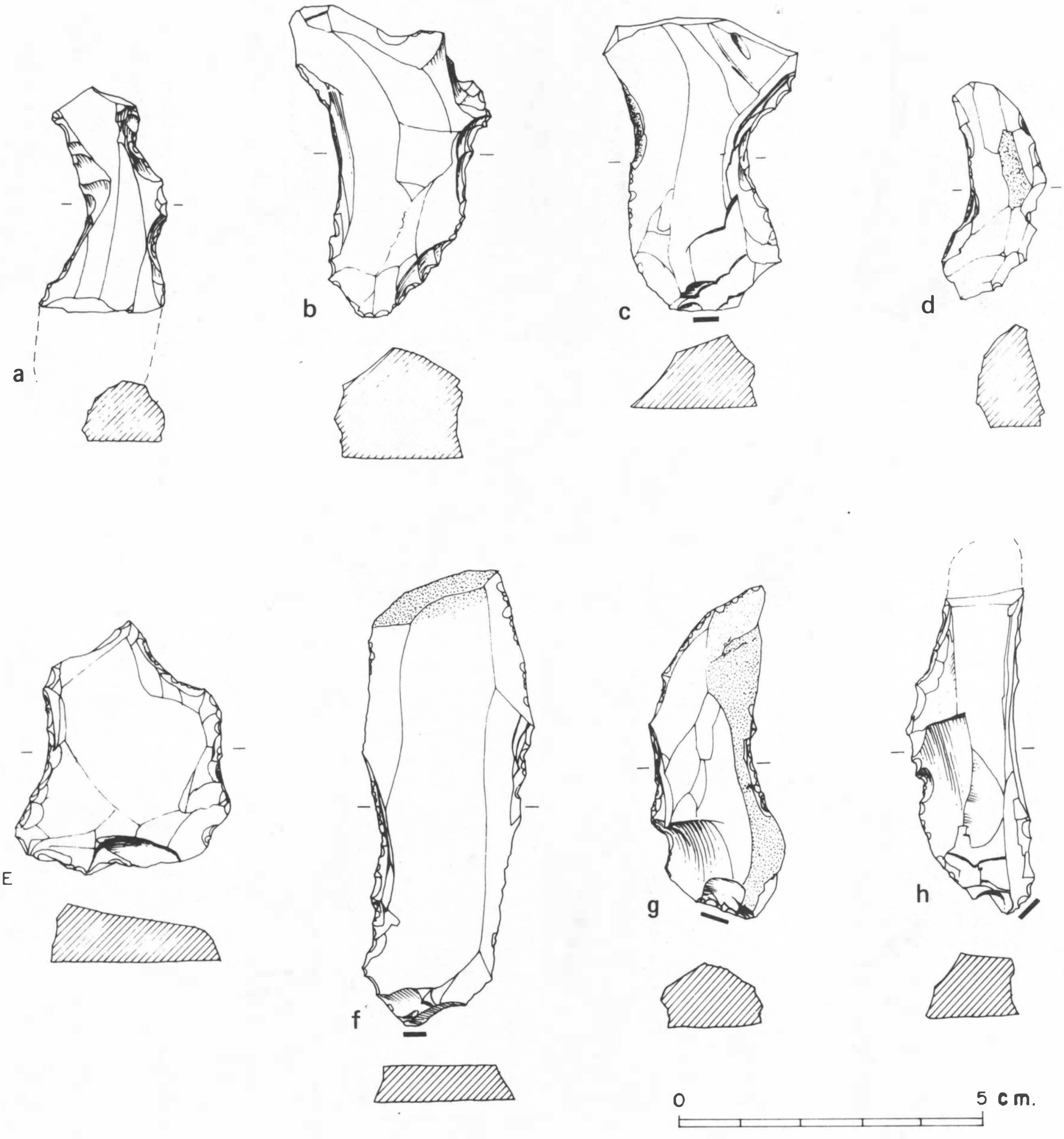


Fig.16 Lie Siri: scrapers

a 7126, side scraper, two worked edges, broken, Square N1W3(4), Horizon VIa
b 7026, side scraper, two worked edges, Square N4W9(3), Horizon VIa
c 7457, side scraper, one worked edge, silica gloss on opposite edge, Square N1W6(3), Horizon VIa
d 7476, side scraper, two worked edges, Square N2W7(3), Horizon VIa
e 7857, round scraper, Square N2W8(4), Horizon Vc
f 7578, side scraper, two worked edges, Square S0W8(4), Horizon Vc
g 7620, side scraper, two worked edges, Square S0W9(4), Horizon Vc
h 7234, Side scraper, two worked edges, broken, Square N5W12(8), Horizon Vc

Artifacts are shown bulbar face down. The striking platform on complete flakes is shown by a broad line

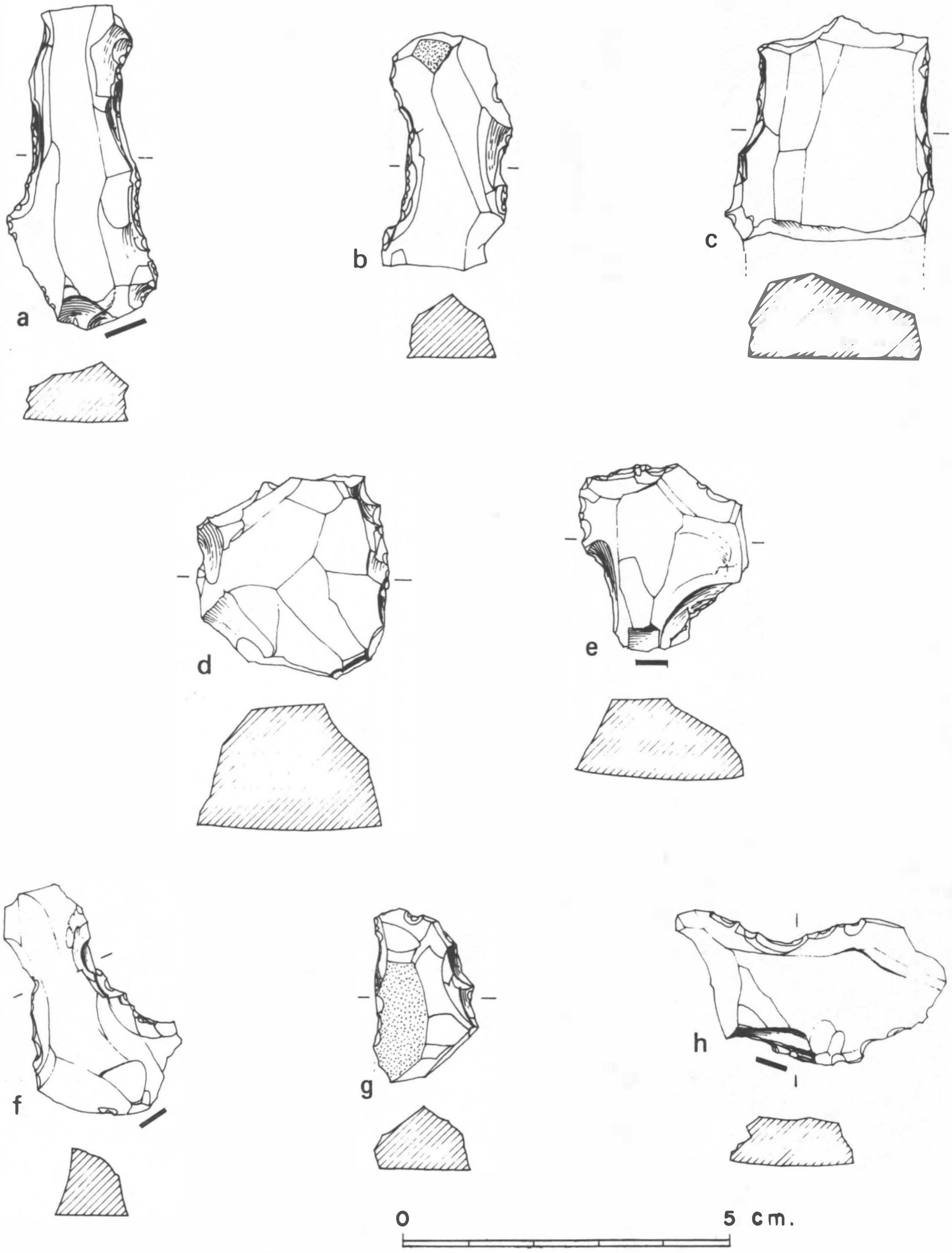


Fig.17 Lie Siri: scrapers

a 7843, side scraper, two worked edges, broken, Square S0W8(2), Horizon VIb
b 7533, side scraper, two worked edges, broken, Square N1W6(2), Horizon VIb
c 7160, side and end scraper, broken, Square N1W4(3), Horizon VIb
d 7809, round scraper, Square N1W9(2), Horizon VIb
e 7192, round scraper, Square S0W3(3), Horizon VIb
f 7560, side scraper, two worked edges, Square S0W6(2), Horizon VIb
g 7516, small side scraper, two worked edges, Square N1W7(2), Horizon VIb
h 7205, end scraper, Square N1W3(3), Horizon VIb

Artifacts are shown bulbar face down. The striking platform on complete flakes is shown by a broad line

ANALYSIS OF POTTERY

Pottery was confined to the top 30-40 cm of deposit, including the goat dung of Horizon VII. The numbers and density of sherds for all areas of the site combined are given in Table 22 and the numbers and density for each area separately in Table 23.

Horizon	Nos	No. per m^3	% per m^3
VII	692	260	27
VIb	2052	491	53
VIa	504	158	17
Vc	84	25	3
Total	3332	934	100

Table 22 Lie Siri: sherd density

	Area												
	A		B		C		D		E		F		Total
Horizon	Nos	m^3	Nos	m^3	Nos	m^3	Nos	m^3	Nos	m^3	Nos	m^3	nos
VII	45	76	127	174	316	427	110	407	-	-	94	427	692
VIb	248	437	158	203	367	692	571	892	171	280	527	579	2042
VIa	54	115	50	75	114	197	149	257	24	56	113	240	504
Vc	15	38	7	14	15	28	6	10	12	28	29	50	84
Total nos	362	-	342	-	812	-	836	-	207	-	763	-	3322

Table 23 Lie Siri: numbers and density of sherds in different areas of the trench

The greatest density in all areas was at the top of the cave earth (Horizon VIb) just below the layer of dung, but as Table 23 shows there was much variation at all levels between different parts of the trench. These result from local concentrations of pottery surrounding areas of hearths. To judge from the few decorated vessels, of which at least some sherds can be joined, the horizontal scattering was seldom more than 1-2 m. The low concentration of pottery in Area E is surprising and is not the result of less careful excavation.

A small number of sherds were found in Horizon Vc in all squares, and in 37 out of the 47 metre squares dug at that level. It is possible, even so, considering the thinness of the pottery layer, that all these sherds should belong in Horizons VIa and VIb, and have migrated down as the result of minor disturbances as the deposit accomulated. If these sherds are accepted as being *in situ*, however, the pottery sequence at Lie Siri parallels those from the other four excavated sites where small quantities of plain and burnished ware clearly precede the appearance of decorated pottery.

In the chronology for the site previously outlined, Horizon Vc is dated to about 5500-3700 years ago; such a date for the introduction of pottery agrees with those obtained at the other sites.

Table 24 gives the distribution of the most useful sherds for an analysis of change within the site, and for comparison with other sites. Because of the small numbers, pottery from all parts of the trench have been grouped in the table. All the paddle-stamped sherds in Horizon VII were in Areas A-C, and most of the incised and impressed sherds were in Areas D-F.

Horizon	Plain body sherds	Burnished body sherds	Incised, impressed and relief decoration	Paddle-stamped	Angular shoulders	Rims	Bases	Total
VII	604	29	-	36	-	21	-	690
VIb	1794	130	61	1	2	64	-	2052
VIa	451	29	8	-	2	14	-	504
Vc	73	7	-	-	-	4	-	84
Total	2922	195	69	37	4	103	-	3330

Table 24 Lie Siri: distribution of the principal sherd classes

Rims

The main rim types are listed in Table 25, where the figures for the entire trench are again combined. Rim profiles are illustrated in Figure 18.

Horizon	Everted A	Everted B	Direct	Indeterminate	Total
VII	4	7	8	2	21
VIb	14	25	4	21	64
VIa	1	3	-	10	14
Vc	1	1	-	2	4
Total	20	36	12	35	103

Table 25 Lie Siri: rim types, sherd count

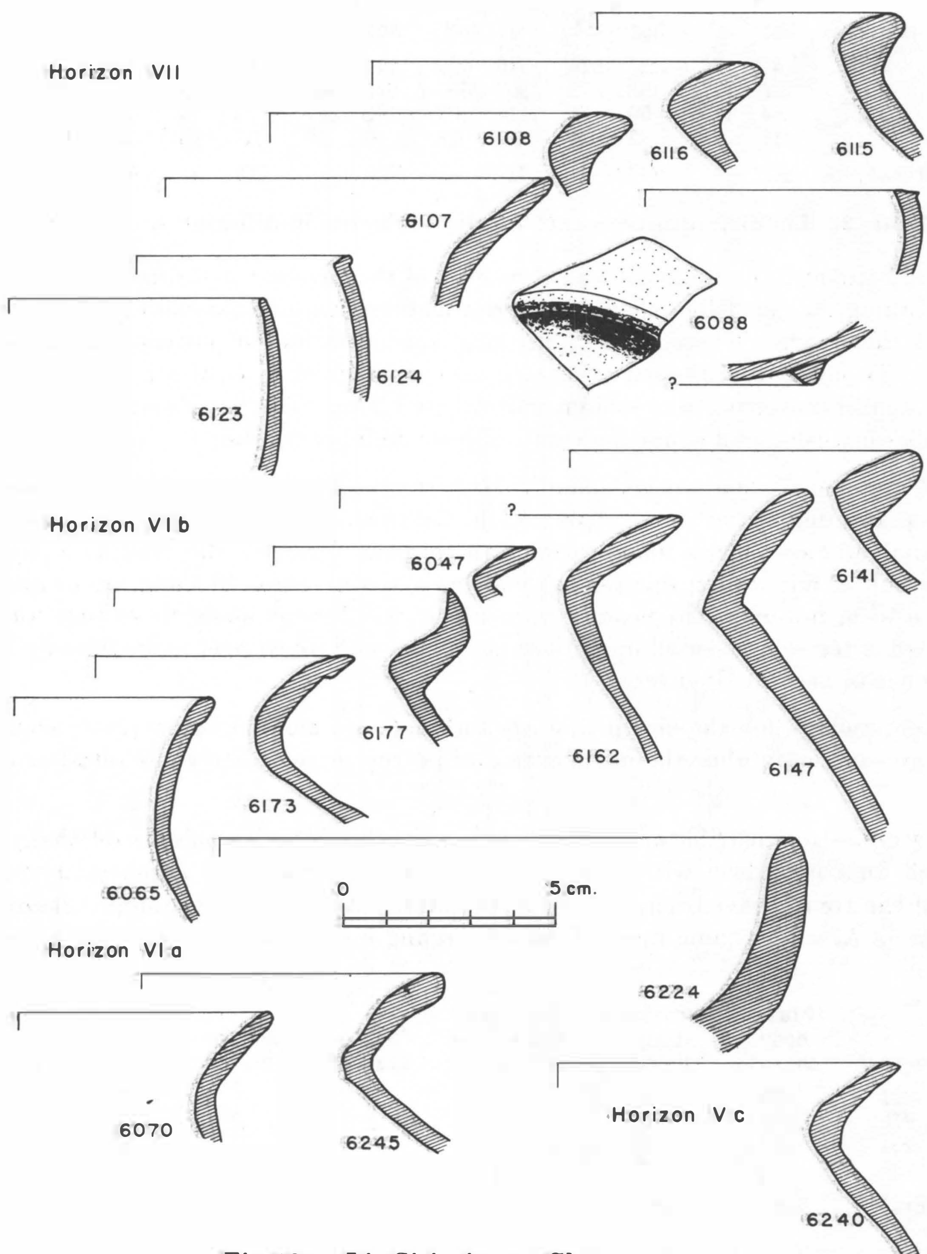


Fig.18 Lie Siri: rim profiles

The pottery at Lie Siri has been broken and trampled to such an extent that even relatively few rim sherds could be joined together. However, occasionally, even when pieces of a rim cannot be joined, it is quite clear that they belong to the same vessel. And in Table 26 the 56 everted rim sherds have been reduced to 22 separate pots. In contrast to Bui Ceri Uato, more Type B everted rims were found at Lie Siri; rims that is, with no appreciable thickening of the body wall at the neck. Although Bui Ceri Uato undoubtedly contains more pottery from later periods than does Lie Siri, the samples from both sites are really too small to show accurately any changes over time. It is possible that the pottery in the two sites was derived from several manufacturing villages and that the differences reflect local stylistic variations within a single tradition.

Horizon	Mouth/body angle $\bar{x}$	Mouth/rim angle $\bar{x}$	Rim height $\bar{x}$	Mouth radius $\bar{x}$	Neck radius $\bar{x}$	nos
VII	55°	39°	7	8	6	4
VIb	65°	49°	16	8	6	16
VIa, Vc	40°	55°	13	7	5	2

Table 26 Lie Siri: everted rim attributes, by separate vessels; measurements in cm

Three rim sherds (Plate 20h) from Horizon VIb are thought to be from a vessel, either thrown on a potter's wheel, or at least finished on one. They stand out from all the other rims because of the symmetry of finish, the hollow inner face of the rim, and the pronounced parallel striations on both surfaces. They are probably from a round-based water or cooking pot, with a mouth diameter of about 12 cm. To the best of my knowledge, no wheel-made pottery is made today in Timor and it is possible that the vessel from Lie Siri is an import from another island. Mineralogical examination, however, of the sherds from Lie Siri, failed to support this idea.

The direct rims in Horizon VII come from four or five vessels which are all small open bowls or dishes, about 14 cm in diameter, and similar to those shown in Figure 7. At least one of these probably had a ring base. The lip forms of these rims, which vary from rounded to angular and slightly everted, are shown in Figure 18. Of the direct rims in Horizon VIb, one is from a larger and heavier bowl, about 28 cm in diameter, with an angular shoulder 4 cm below the lip where the wall is 12 mm thick. The other three direct rims are from three separate vessels, but are too small to measure.

Decoration

There was more decorated pottery at Lie Siri than at any other excavated site. The numbers of sherds decorated by paddle-stamping, incision, relief and so on, are given in Table 24. The 36 paddle-stamped sherds in Horizon VII are from no more than two or three vessels, and all but three sherds (and the one in Horizon VIb) are probably from the same pot. The sherds are hard, not more than 2-3 mm thick, with stamped parallel ridges more or less vertical on the body wall (Plate 20d). The pottery appears to be identical to that made today in *suco* Uai Tami, *posto* Quelicai, and sold in the Baucau market (Plate 4).

In Horizons VIb and VIa there are 69 other decorated sherds of which five were rims. All except the smallest of these sherds are illustrated in Plates 19 and 20 and the designs are drawn in Figure 51. They come from at least 10 vessels, but from some of these only one or two small fragments were recovered. Three vessels stand out because the shapes are unique in the collections excavated in Timor, and because the designs, although found on many vessels and in most sites, are more elaborate and carefully executed than is commonly the case. Some sherds from these vessels have already been illustrated in Glover (1969:Pl.1a-c). The first of the three is shown in Plate 19a. Sixteen sherds can be joined into three pieces, and a further 27 plain sherds were found which are thought to belong to the same vessel. The shape is difficult to determine as neither rim nor base has been found. The decorated pieces could be from a circular lid or cover with a diameter of about 30 cm. The outer surface only is well

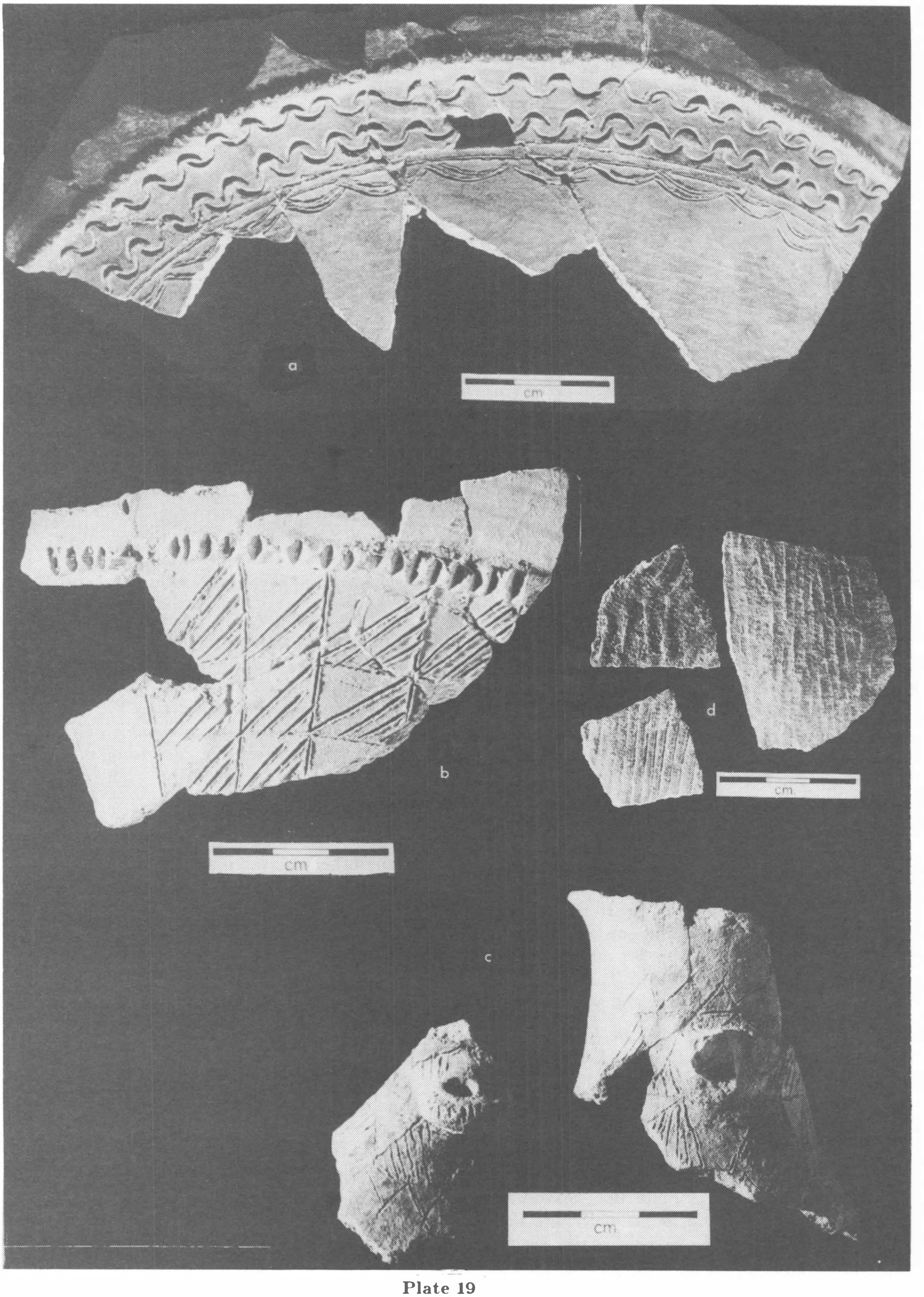


Plate 19

burnished and dark grey in colour. Irregular hollows on the inner surface show that a paddle and anvil was used to finish the vessel walls, and presumably only the decorated outer surface was intended to be seen. The pottery is hard and well fired with no unburnt core remaining. Thickness varies from 3-5 mm. Four decorative motifs are used, arranged in a single horizontal band 2.7 cm wide: (a) a narrow raised rib, apparently pinched out of the clay and not applied, with rough, shallow impressions every 5 mm; (b) two rows of overlapping, opposed semi-circles probably impressed with the end of a split bamboo or bone; (c) two parallel incised lines 8 mm apart; and (d) incised linked double semi-circles or 'festoons', 10-15 mm long. The second motif, of impressed overlapping semi-circles is not found on any other pottery so far known from Timor, and has its closest parallels in the collection from Kalumpang, west central Sulawesi, collected by Heekeren and Stein Callenfels (Heekeren 1972:185-90) and Plate 21a-c (in this monograph), and on sherds (cf. Plate 21d) found in the disturbed burial caves at Ulu Wae and Ulu Leang 2 near Maros in south Sulawesi (Mulvaney and Soejono 1970). None of these sites is dated; at Kalumpang the pottery is found with both iron and stone tools, but the association is not necessarily original. At Ulu Leang 2, the absence of any Chinese porcelain in the cave, and the find of many glass beads suggests that the deposit can be dated to somewhere between 500-2500 years ago, on present knowledge (Glover 1976).

A thin section was made from the Lie Siri pot by Mr Key to see whether it was made of local clay or was imported. Key reported that it was mineralogically indistinguishable from modern and prehistoric Timorese wares and that it was unlikely to have been made in any of the geologically more recent Indonesian islands.

Fifteen sherds of another vessel, apparently of a similar shape were also found in Horizon VIb, mostly in Areas D-F (Plate 19b). The ware is red, less well fired than the first vessel, and the decoration is dominated by a pattern of incised squares and triangles below a narrow raised rib with V-shaped impressions.

The third unusual vessel in Horizon VIb is a narrow-necked bottle, or flask, of which five sherds were found (Plate 19c). The diameter of the mouth is approximately 2.8 cm. Two vertically pierced lugs are placed on the neck 2 cm below the rim, and the entire neck is encircled with at least four bands of incised triangles. The middle two bands are also obliquely hatched. A hatched triangle is the most common single motif on Timorese pottery and is found in all sites except Uai Bobo 2.

Opposite

Plate 19 Lie Siri: decorated pottery

- a **6015-18, 6151, 6240, 6242, 6246-48, 10 sherds, mostly from Square N4W9(2), Horizon VIb. Six other sherds of this vessel can be joined, but are not illustrated. Vessel shape is uncertain, but it appears to be a circular lid or cover rising to the centre with a diameter of about 30 cm. The profile is shown in Figure 18. The colour is dark grey and the upper surface only is burnished**
- b **6028-33, 6072 and 6073, eight sherds, mostly from Square N2W8(2), Horizon VIb. Seven other sherds from this vessel are not illustrated. The shape appears to be similar to the vessel shown above, but the diameter cannot be determined. The colour is red, and the surface is not burnished**
- c **Five sherds from a narrow-necked bottle with two vertically pierced lugs 2 cm below the lip: mouth diameter is 2.8 cm. Most sherds were found in Squares N5W9 and N5W10, Spits 2-5, Horizons VIa and VIb**
- d **6091, 6086, 6237, paddle-stamped sherds, Horizon VII**

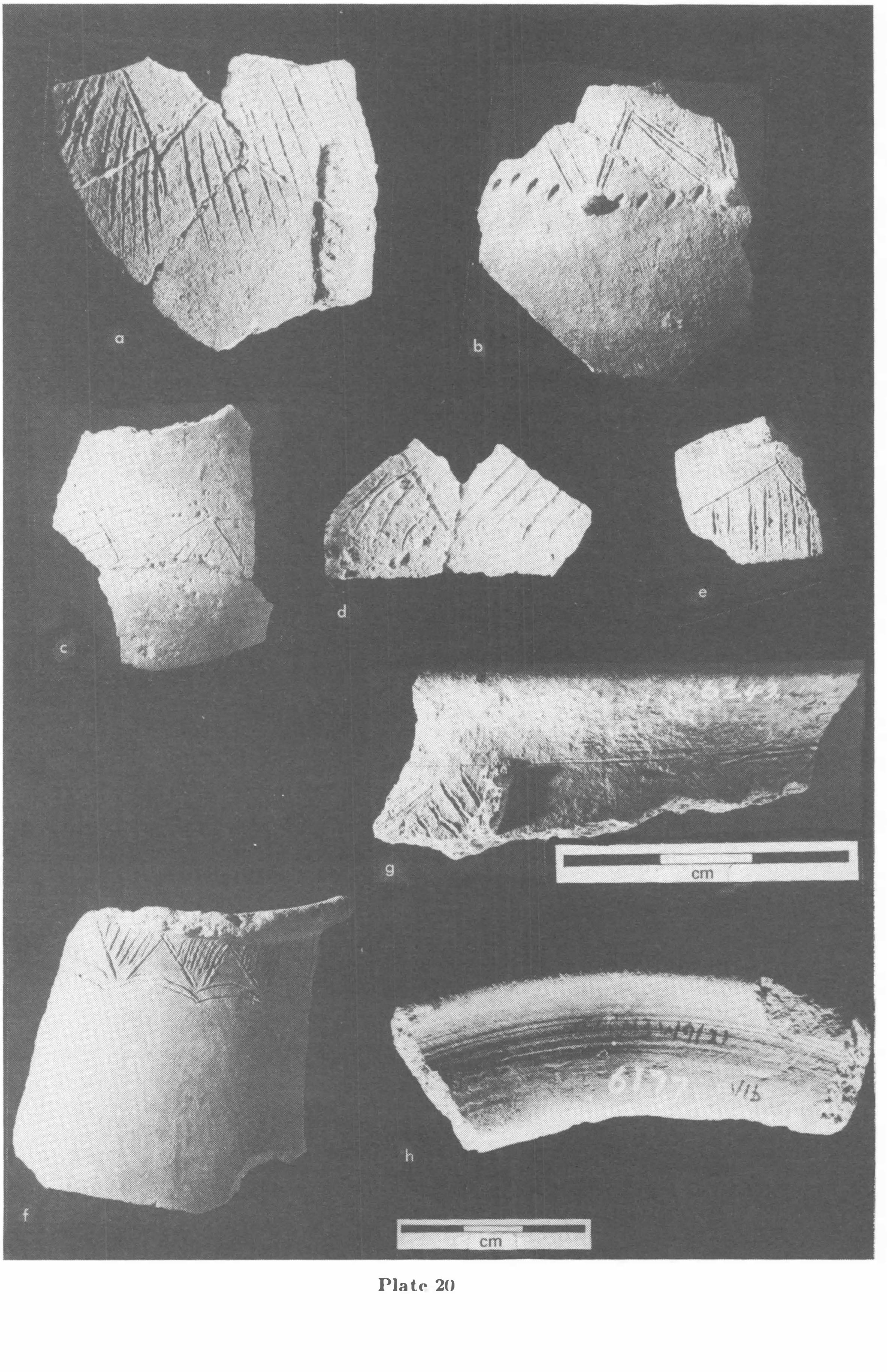


Plate 20

Six other decorated vessels in Horizon VIb are represented by 1-4 sherds each, and are illustrated in Plate 20. There are possibly two more vessels with very simple incised patterns, of which only one or two fragments were found, and they are not illustrated.

Burnished sherds form a small minority in all horizons. The proportion decreases from 9% in Horizons Vc and VIa to 5% in Horizon VII, but this may be the result of the small numbers and irregular distribution of pottery in the site. At Bui Ceri Uato a similar small proportion of burnished sherds was found in all the pottery-bearing horizons. This contrasts with the situation in the inland sites at Uai Bobo, where there was a regular decrease in the proportion of burnished ware.

Because of the shallow depth of the deposit containing pottery it was not possible to see if there was a reduction in average body wall thickness over time such as found at Bui Ceri Uato and Uai Bobo 2. Apart from one or two exceptionally thick sherds - up to 12 mm - the sherd thickness at the two sites was generally similar and most sherds fell within the range of 2-10 mm.

Opposite

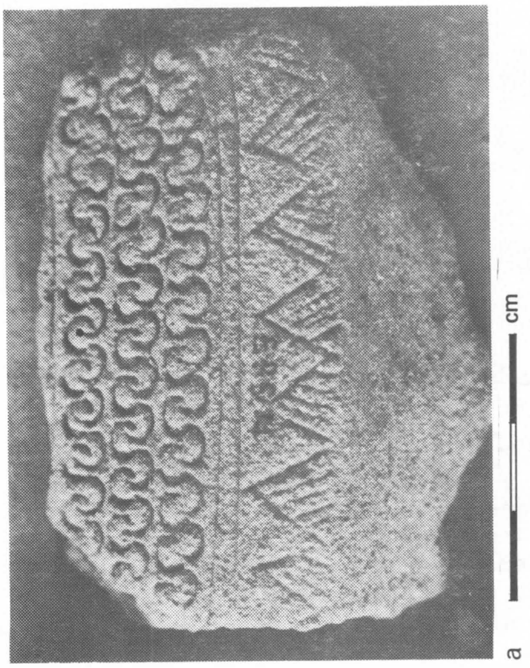
Plate 20 Lie Siri: decorated pottery

- a **6164, 6167, 6170 and 6187, 4 sherds, colour reddish-brown, Horizon VIb**
- b **6025 and 6026, two sherds, colour reddish-brown. Decoration is placed just below the neck, Horizon VIb**
- c **6034 and 6035, two sherds a band of adjacent cross-hatched triangles is placed below the neck, Horizon VIb**
- d **6257 and 6058, two sherds Horizon VIb; may be from the same vessel as 6034 and 6035**
- e **6038, same design as above, from another vessel, Horizon VIb**
- f **6024, one rim sherd with hatched triangles and festoons just below the neck, Horizon VIb**
- g **6243, one sherd, the everted rim of a small vessel with incised and applied decoration below the neck, Horizon VIb**
- h **6177, one sherd, wheel-thrown rim, Horizon VIb. Two other sherds of this vessel, 6259 and 6260 are not illustrated.**

Overleaf

Plate 21 Sulawesi: decorated pottery

- a **Kalumpang, collected by Heekeren 1949, Jakarta National Museum Catalogue number 5994** $\frac{KI}{55}$
- b **Kalumpang, collected by Stein Callenfels 1951, Jakarta National Museum Catalogue number** $\frac{1506}{0}$
- c **Kalumpang, collected by Heekeren 1949, Jakarta National Museum Catalogue number 5994** $\frac{KI}{17}$
- d **Leang Paja (Ulu Wae), Maros. From a disturbed burial cave, collected by Australian National University National Archaeological Institute of Indonesia Expedition 1969**



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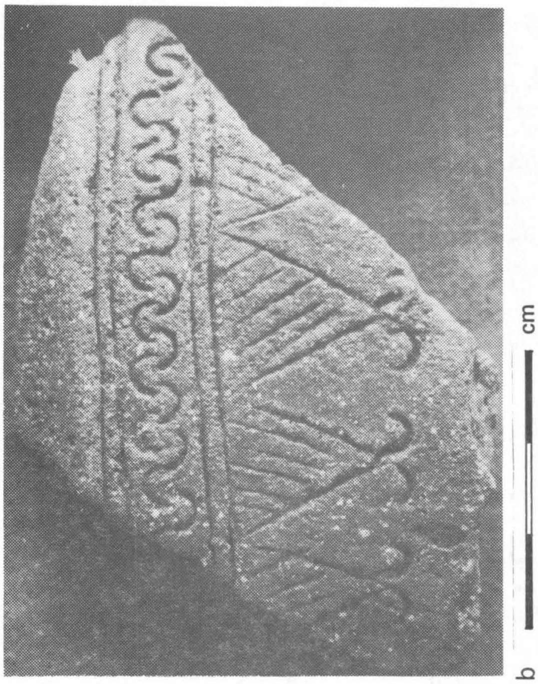

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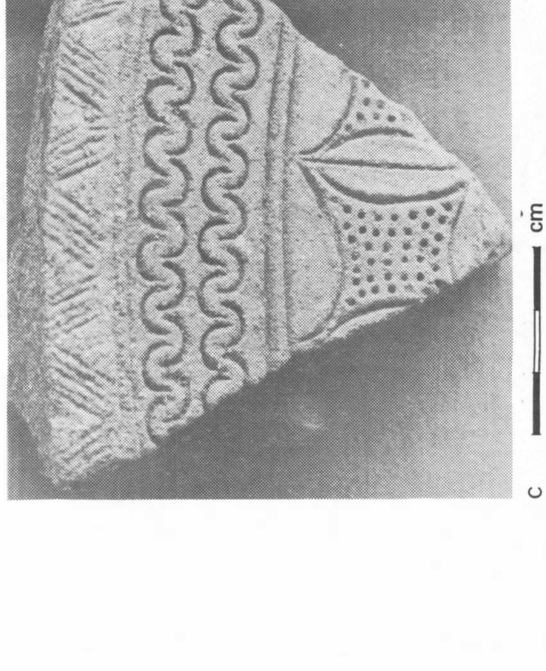

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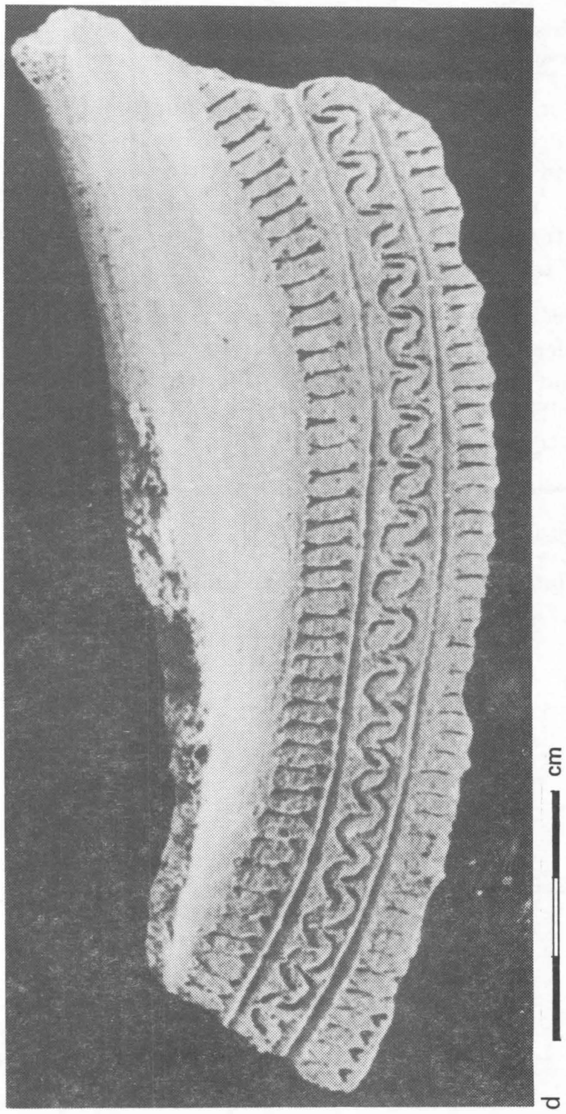


d

Plate 21

SHELL ARTIFACTS

Only one shell ornament was found in the excavation - a small disc, probably of *Nautilus* shell, 4.5 mm in diameter, with a hole of 1.8 mm, asymmetrically placed. The hole appears to have been drilled from the nacreous, inner surface. It was found in Square N1W9(3), Horizon VIa. A number of identical pierced shell discs were found in the Uai Bobo sites (Chapters VII and VIII), and at a comparable date.

Six *Geloina* sp. shells were found with a regular pattern of small fractures along the edge which suggests that they have been used for scraping or cutting (Plate 22a, b). Five were in Horizon Vc, and one in Horizon Vb. Two of the shells in Horizon Vc also appear to have slightly polished edges, although it is not easy to distinguish between this and the natural glossy surface of the shell. The samples from Bui Ceri Uato (Chapter VI) contained 23 specimens of *Geloina* but none were utilised, nor were any seen during the excavation there. On the other hand, a few edges of *Geloina* were found at the inland sites, and shells with very similar utilised edges have been found in many excavations in western Indonesia (Willems 1939) to Australia (White 1967a:Pl.IV-10, 11). Verhoeven (1959:Taf.3) records *Muschelartefacte* commonly found in Timor, Sumba (1959:Taf.4), and Flores (1953:Taf.1, II), which are probably *Geloina*.

HAMMERS, ANVILS AND GRINDSTONES

Over 50 complete or broken pebbles were found in the trench, but only seven showed definite signs of use as hammers or anvils, for food preparation or for preparing stone tools. In addition to these, which are listed below, a large basalt pebble weighing 1.3 kg was found under one of the corn drying racks at the northeastern end of the trench. Corn flour still clung to the rock which must have been used to prepare food during the previous year's harvest in the small garden in front of the cave.

Horizon VIb, Area F: a broken slab of a fine-grain micaceous rock which has been used for sharpening knives or other cutting tools (Plate 23a). Many caves in Timor contain discarded whetstones on the surface which may be used by the occasional visitor to sharpen his bush knife.

Horizon VIb, Area A: a broken sandstone mortar which appears to have been roughly shaped on one edge. Traces of red pigment remain near the centre of the mortar which suggests that it was used for grinding ochre (Plate 23b).

Horizon Vc, Area C: a small limestone pebble, weighing 47 gm. It is extensively worn at both the narrow ends (Plate 23c) indicating its use as a hammer - probably for stone working.

Horizon Vb, Area D: a basalt pounder, broken and with slight traces of grinding on one face.

Horizon Va, Area F: a domed basalt anvil, slightly pitted on one side.

Horizon III, Area D: a small oval pebble hammer stone, weighing 17 gm. Like the one in Horizon Vc, it has probably been used for retouching stone tools.

OCHRES

Small fragments of red ochre were found scattered in all levels and areas of the site. The weight of ochre in each horizon for all areas of the trench combined is listed in Table 27. Six of the ochre pieces (Plate 22d) bore irregular grooves on one or more surfaces and must have been used for the manufacture of pigment; perhaps to make the hand stencils at the back of the cave.

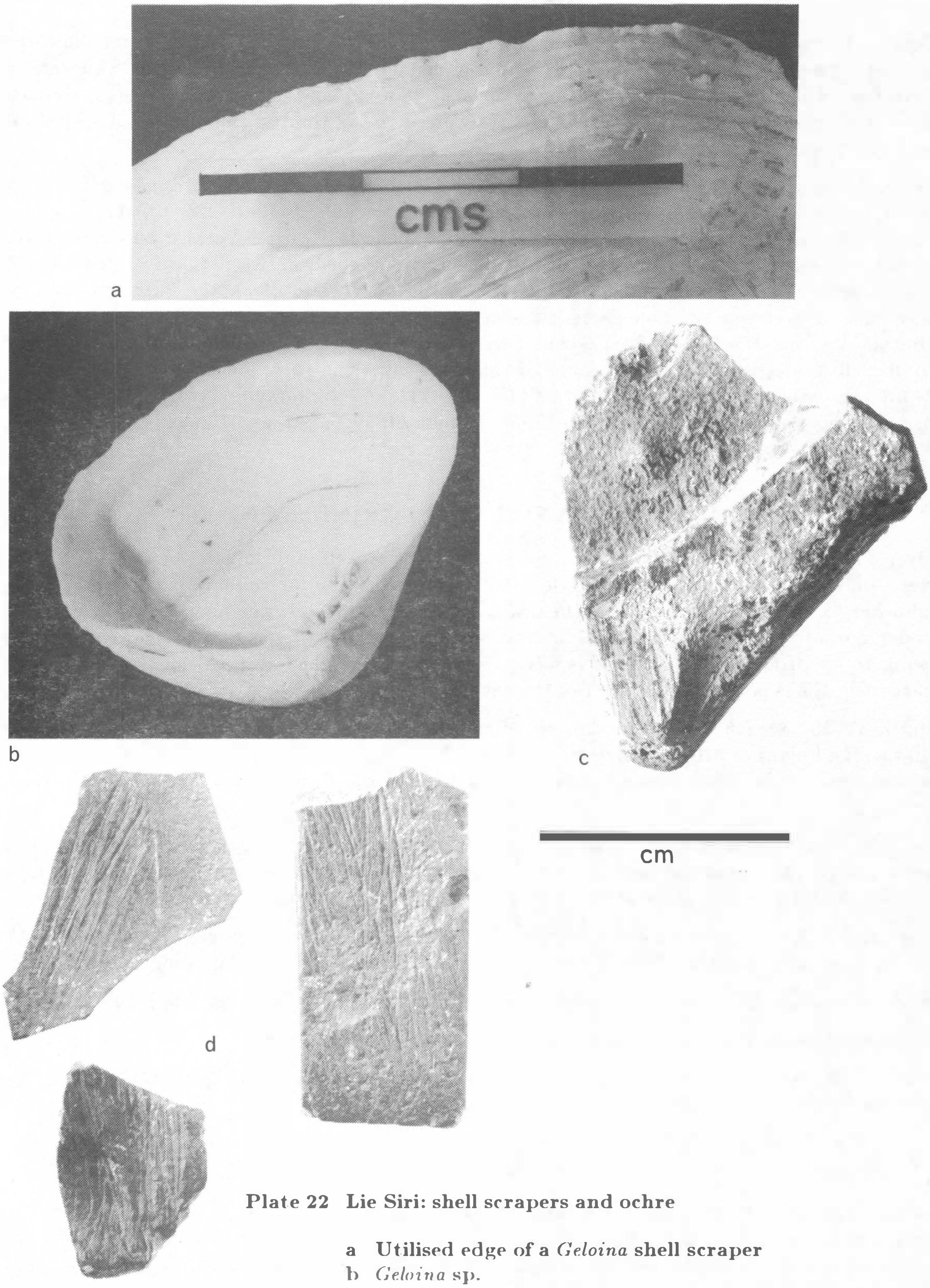


Plate 22 Lie Siri: shell scrapers and ochre

- a Utilised edge of a *Geloina* shell scraper
- b *Geloina* sp.
- c Ground ochre fragment, Square N2W9(3). Horizon VIa
- d Ground ochre fragments from:
  Top left. Square N1W7(8), Horizon II
  Top right. Square N2W10(5), Horizon Vc
  Bottom. Square N4W9(10), Horizon IVb

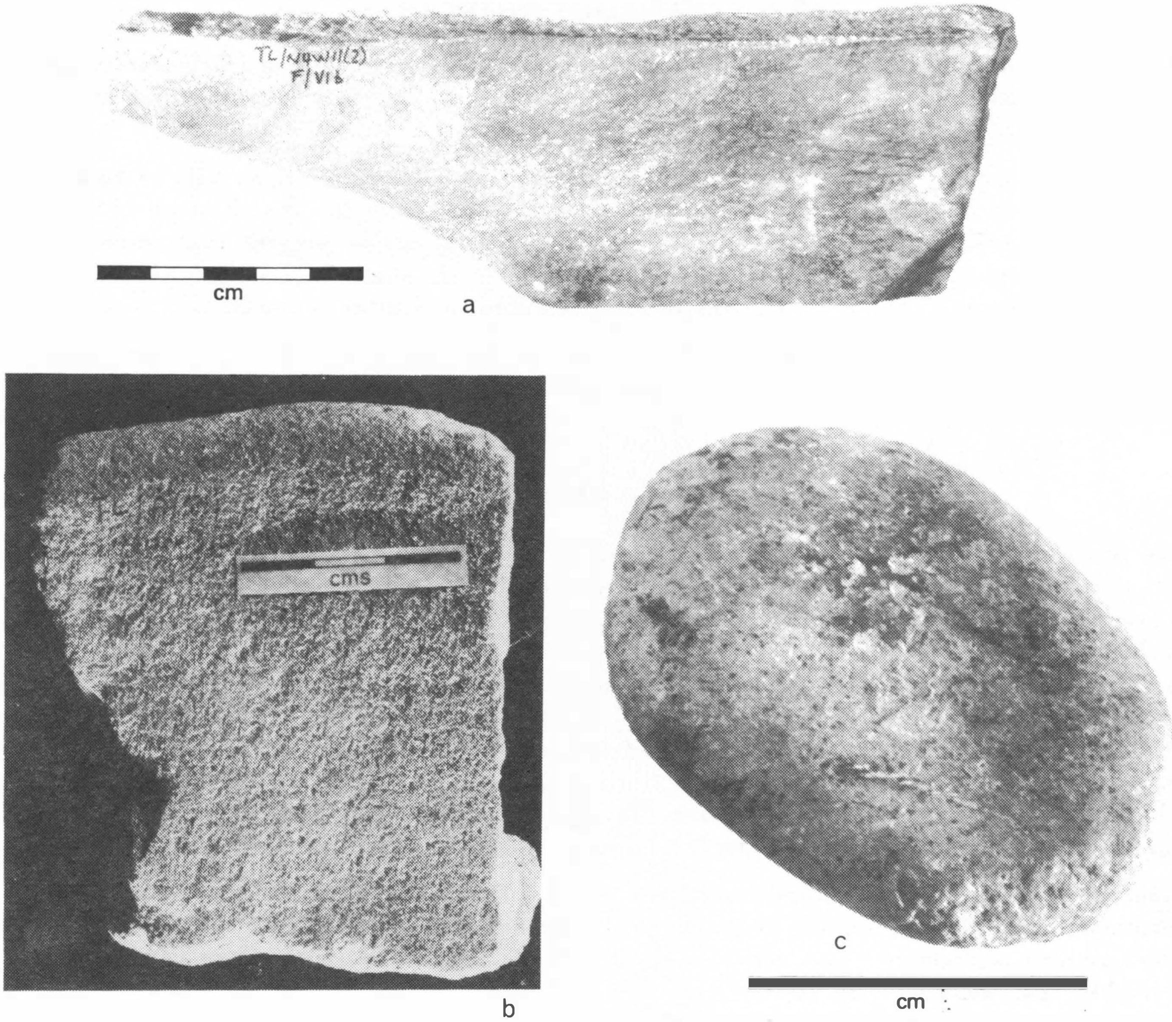


Plate 23 Lie Siri: stone tools

a Whetstone, Square N4W11(2), Horizon VIb
b Broken sandstone mortar. Outer edge has been shaped, and traces of red ochre are visible nearer the centre, Square N1W3(4), Horizon VIa
c Limestone hammer stone weighing 47 gm, Square N1W9(4), Horizon Vc

Horizon	Weight (gm)	Ground pieces	
VII	-	-	
VIb	12	-	
VIa	51	1	area D
Vc	87	1	area D
Vb	68	1	area D
Va	2	1	area F
IVa,b	13	1	area D
III	2	-	
II	7	1	area B
Ia,b	4	-	
Total	246	6	

Table 27 Lie Siri: distribution of ochre

MISCELLANEOUS OBJECTS

No metal, glass, porcelain or glazed ceramics were found within the area of the excavated trench, although fragments of glass were found below one of the wooden structures at the northeastern end of the cave.

Two strips of tortoise shell were found within the layer of goat dung (Horizon VII) in Area A. Both have been cut and are, no doubt, the waste material from the manufacture of some tortoise shell ornament. Parallel grooves along one of the strips suggest that some tool broader and blunter than a steel knife has been used to cut the shell. It is unlikely that it was stone, however, since little or no flaked stone was found in the surface of the trench.

One piece of a broken coconut shell ladle was found in the goat dung layer in Area B; similar finds were made on the surfaces of many caves, and a complete ladle, found in shelter Baucau 1 is illustrated in Plate 41.

THE ANALYSIS OF FAUNAL REMAINS

The procedures for the sorting and identification of animal remains are discussed in Chapter IV, and Appendices 1-3 give further details of the identifications made by various experts to whom the material was sent. It has not been possible so far to complete the identification of all bones recovered from Lie Siri. The most important gap is the absence of final data on the larger wild, and domesticated land mammals and I hope that it will be possible to publish data on these in due course. Preliminary sorting was undertaken in Canberra by Mr P. Thompson and myself, and this indicated that *Capra/Ovis* bones were present in most excavated squares of Horizon VII, and in Horizons VIa and VIb in Areas C and D at least. Phalanger, monkey, pig and dog were also provisionally identified in Horizon VIb from a few bones and teeth. These identifications are, however, not to be relied on at present.

Small numbers of fish, reptile and insectivore bones still await identification. Fish bones are surprisingly rare considering the closeness to the sea and that shellfish were numerous. The small number of diagnostic fish bones makes it unlikely that much useful information will be gained by their identification.

Murids

The sorting and identification of murids is discussed in Chapter V and in Appendix 2. Table 28 lists the minimum number of individual animals counted by Mahoney.

Although the numbers are fewer than in the Uai Bobo sites the sample is adequate enough to permit some comparisons with them.

All four genera of large murids are represented, but genus A is the most common of those identified to species compared with the inland sites where genus B is predominant. The large murids are found closer to the surface than in any other excavated site, and this is in keeping with the dates obtained for Horizons VIa and VIb.

Among the smaller rats, *Rattus exulans* is only found near the surface as it is at Uai Bobo 1. But for a single mandible from Uai Bobo 2, Horizon III, it would be certain that *Rattus exulans* is a recent introduction into Timor.

Of the *Melomys* sp., the smaller is less common than the larger species at the inland sites, and is absent from both Bui Ceri Uato and Uai Ha Ie. At Lie Siri there is only one tentative identification of this smaller *Melomys*, from a single edentulous mandible.

The other *Rattus* sp. includes at least two species, not yet positively identified by Mahoney. The smaller one of these occurs throughout the sequence, from Horizons Ia-VIb, and the larger only in Horizons Vb and Vc. A parallel situation is found in the other sites, for Mahoney notes that in Uai Bobo 1 and Uai Bobo 2 one species of *Rattus* is present in all levels, and a

LARGE MURIDS

Horizon	*Coryphomys*	A	B	C	Not identifiable	Total
VII	-	-	-	-	-	-
VIb	-	-	-	-	2	2
VIa	-	-	-	-	3	3
Vc	-	3	-	-	-	3
Vb	-	4	-	-	4	8
Va	1	1	-	-	3	5
IVb	-	2	-	-	-	2
IVa	-	-	-	-	2	2
III	-	-	1	1	1	3
II	-	-	2	-	-	2
Ia	-	-	-	-	4	4
Ib	-	-	-	-	1	1
Total	1	10	3	1	20	35

SMALL MURIDS

Horizon	*Melomys* sp. incl. *Pogonomelomys* Small	Large	*Rattus exulans*	Other *Rattus* sp.	Total
VII	-	-	-	-	-
VIb	-	-	9	14	23
VIa	1?	4	2	7	14
Vc	-	7	-	6	13
Vb	-	15	-	16	31
Va	-	5	-	1	6
IVb	-	3	-	4	7
IVa	-	4	-	3	7
III	-	9	-	25	34
II	-	15	-	79	94
Ia	-	33	-	82	115
Ib	-	8	-	9	17
Total	1?	103	11	246	361

Table 28 Lie Siri: minimum numbers of identified murids

second one in the lower part of the sequence only. That is to say, from Uai Bobo 1, Horizons I-V and Uai Bobo 2, Horizons I-IX.

Chiroptera

Identifications of the various species are discussed in Appendix 3 and the minimum numbers of individuals are listed in Table 29. Only one fruit bat was found, represented by a single *Pteropus* mandible, which was certainly brought into the cave by man. The predominance of cave dwelling species no doubt reflects the fact that Lie Siri has been occupied by a bat colony for a long time. Most of the bats which die naturally, however, would be incorporated into the deposit at the back of the cave.

Horizon	Not cave dwellers *Pteropus* sp.	Possibly cave dwellers *Hipposideros diadema*	Cave dwellers *Rousettus amplexicaudatus*	*Taphozous* sp.	Nos
VII	-	-	1	-	1
VIb	-	-	-	2	2
VIa	-	-	-	1	1
Vb	-	-	-	5	5
Va	1	1	-	1	3
IVb	-	-	1	1	2
Total	1	1	2	10	14

Table 29 Lie Siri: minimum numbers of identified chiroptera

As far as I could discover, the Uai Ma'a speaking people of the plateau do not eat bats today, and the scarcity of large bats in the deposit suggests that this custom may have a great antiquity. There was considerable resistance to my attempts to collect bat specimens in Lie Siri and Uai Ha Ie although I never fully understood the basis of this.

Human bones

Dr A.G. Thorne reported the following identifications:

Horizon Vc, Area A	three cranial vault fragments
Horizon Vc, Area B	foetal tibia fragments
Horizon Vc, Area A	left adult calcaneum fragment
Horizon IVb, Area E	parietal fragment of a young adult
Horizon III, Area B	six long bone shaft fragments, probably human
Horizon II, Area D	radius, fragment of proximal end, rib fragments, number 7 or 8

The extensive scatter of small fragments suggests that the remains are derived from the shallow burials of a possible five people, of whom one was very young to foetal, and the others adult. Cannibalism, of course, cannot be ruled out although there is no evidence of which I know, to show that this has been customary in Timor.

PLANT REMAINS

The list of plant remains identified by Dr Yen is contained in Appendix 4. Fragments of coconut, corn husks and cobs were common on the surface of the deposit and some were well embedded in the hard layer of goat dung which covered the entire site. A number of *Anona* seeds and one *Garcinia* fruit were found in Area A near the wooden frames shown in Plate 17. *Anona* is a large genus of trees, most of which, including, I believe, all the cultivated species, are of American origin (Burkill 1935:165). *A. reticulata* (custard apple) is now widely grown in Timor. Several of these trees grow near the cave, and they can be found near most house clusters on the plateau where there is enough groundwater. Other species of *Anona* are not common in this part of Timor if they are grown at all.

Garcinia is a large genus of trees and shrubs of the family Guttiferae, native to the Old World tropics. Many are large forest trees yielding edible fruits, wood and other products which are put to an immense variety of uses in Southeast Asia (Burkill 1935:1046-57). Mangosteen (*G. mangostena*) is the best known species producing edible fruits, but it is not common in eastern Timor as far as I know.

Below the surface, seed cases of *Celtis* are common in all areas of the trench. These are discussed in Appendix 4, and in Chapters VIII and IX. The point to make here is that they are found from Horizons II-VIb which are dated to between 7400 and 2000 years ago, but not one was found in Horizon VII. In the Uai Bobo sites also, *Celtis* is not found in the most recent levels.

In Horizon IVb, Area B, there is a broken seed, tentatively identified by Yen as *Arachis* (peanut). In Uai Bobo 1 peanut shells were found in levels which I believe should be dated to between 650-1600 BP. At Lie Siri, Horizon IVb in Area B, is stratigraphically below the hearth dated to 6635 ± 140 (ANU-171), and is bracketed by the date (ANU-236) which gives an average date for Horizons I-III of 7270 ± 160 BP. The implication of these early dates is discussed in Chapter VIII in the section on Plant Remains.

ANALYSIS OF MOLLUSCA

The method of collection of the shell samples is set out in Chapter IV. Seventy samples were collected with a total weight of 10.5 kg which would have been adequate for a detailed analysis of the molluscs in the site if the diversity had not been so great. About 4000 individual shells were collected but only 10 out of the 100 varieties in the site were represented by more than 20 specimens in any one horizon.

Table 30 shows the sample weights and the weight per m^3 for each horizon, expressed as a percentage of the total weight of all the samples per m^3. This is not perhaps the best method of estimating the proportion of shell in the deposit but it was not possible to do more at the time of excavation, and I have been unable to reanalyse the solid samples which were collected from all sites.

Horizon	Weight of shell sample	Volume of shell collected (m^3)	Weight of shell (m^3)	% shell
VII	(density data incomplete)			
VIb	1687	0.34	4.96	10.20
VIa	688	0.07	9.82	20.19
Vc	2335	0.27	8.68	17.85
Vb	1595	0.42	3.80	7.81
Va	862	0.21	4.10	8.43
IVb	1840	0.33	5.58	11.47
IVa	333	0.12	2.78	5.70
III	554	0.19	2.92	6.00
II	648	0.27	2.40	4.93
Ib	3097	1.42	2.18	4.48
Ia	419	0.30	1.40	2.80

Table 30 Lie Siri: shell sample weights and density of shell

The density of shell is higher in horizons above Vb where there were more individuals and a greater range of species. Molluscs from a variety of habitats were brought regularly to the site from the time of its earliest occupation to its abandonment and it is probable that molluscs were more abundantly collected and more varied in the upper horizons, but further interpretation is limited by the variable rate of accumulation of the deposit and the uneven degradation of the shell.

Each sample was sorted and minimum numbers of individuals recorded for every molluscan species. Because of the small numbers of individuals of some species the total weight of shell of each species was not measured. The original site samples were sorted separately but for presentation here the figures were combined into Horizons Ia-VII as discussed in Chapter IV and shown in Table 2.

Table 31 shows the number of field samples and the mean weight of the samples which range from 133-431 gm. It would have been useful to have a more even series of samples for each horizon and the results of analysis of Horizons Ia, Va and IVa are probably less reliable because of the small sample size, particularly as many of the molluscs occur in low numbers.

Horizon	Nos of samples	Mean weight of each sample (gm)
VII	13	133
VIb	7	241
VIa	6	420
Vc	7	416
Vb	6	265
Va	2	431
IVb	7	262
IVa	1	333
III	4	138
II	4	162
Ib	11	281
Ia	2	209

Table 31 Lie Siri: number of field samples and mean weight of samples in each horizon

The mollusca from Lie Siri are distributed among 39 families, a diversity perhaps to be expected in the vicinity of a fringing coral reef. However, 32 species are represented by only one individual of each, and only 10 species have more than 20 individuals in one horizon. Thus, although there is a great richness of species, only 20 or so were brought regularly to the site throughout its occupation. Table 32a lists, in systematic order, the 43 species of molluscs that are more abundant. Some are listed by family where species determination was not possible. In this table we show (n) the estimated minimum number of individuals per 10 kg of sieved deposit, and (%), percentage frequencies that are based on the total minimum number of individuals in the site, which includes the 57 rarer species listed in Table 33. Most of the uncommon species account for less than 1% of the total individuals in each horizon. In a few cases they exceed this figure and for them the percentage is listed in brackets.

Most of the quantitative data in this analysis of molluscs from Lie Siri is presented in Tables 32-35. Some species occur from either Horizon Ia or Horizon Ib to the top of the site. These common species are *Haliotis varia*, *Cellana radiata*, *Trochus maculatus*, *Turbo* sp., *Nerita plicata*, *Nerita undata*, *Nerita costata*, *Tectarius pagodus*, *Thais savignyi*, *Thais armigera*, *Ostraea* sp., Corbiculidae (?*Geloina* sp.) and chiton as well as the three larger terrestrial gastropods. There are more molluscs of all species in Horizons IVb-VIa and there are lower numbers in the top two and three basal horizons. Above Horizon Va there is an increase in diversity of species, that is new species appear for the first time. Some of these are numerous; for example, species of Strombidae, Cypraeidae, Muricidae and Conidae and most of these new species persist to the top of the site. Others are quite rare with only one or two individuals in the whole site; for example, *Bursa* sp., *Nassarius* sp., *Leucozonia* sp..

The distribution of *Nerita textilis* presents an anomalous pattern; it is particularly common in Horizons Ib-IVa but does not appear above Horizon Va. A similar distribution was found at Bui Ceri Uato. It is the only one of the more abundant species not to appear in the upper part of the site and this fact needs some explanation. It does not seem possible that given the abundance of all other *Nerita* spp. in the upper horizons that its absence is the result of inadequate sampling. Alternatively, it could have been overfished or perhaps there was some change in the environment to which it was sensitive. Its ecology is well understood and this may help explain its disappearance. It is a common Indo-Pacific species on rocky limestone shores exposed to heavy wave action where they live in tide pools and on exposed rocks. They have been observed in densities of 12-13 individuals per m^2 on Aldabra Atoll (Hughes 1971). It is one of the larger Nerites, with a rugged shell and though not as common as *Nerita plicata*, it is easily collected and unlike all other *Nerita* species it does not seek shelter during periods of exposure at low tide. Therefore, it would be an attractive species for collectors and could easily be collected in such numbers that the local population was no longer viable. On the other hand, it is found only on shores exposed to heavy wave action and never on moderate or sheltered shores. During the 5000 years of occupation of the site the extent of the fringing reef may have fluctuated. An increase in the area of reef would give rise to more sheltered waters along the shoreline and the species would no longer thrive. Unfortunately there is no modern study of its distribution along the Timorese coast and there is not enough evidence from Lie Siri to choose between a cultural or natural explanation for its disappearance in the upper part of the site.

The molluscs at Lie Siri have been brought to the site from a variety of habitats; fringing reef, raised reef, mangrove mudflats, estuaries and terrestrial habitats, in this case leaf litter and forest trees. The nearest fringing reef is over 3 km, and the raised reef is less than 1 km from the site and most of the molluscs come from these two habitats. The fringing reef is not extensive and examination of aerial photographs of the coast near Uai Ono (Plate 13) show that it is perhaps no more than 150 m at its widest point and that it is discontinuous along the coast. The outer slope of the fringing reef, the subtidal zone, is always immersed and slopes away towards deeper water. Several of the molluscs that were found in the site inhabit both the subtidal and intertidal zones. They include *Trochus maculatus*, *T. niloticus*, *Tectus pyramis*, *Turbo marmoratus*, *Neritopsis radula*, *Mancinella mancinella*, *Chicoreus brunneus*, *Pleuroploca* sp., *Conus marmoreus* and *C. miles*; most of these are rare and only

Conus marmoreus and *Trochus maculatus* occur regularly on the site. Behind the outer slope lies the reef flat itself, the mid to lower littoral, which is a more or less horizontal platform on top of a coral reef structure. Tropical reef flats have diverse mollusc populations with some abundant species. The upper littoral is old raised coral reef which is extensive along the coast. In some places it lies behind the reef flat and elsewhere it is a narrow platform or irregular limestone boulders which fall away steeply into deeper water on the seaward margin. It is a more extensive habitat than the reef flat but there are fewer species of molluscs associated with it, although some are very abundant such as *Nerita* and *Cellana*. East of the reef flat at Uai Ono the fringing reef is disrupted by the outflow of fresh water and here there is a narrow sandy beach which is exposed to occasional heavy wave action. Molluscs from sandy habitats are uncommon throughout the site. They include *Oliva* sp., *Strombus aurisdianae*, *S. luhuanus*, *Anadara* sp., *Cardium alternatum*, *Meretrix* sp., and *Periglypta* sp.. These molluscs can inhabit sandy areas on the reef flat and in Tables 34 and 35 they have been numbered with other intertidal reef species.

Among the marine molluscs there are many more gastropods than bivalves although both occur throughout. Gastropods comprise 70-90% of the total individuals of molluscs at Lie Siri, bivalves 3-5% above Horizon Vb and 1-2% below that horizon, and chitons 5-10% above Horizon Vb and 20-25% below. Meehan (1982) writing on the Anbarra people of the Northern Territory found quite the reverse preference amongst shellfish collectors. Gastropods, although readily available, were collected only occasionally. Thus, of the combined weight of shellfish collected by the Anbarra during the year 1972-73, 2% were gastropods and 98% bivalves. It is not possible to compare in detail the pattern of Anbarra collection of shellfish and that found in prehistoric Timor but the differences are worth mentioning. The mollusc resources available to the Anbarra were diverse, coming from rich sandy intertidal areas and mangroves in contrast to the narrow reef and rocky shoreline of Timor. Nonetheless, the absence of bivalves, particularly mussels, at Lie Siri was surprising. The choice of bivalve or gastropod would depend on their natural availability and abundance as well as consumer preference, and these groups of molluscs are not evenly distributed on tropical reef shores. Along the southeast coast of India for example Pillai *et al.* (1979) showed that the molluscs of the littoral fringe or upper littoral were composed entirely of gastropods, while the mid to lower littoral contained 68.5% gastropods, 27.8% bivalves and 3.8% chitons and the sub-littoral contained 38.8% gastropods, 60.0% bivalves and 1% chitons. The low numbers of bivalves at Lie Siri suggest that generally the occupants of the site did not venture beyond the reef edge to collect shellfish but preferred the more accessible reef flats and higher shores where there were large numbers of easily collected gastropods and chitons.

Tables 34 and 35 show the percentage frequency of species for each of seven habitats and of the minimum number of individuals for the same seven habitats. The molluscs have been grouped into habitats to give some idea of the way in which these resources were exploited and perhaps to reveal any change that may have occurred in the pattern of exploitation. Marine molluscs from the reef flat are the most abundant throughout the site, followed by molluscs from the raised reef, then mangrove and only a small percentage came from the other habitats. Terrestrial molluscs are discussed below. There seems to have been remarkably little change in the exploitation of mollusc resources throughout the occupation of the site during which there were quite substantial changes in Timorese lifestyle, for example the introduction of pottery, the development of agriculture and the appearance of a range of introduced fauna, such as pig. However, there is an increase in species richness above Horizon IVb; thus, among samples of similar size, that is more than 400 individuals, Horizon Ib has 26 species compared to Horizon Vc which has 47, Horizon VIa 56 and Horizon VII with 51 species. Most of these new species are from the reef flat. Tables 34 and 35 show that there is a small increase in the proportion of reef flat species from Horizons Vb-VII although this is not accompanied by an increase in the proportion of minimum number of individuals on molluscs from that habitat.

It is tempting to relate this change to an increasing exploitation of the reef which would have

Table 32a Lie Siri: analysis of the 43 most abundant mollusc species (i.e. those of which more than five specimens were found at the site)

	HORIZON																								Total m.n.i. per species
	VII		VIb		VIa		Vc		Vb		Va		IVb		IVa		III		II		Ib		Ia		
Species	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
GASTROPODA (marine)																									
Haliotidae																									
Haliotis varia	67	13	62	9	867	21	483	32	220	33	172	13	219	23	127	30	183	23	156	17	189	13	71	15	859
Patellidae																									
Cellana ?radiata	9	2	3	1	34	1	12	1	13	2	86	6	15	2	3	1	22	3	19	2	3	*	17	4	56
Acmaea sp.	2	*	3	1	21	*	7	*	2	*	69	5	-	-	-	-	-	-	-	-	-	-	-	-	18
fam. Patellidae	5	1	2	*	21	*	-	-	2	*	-	-	-	-	-	-	-	-	-	-	6	*	-	-	10
Trochidae																									
Trochus maculatus	16	3	17	3	48	1	30	2	8	1	34	3	7	1	10	2	6	1	6	1	19	1	17	4	67
Turbinidae																									
Turbo setosus	29	5	15	2	55	1	28	2	14	2	9	1	13	1	-	-	22	3	45	5	71	5	4	1	98
Turbo chrysostomus	16	3	13	2	89	2	30	2	-	-	9	1	2	*	-	-	6	1	-	-	6	*	-	-	48
Neritidae																									
Nerita polita	2	*	8	1	34	1	9	1	6	1	26	2	9	1	3	1	-	-	19	2	9	1	8	2	36
Nerita textilis	-	-	-	-	-	-	-	-	-	-	17	1	11	1	20	5	22	3	45	5	177	12	63	13	97
Nerita undata	5	1	-	-	28	1	14	1	11	2	26	2	24	3	10	2	33	4	52	6	43	3	21	4	72
Nerita plicata	131	24	231	34	1252	30	353	23	41	6	95	7	96	10	107	25	122	15	71	8	136	9	17	4	748
Nerita grossa	7	1	-	-	7	*	-	-	-	-	9	1	-	-	-	-	-	-	6	1	-	-	-	-	7
Nerita costata	47	9	69	10	344	8	86	6	22	3	9	1	20	2	3	1	11	1	26	3	25	2	-	-	196
Nerita ?polita	-	-	5	1	-	-	7	*	-	-	-	-	-	-	10	2	11	1	-	-	-	-	-	-	11
Littorinidae																									
Tectarius ?grandinatus	-	-	7	1	21	*	5	*	5	1	-	-	2	*	-	-	-	-	52	6	12	1	-	-	25
Tectarius pagodus	3	1	39	6	138	3	58	4	8	1	17	1	28	3	17	4	28	3	26	3	31	2	17	4	120
Melaniidae																									
Melanoides sp.	-	-	-	-	-	-	5	*	-	-	26	2	4	*	-	-	-	-	6	1	-	-	-	-	8
Potamiidae																									
Terebralia palustris	-	-	-	-	21	*	2	*	10	1	103	8	9	1	-	-	6	1	-	-	-	-	-	-	28
Terebralia sulcata	-	-	2	*	7	*	2	*	6	1	43	3	9	1	-	-	-	-	-	-	-	-	-	-	17
Terebralia sp.	-	-	-	-	-	-	-	-	3	*	43	3	2	*	-	-	-	-	-	-	-	-	-	-	8
Strombidae																									
Strombus decorus	16	3	5	1	28	1	7	*	-	-	-	-	2	*	-	-	-	-	-	-	-	-	-	-	20
Strombus luhuanus	14	3	15	2	55	1	9	1	-	-	-	-	4	*	-	-	-	-	-	-	-	-	-	-	31
Cypraeidae																									
Cypraea caputserpentis	10	2	13	2	62	1	26	2	10	1	-	-	31	3	-	-	6	1	-	-	-	-	-	-	58
fam. Cypraeidae	2	*	3	1	21	*	2	*	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
Muricidae																									
Thais savignyi	3	1	12	2	41	1	14	1	8	1	9	1	13	1	7	2	11	1	13	1	31	2	4	1	51
Thais armigera	-	-	2	*	34	1	9	1	5	1	9	1	2	*	-	-	-	-	-	-	6	*	-	-	17
Thais sp.	2	*	-	-	7	*	2	*	2	*	-	-	11	1	-	-	6	1	-	-	3	*	-	-	12
Mancinella mancinella	2	*	3	1	14	*	2	*	8	1	9	1	11	1	-	-	-	-	-	-	-	-	-	-	18
Drupa ricinus	-	-	7	1	-	-	7	*	2	*	-	-	2	*	-	-	-	-	-	-	-	-	-	-	9
Conidae																									
Conus marmoreus	3	1	7	1	28	1	12	1	-	-	-	-	2	*	-	-	-	-	-	-	-	-	-	-	16
Conus sp.	2	*	-	-	7	*	12	1	-	-	-	-	-	-	-	-	-	-	-	-	3	*	-	-	8

BIVALVIA (marine)																									
Ostraeidae																									
Ostraea sp.	-	-	2	*	14	*	5	*	5	1	-	-	4	*	-	-	6	1	6	1	3	*	-	-	13
Tridacnidae																									
Tridacna maxima	5	1	12	2	7	*	2	*	-	-	9	1	-	-	-	-	-	-	-	-	-	-	-	-	13
Hippopus hippopus	3	1	2	*	21	*	2	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Corbiculidae																									
Geloina sp.	16	3	7	1	55	1	23	2	18	3	9	1	15	2	-	-	6	1	6	1	-	-	-	-	53
CEPHALOPODA																									
Nautilus pompilius	9	2	7	1	28	1	7	*	8	1	-	-	7	1	3	1	-	-	6	1	-	-	-	-	27
POLYPLACOPHORA																									
Chiton spp.	26	5	34	5	344	8	128	8	99	15	379	28	162	17	83	20	227	28	136	15	508	35	193	40	631
GASTROPODA (terrestrial)																									
Amphidromus contrarius	3	1	3	1	48	1	12	1	8	1	-	-	9	1	10	2	-	-	39	4	40	3	4	1	49
fam. Ariophantidae	2	*	7	1	7	*	5	*	3	*	26	2	22	2	10	2	22	3	58	6	46	3	-	-	56
Chloritis sp.	36	7	27	4	151	4	84	5	69	10	60	4	112	12	-	-	28	3	71	8	62	4	21	4	247
Geophorus oxytropis	2	*	2	*	62	1	2	*	5	1	-	-	7	1	-	-	11	1	-	-	-	-	-	-	21
Cyclotus succinctus	-	-	-	-	7	*	2	*	2	*	-	-	20	2	-	-	-	-	6	1	-	-	-	-	15
other landsnail	5	1	2	*	21	*	2	*	24	4	26	2	-	-	-	-	-	-	13	1	12	1	-	-	32

n is the estimated minimum number of individuals per 10 kg of sieved material
% is the frequency of each species as a percentage of the total individuals (including rare specimens) in each horizon
* = <0.5%

Table 32b(i) Lie Siri: total minimum number of individuals of all species (including rare ones) per horizon

HORIZON											
VII	VIb	VIa	Vc	Vb	Va	IVb	IVa	III	II	Ib	Ia
312	399	611	655	417	157	507	127	144	139	470	114

Table 32b(ii) Lie Siri: species richness per horizon

HORIZON											
VII	VIb	VIa	Vc	Vb	Va	IVb	IVa	III	II	Ib	Ia
51	46	56	47	39	27	45	15	22	25	26	16

Species	Horizon	Nos
GASTROPODA (marine)		
Cellana sp.	Ia	4
Trochus ?squarrosus	VIa, IVb, Ia	7, 2, 4
Trochus niloticus	Vc	2
Trochus sp.	VIb, Vb, Ib	2, 2, 6
Tectus ?pyramis	VIa, IVb	14, 4
Monodonta sp.	VIa	7
Turbo marmoratus	Va, IVb	26 (2%), 2
Nerita albicilla	VIa	14
Nerita ?chamaeleon	VIa	7
Nerita exuvia	VII, VIb, IVb	2, 2, 2
Nerita ?undata	VII, VIb, Vb	2, 2, 5
Neritopsis radula	VIa, Vc	7, 2
Littorina undulata	VIb	2
Tectarius tectumpersicum	VIa	7
Echininus cumingii	VII	2
Melanoides tuberculata	VIa, II	7, 6
Clupeomorus sp.	Ib	3
Cerithidae	VIa	14
Strombus lentinginosus	VII	2
Strombus aurisdianae	VII, VIa	3, 14
Strombus maculatus	Vc	2
Lambis sp.	VIa, II	14, 6
Lambis crocata	IVb	2
Cypraea arabica	VII, VIb	2, 5
Cypraea depressa	VII, VIb, VIa	2, 2, 7
Cypraea tigris	VII	2
Cypraea helvola	VII	2
Cypraea moneta	VII	2
Bursa sp.	VIa, Vc	7, 2
Cymatidae	Ib	3
Purpura rudolphi	VIa	7
Drupa morum	VII, VIb, IVb	2, 2, 2
Chicoreus brunneus	Vc	2
Muricidae	Vc	2
Nassarius ?fida	IVb	2
Nassarius sp.	Vb	2
Cantharus undosus	Vb	2
Leucozonia sp.	VIb	2
Leucozonia smaragdula	VIb	2
Pleuroploca filamentosa	VII	2
Vasum turbinellus	Vb	2
Oliva ?carneola	VIa, Vc	7, 2
Oliva oliva	Vc, Vb, IVb	2, 2, 6
Melo sp.	Vb	2
Conus ebraeus	VII	5
Conus miles	VIa	7
Conus virgo	VII	2
Conus ?imperialis	VIb	2
Conus spectrum	VIb	2
Pyramellidae	VII, IVb	2, 4
BIVALVIA (marine)		
Anadara sp.	VII	2
Barbatia sp.	VII	3
Trachycardium alternatum	VIa	7
Tridacna sp.	VII, VIb	2, 3
Meretrix sp.	IVb	2
Periglypta sp.	VII, VIa	2, 7
Asaphis deflorata	IVb	2

Table 33 Lie Siri: estimated minimum number of individuals per 10 kg of sieved material of the less common molluscs

Horizon	Total species	Mid-lower littoral reef flat nos	%	Upper littoral raised reef nos	%	Subtidal nos	%	Mangrove nos	%	Estuarine nos	%	Arboreal nos	%	Leaf litter nos	%
VII	51	31	59	13	25	1	2	1	2	-	-	2	4	3	7
VIb	46	26	57	12	26	1	2	1	2	1	2	2	4	3	7
VIa	56	31	53	14	25	1	2	3	5	1	2	2	4	4	7
Vc	48	28	58	10	21	1	2	3	6	-	-	2	4	4	9
Vb	39	18	46	10	26	1	3	4	10	-	-	2	5	4	10
Va	27	10	37	9	33	-	-	3	11	1	4	-	-	4	15
IVb	45	24	53	9	20	1	2	4	9	1	2	2	5	3	7
IVa	15	4	26	8	53	1	7	-	-	-	-	1	7	1	7
III	22	10	45	8	36	-	-	1	5	-	-	1	5	2	9
II	25	8	32	9	36	-	-	1	4	2	8	1	4	4	16
Ib	26	12	46	9	35	1	3	-	-	-	-	1	3	3	12
Ia	16	7	43	7	44	-	-	-	-	-	-	1	6	1	6

Table 34 Lie Siri: molluscs, percentage frequency of species for each of seven habitats

Horizon	Total m.n.i.	Mid-lower littoral reef flat nos	%	Upper littoral raised reef nos	%	Subtidal nos	%	Mangrove nos	%	Estuarine nos	%	Arboreal nos	%	Leaf litter nos	%
VII	312	148	46	125	40	5	2	9	3	-	-	3	1	22	7
VIb	399	147	37	218	55	4	1	4	1	1	*	4	1	21	5
VIa	611	273	44	281	46	4	1	11	2	1	*	16	3	25	4
Vc	655	359	55	234	36	3	*	12	2	1	*	7	1	39	6
Vb	417	246	60	72	17	5	1	25	6	-	-	8	2	60	14
Va	157	79	49	39	25	-	-	23	15	3	2	-	-	13	8
IVb	509	279	55	112	22	4	*	19	4	2	*	9	2	84	17
IVa	127	68	54	52	41	1	*	-	-	-	-	3	2	3	2
III	144	85	59	46	32	-	-	2	1	-	-	2	1	9	6
II	139	56	40	50	36	1	1	1	1	2	1	6	4	23	17
Ib	470	276	59	40	30	1	*	1	*	-	-	13	3	39	8
Ia	114	73	64	35	31	-	-	-	-	-	-	1	1	5	4
Total	4052	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 35 Lie Siri: molluscs, percentage frequency of minimum number of individuals for each of seven habitats

ultimately affected reef mollusc biomass. Intensive exploitation could have reduced both numbers and size range of molluscs. New species may have been collected to make up the shortfall. Alternatively, the collection of new species may represent a change in the use of molluscs, for example for making shell artifacts which appear about this time at the inland sites of Uai Bobo 1 and Uai Bobo 2. Shell artifacts were made from *Conus* sp., *Cypraea* sp., *Trochus* sp., *Anadara* sp., *Cardium* sp., and *Nassarius* sp., which were the same species found at Lie Siri.

On the other hand the increased reef flat species may reflect change in the local environment and thus their availability for collectors. For example an increase in the extent of the fringing reef. At Bui Ceri Uato there is no corresponding increase in the number of reef flat species, although *Conus* and *Cypraea* species are more abundant in the later horizons. However, the samples are small and difficult to compare in detail to those from Lie Siri.

The proportion of species from the raised reef is smaller in the upper horizons compared to earlier horizons, and there is an increase in the proportion of minimum number of individuals from that habitat in Horizons VIa-VIb.

The small number of mangrove species at Lie Siri includes *Terebralia sulcata*, *T. palustris* and at least one member of the Corbiculidae, possibly *Geloina* sp. The *Terebralia* sp. are found from Horizons III-VIa and the *Geloina* sp. from Horizons II-VII, and together they comprise about 10% of the total individuals in Horizons IVb-Vc and 3-4% in the other horizons. There are no mangroves near the site today although there are extensive areas at river estuaries along the coast. It is possible that the wetland behind the beach at Uai Ono may have once supported a small mangrove swamp but there is no other evidence for this. However, we can see that there was regular trade in these mangrove species because they appear at the inland sites of Uai Bobo 1 and Uai Bobo 2 at about the same time as at Lie Siri. Thus their presence at Lie Siri may have been the result of such trade or long-distance foraging.

There is evidence from both coastal and inland sites that *Geloina* sp. were used as artifacts, possibly as scrapers, as elsewhere in Indonesia (Willems 1939) and Australia (White 1967a:11) but it is not known whether this species was transported live for consumption, or only for making tools and ornaments.

Terrestrial gastropods were found in all horizons and the data is found in Table 32a. Terrestrial gastropods have not been recorded from other sites in Timor but that is most likely due to failure to preserve or identify them. Although the shells are fragile many of them at Lie Siri were in good condition. There were three abundant and possibly edible species; *Amphidromus contrarius*, an arboreal species, a species of Ariophantid which could not be accurately identified, and *Chloritis* spp. (including *Chloritis argillacea*) both leaf litter dwellers. *Chloritis* spp. were the most common and made up between 3-11% of the total of molluscs. They were particularly common in the middle horizons but occurred throughout the site. The other two species were also distributed throughout, comprising less than 1% of the total individuals above Horizon Va and between 2-6% below. There were two other species of landsnail, *Geophorus oxytropus* and *Cyclotus* sp., both very small, which must have found their way into the site by accident and comprised less than 1% of the total individuals.

None of the molluscs at Lie Siri come from deep water with the exception of *Nautilus pompilius*. This species is found in most Horizons above Ib. All the shells were fragmentary and it was not possible to identify individuals so that a minimum of one individual has been recorded for each horizon. *Nautilus* was used for the manufacture of shell beads at Lie Siri; there is one pierced bead from Horizon VIa, and several beads were found at Bui Ceri Uato and Uai Bobo 1 and Uai Bobo 2 at a comparable date. *Nautilus* is fished with hook and line in the Loyalty Islands (CNL 1979) but it is not known whether this animal was collected alive in Timor and the absence of any other deep water molluscs and the scant fish remains in the site suggest that the ancient Timorese were no more at home on the sea than their modern descendants, and the shells were probably picked up on the beach.

There is little comparable quantitative data on mollusca from other Southeast Asian archaeological sites, particularly those adjacent to coral reefs. Only the material from Leang Tuwo Mane'e in the Talaud Islands proves suitable. This site was excavated in 1974 (Bellwood 1978) and the mollusca were analysed as an undergraduate project by Heffernan (1980). There are some interesting parallels with Lie Siri. Leang Tuwo Mane'e is a rockshelter in coral limestone and dates from 5000 BP to between 400 and 200 BP, a period which, as at Lie Siri, covers the introduction of pottery and agriculture. Marine and terrestrial molluscs are found throughout the site and are derived from seven main habitats; terrestrial, freshwater, reef edge, reef intertidal, supra littoral, sandy intertidal and tidal mudflat. With the exception of the sandy intertidal habitat similar ecological zones were exploited in roughly the same proportions as at Lie Siri.

The proportion of individuals from different habitats at Leang Tuwo Mane'e are shown in Table 36 and can be compared to Lie Siri (Table 35). There was an increase in the numbers of individuals from the upper littoral during the late period at Leang Tuwo Mane'e which also occurred at Lie Siri at about the same time (Horizons VII and VIb) and there was a corresponding decline in molluscs from other habitats.

	Intertidal reef and reef edge	Upper and supra littoral	Sandy intertidal	Tidal mudflat	Terrestrial	Freshwater
Late	20	57	15	1	5	1
Early metal	22	47	24	1	6	1
Neolithic	24	52	13	1	9	<0.5
Pre-ceramic	39	37	6	7	7	3

Table 36 Leang Tuwo Mane'e: percentage frequency of molluscs from different habitats

Remains of fish were scarce at both sites, and it is clear that exploitation of marine resources was largely confined to the molluscs and crustacea of the littoral zone. There appears to have been no reduction in the use of molluscs after the introduction of pottery.

Some aspects of the study of mollusca from Lie Siri await further study; for example, shell sizes might indicate the effect of human exploitation on the littoral; a more detailed study of the shell artifacts and the trade in mollusca to the inland sites might permit comparisons with evidence from other parts of Southeast Asia; finally one could study the contribution of each species to the food supply. But in order to do this reliable quantitative data is needed on the calorific and nutritional values of all the major species and the productivity of the different habitats exploited and this data is not yet available.

ROCK PAINTINGS

During a visit to Timor in July 1967 Mulvaney noticed some faded hand stencils in red ochre on the roof at the back of the cave. Close examination of all the cave walls showed that there were at least eight recognisable, complete or partial stencils, and scattered patches of flaking ochre indicated that there had probably been more. The stencils are in two places about 6 m apart. The eastern location consists of a single negative hand impression against a red ochre background on a stalagmite pillar. The painting is in very poor condition. The fingers are spread out, and the impression is roughly 17 cm^2. The western site contains three distinct groups of hands with four, two, and one hand impressions in each group. The paintings are about 1.8 m above the cave floor. As the stencils are all in poor condition, they are not illustrated.

Although my workmen were familiar with the paintings at the shelter of Lie Kere on the plateau (Glover 1972a:54), not one appeared to have seen these stencils before, and I could learn nothing about the local traditions associated with them. At the painted sites previously mentioned, Almeida (1967) mentions their occurrence at both Ili Kere Kere and Lene Hara, so it is only the more elaborate motifs found at these sites which are absent at Lie Siri.

VI EXCAVATIONS ON THE BAUCAU PLATEAU: BUI CERI UATO

DESCRIPTION AND EXCAVATION

While excavation at Lie Siri was in progress a number of shelters and small caves were examined on the western edge of the Baucau Plateau between Punta Bundura and *suco* Buccoli, on the Baucau-Dili road (Fig.5). Almost every cave contained signs of occupation - broken pots, corn drying racks, and occasionally struck flakes of flint. One cave in particular looked promising for excavation because of the number of flakes eroding from the slope in front, and for the ease of access from my base camp at Uai Ono. A small test pit dug in July 1967 produced more flaked stone than any cave yet found in Timor, and further excavation was carried out in September and November of that year.

The name most regularly given to the cave was Bui Ceri Uato, literally the 'cat with teeth of stone' in Uai Ma'a, but for what reason I never found out. *Bui* is also sometimes used to refer to a girl in Uai Ma'a, and in other Timorese languages. The code TB has been used for this cave. It lies in dense scrub behind the spring at Uai Mata Ba'i about 175 m above sea level (575 ft) and within the boundary of *suco* Buccoli (*posto* Baucau), at approximately 126° 22' E, 8° 27' S. It is a long but shallow shelter facing northwest, eroded into one of the many plateau terraces (Plate 24). Like so many caves in Timor, there is a limestone rubble wall along the line of overhang, and a layer of hard goat dung on the floor, showing the use of the cave as a goat pen in the wet season when the growing corn needs protection. At the southwestern end were two frames of wood and bamboo about 1.5 m high and 1.5 x 1.0 m^2 (Fig.19a). These frames, called *resa* in Uai Ma'a, are built in many caves about April, after the corn harvest (Plate 17). Most of the corn husks are removed and the cobs, tied in bundles

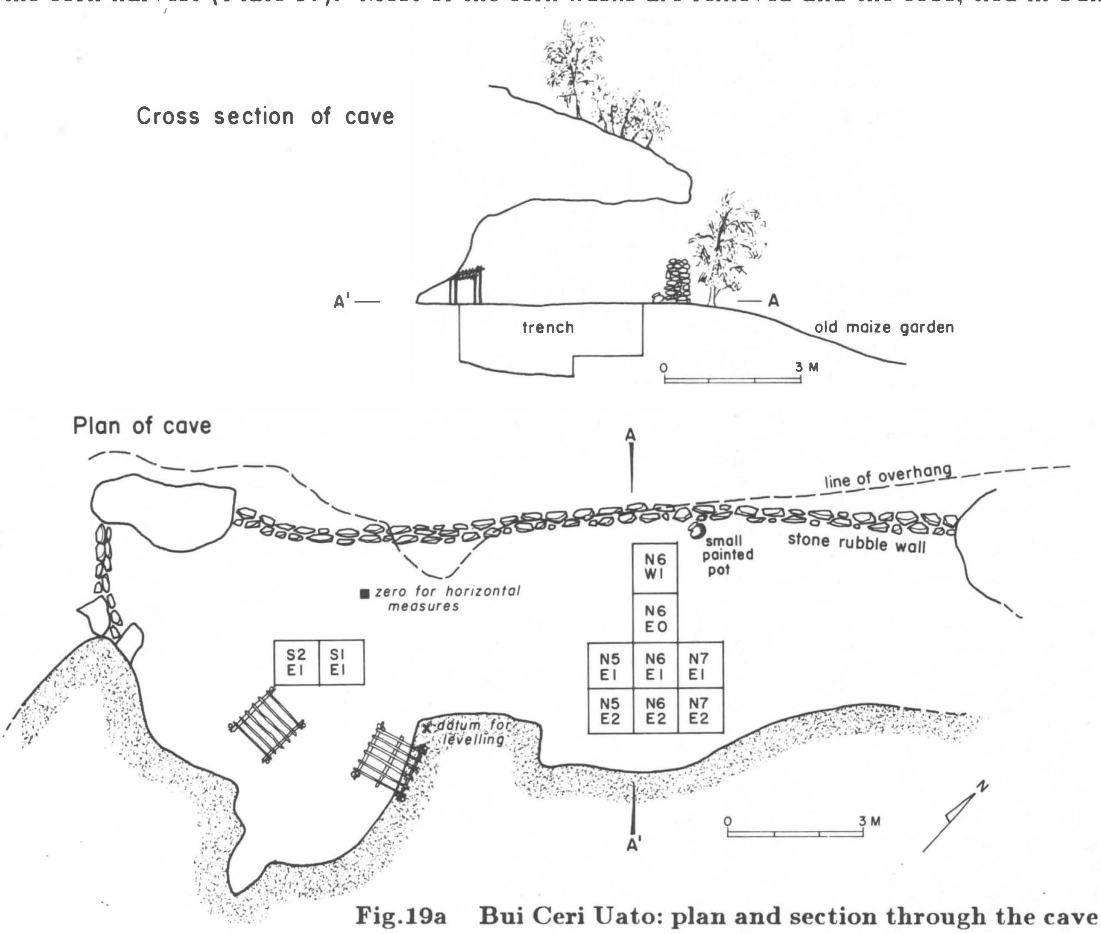


Fig.19a Bui Ceri Uato: plan and section through the cave

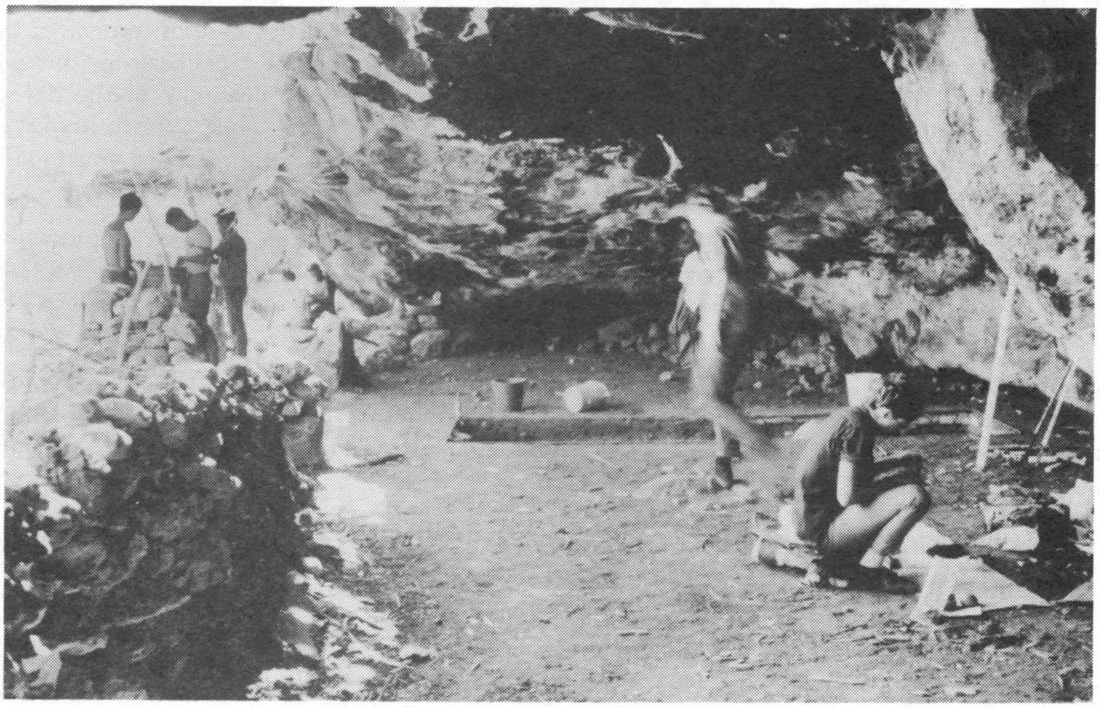


Plate 24 Bui Ceri Uato: during excavation

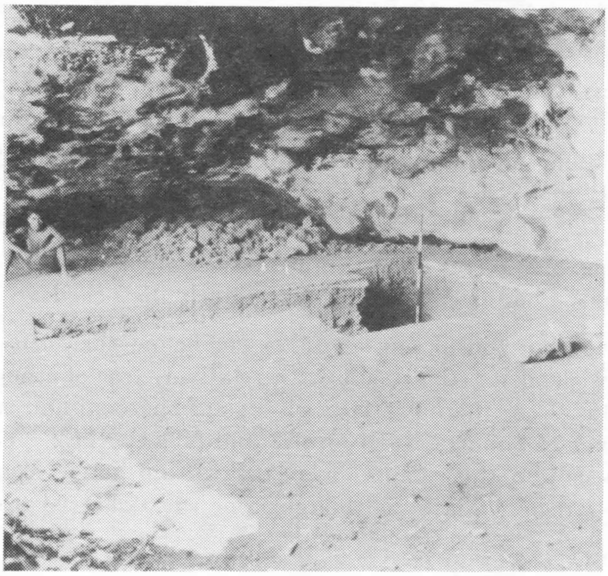


Plate 25
Bui Ceri Uato: after excavation

of 4-5, are hung on wooden slats over a slow fire for about three days to parch the grain before it is stored in the roof-top granaries of the nearby villages. Under each rack there was a patch of white ash about 50 cm in diameter and up to 5 cm thick. It seems probable that the postholes and the extensive layer of white ash found later in the excavation at the northeastern end of the cave (Plate 25) are the remains of this process.

Although the cave was wider at the southwestern end, there were more rocks below the surface, and the first trench was laid out near the northeastern end, where eight 1 x 1 m squares were excavated under the overhang. It was intended to take the trench beyond the shelter onto the talus slope, but as the excavation proceeded, it became clear that the preservation of charcoal and bone was better in the drier conditions nearer to the back wall. In addition, the stratification was more clearly visible inside the shelter (Plate 25).

Two datum points were used; a peg was driven into the cave floor and horizontal measures were recorded as so many metres north, south, east or west of this. For ease of recording, the cave was assumed to be facing due west. The excavated squares were labelled from this peg (Fig.19a). For recording levels, a cross was cut into the back wall near one of the drying racks about 1.10 m above the floor at that point. This was taken to be 5.98 m above an assumed zero datum. All level readings were subtracted from 5.98 m and recorded as so many metres above zero.

A second trench of two 1 x 1 m squares at the southwestern end of the cave was dug down to 70 cm (Fig.19a). The deposit there was rocky, poor in artifacts and faunal remains, and the layers were difficult to correlate with those recorded in the main trench. The pottery and flaked stone from this area has not been included in the analysis.

The methods of excavation, recording and correlation, followed the lines outlined in Chapter IV. Work started in the two Squares N6EO and N6E1, and after these had been dug to about 1 m below the surface, the sections were recorded and the adjacent squares dug without leaving baulks.

The stratification was consistent over the whole trench except where rain had obscured the finer details at the front of the cave. The stratigraphic sequence (Figs 19b, 20a) was as follows:

1. A layer of hard brown goat dung 2-10 cm thick (Munsell 10 YR 4/3).

2. White ash (7.5 YR 8/0) on top of a dark grey (10 YR 4/1) charcoal-rich layer which, in turn, overlay a brown to pale brown (10 YR 6/3) oxidised soil. These three colour layers comprised a single unit about 10-20 cm thick which is most probably the result of the corn parching process already mentioned. This interpretation is strengthened by the presence of numerous postholes found in Squares N6E0, N6E2 and N7E2 (Figs 19b, 20a; Plate 26). Some of these holes were sealed by the goat dung whereas others had been dug through it. In the north section of Square N7E2 a rotted post was found projecting 40 cm into the deposit, and in the south section of Square N6E2 a large posthole (Plate 26) 20 cm in diameter, penetrated 65 cm below the surface. The contents included dried leaves, stones, half a dozen sherds, and fragments of bottle glass.

The burning layer was not found at the front of the trench; it thinned out in Squares N6E1 to N6EO (Fig.20a) but there were no signs that it had been removed or seriously disturbed.

3. The oxidised soil ended in a fairly clear horizontal line at 15-25 cm below the surface, giving way to a fine brown or brownish-grey deposit (10 YR 5/3-6/2), relatively free of stones, down to 50-60 cm. Within this layer at 45-50 cm there was a thick lens of charcoal and ash nearly 1 m in diameter centred on the corner of Squares N6E1, N6E2 and N7E1, N7E2. The charcoal sample ANU-327 discussed previously in this chapter were taken from here. Apart from this lens, there was little visible charcoal in the layer, although some was collected from the sieves.

4. At 50-70 cm below the surface, there was a gradual transition to a light brownish-grey (10 YR 6/2) layer 25-35 cm thick. At the front of the cave, the deposit at this level was a reddish-yellow colour (7.5 YR 6/6) presumably through leaching. There were more stones and large fallen rocks in this layer than above.

5. At about 75-85 cm from the surface there was a change to a yellowish-red (5 YR 4/6-5/6), hard packed deposit with more small limestone fragments (Plate 27), which continued to the base rock which was reached at between 1.20-1.45 m. The transition to this layer was quite clearly marked at the back of the cave, more gradual at the front. Because of the poor preservation of charcoal and bone, and the hard clayey deposit, Squares N6EO and N6W1 were not dug to base rock.

During excavation the layers were followed where they were clearly visible. Spit 1 in all squares comprises the surface goat dung and Spit 2, the burnt layer underneath it. Below

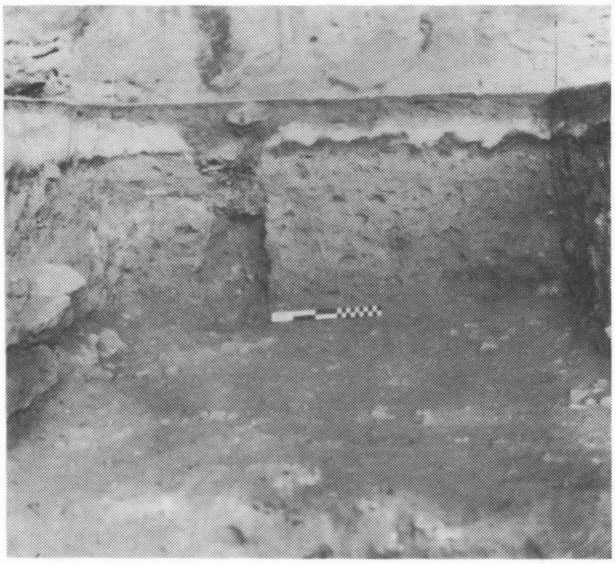


Plate 26

Bui Ceri Uato: posthole in south face of Square N6E2 with filling of stones, leaves and goat dung

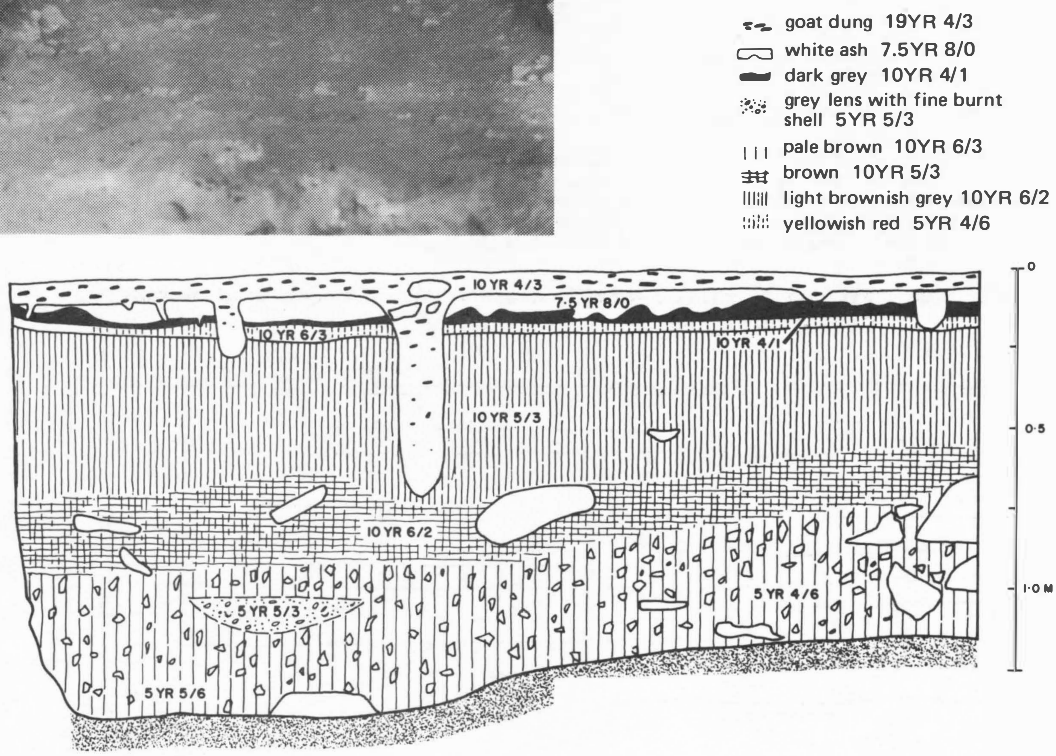


Fig.19b Bui Ceri Uato: soil stratification in the south section of Squares N7E2, N6E2, N5E2

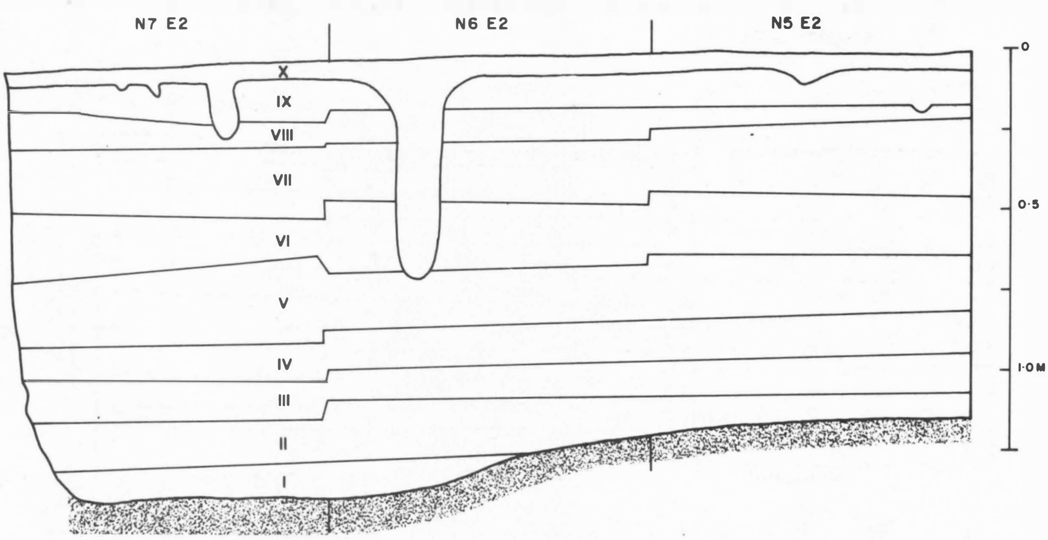


Fig.19c Bui Ceri Uato: horizon correlations projected onto the section in Figure 19b

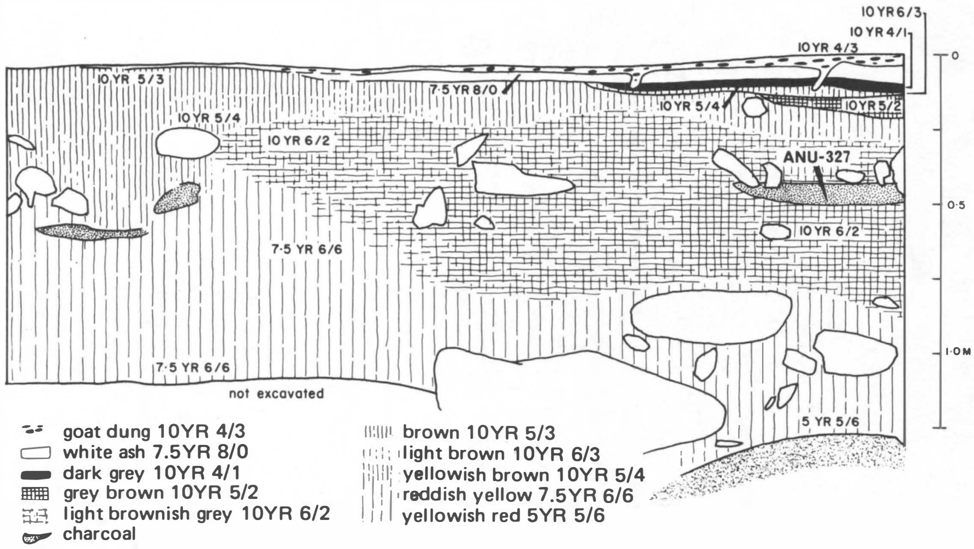


Fig.20a Bui Ceri Uato: soil stratification in the east section of Squares N6W1, N6E0, N6E1

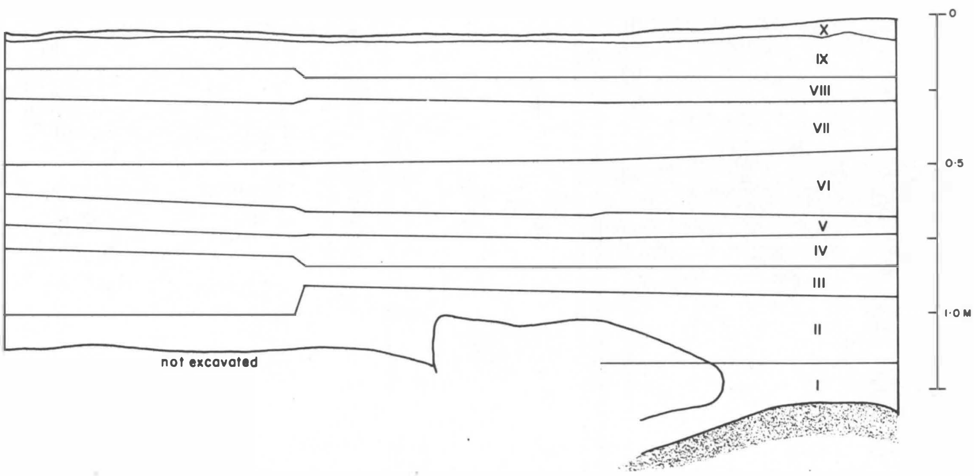


Fig.20b Bui Ceri Uato: horizon correlations projected onto the section in Figure 20a

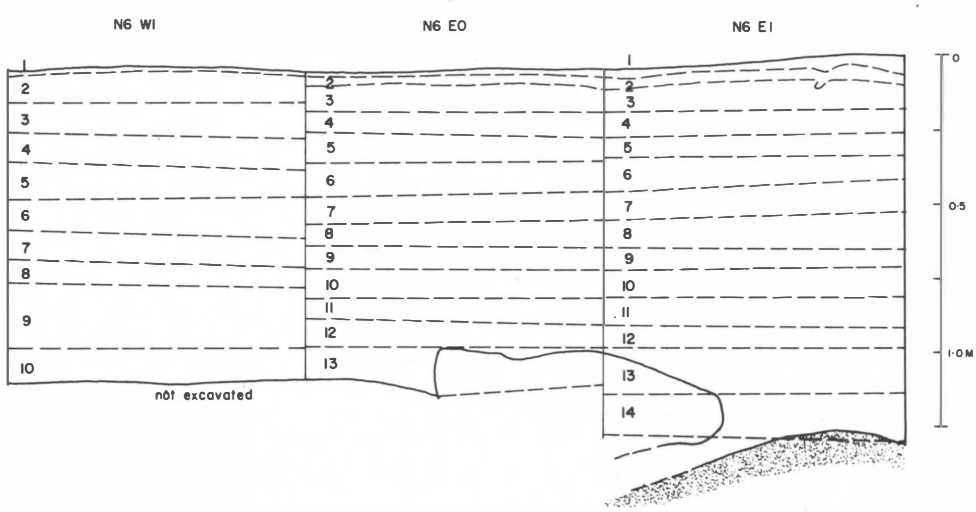


Fig.20c Bui Ceri Uato: excavated units projected onto the section in Figure 20a

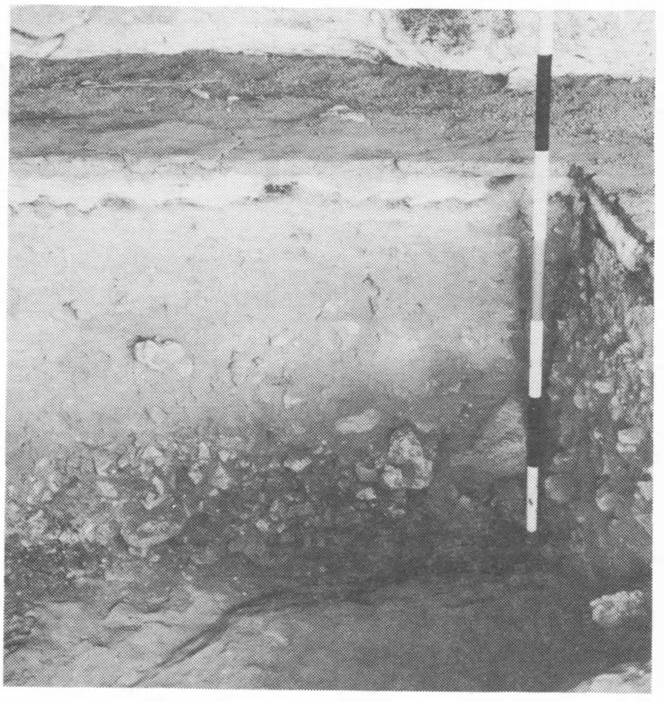


Plate 27

Bui Ceri Uato: south and west sections of Square N5E2, showing the increase of stone towards the base rock

this, the layers were too thick to dig as single units, or too indistinct to follow with certainty and they were subdivided into 10 cm spits, which followed the stratigraphic contours. The maximum number of spits was 16 in Square N6E1 where the greatest depth, 1.45 m, was reached. In order to analyse the change in faunal and artifact remains, these spits have been combined over all the trench into 10 horizons, as shown in Table 37 and Figures 19c and 20b. Squares S1E1 and S2E1 have been provisionally correlated with the main trench as shown in the table but pottery and flaked stone artifacts from there have not been included in the analysis.

Horizon	N7 E1	N7 E2	N6 W1	N6 E0	N6 E1	N6 E2	N5 E1	N5 E2	S1 E1	S2 E1
X	1	1	1	1	1	1	1	1	1	1
IX	2	2	2	2,3	2,3	2	2	2	2	2
VIII	3	3	3	4	4	3,4	3	3	3	3
VII	4,5	4,5	4,5	5,6	5,6	5,6	4	4,5	4,5	4,5
VI	6,7	6	6	7,8	7,8	7,8	5,6	6,7	6,7	-
V	8	7,8	7	9	9	9	7,8	8,9	-	-
IV	9	9	8	10	10	10	-	10	-	-
III	10	10	9	11	11	11	-	11	-	-
II	11,12	11	10	12,13	12,13	12,13	-	12,13	-	-
I	13,14	12	-	-	14,15,16	-	-	-	-	-

Table 37 Bui Ceri Uato: spit correlations

The 10 horizons can be correlated with the five stratigraphic units as follows:

X	goat dung
IX	burnt ashy layer
VIII-VI	brown to brownish-grey earth
V	brownish-grey at rear of cave, yellowish-red at front
IV	transition to yellow-red layer
III-I	yellow-red layer

The volume of each spit was calculated and the figures have been combined to give the horizon volumes shown in Table 38.

Horizon	m^3
X	0.2
IX	0.8
VIII	0.7
VII	1.5
VI	1.3
V	1.0
IV	0.7
III	0.8
II	1.2
I	0.5

Table 38 Bui Ceri Uato: horizon volumes (not including Squares S1E1 and S2E1)

Changes in the intensity of occupation of the cave, which are measured by calculating the number of sherds or flakes per m^3 in each horizon, are shown in Figure 49. In the tables which follow, the actual numbers of artifacts are listed together with the densities where it seems relevant.

RADIOCARBON DATES AND CHRONOLOGY

In Chapter IV I have mentioned the radiocarbon dates obtained for Bui Ceri Uato, and the problems they raise for interpreting the chronology of the site. The matter is discussed in more detail here, so that the exposition of the sequences of faunal remains and artifacts which is made in the following sections can be viewed against the site chronology as I understand it.

Two samples were submitted to the Radiocarbon Dating Laboratory, ANU and both yielded modern dates. ANU-327 was collected from the thick bed of charcoal and ash already mentioned, in Square N7E1(6), Horizon VI. It is projected on the section in Figure 20a. The sample was taken from the cleaned surface of the hearth and every effort was made to ensure that there was no contamination from modern charcoal. Postholes were common in the top 15-20 cm in that part of the trench, and one, in Square N6E2 (Plate 26) penetrated to below the level from which the sample was taken. But these holes were easy to see during excavation because of the interruption they made in the layers of goat dung and ash which formed the top 20 cm of deposit. I am confident that the hearth from which ANU-327 was taken was not contaminated from such a posthole.

In the following sections of this chapter it is argued that pottery, flaked stone tools, shell artifacts, and shell and bone food remains form a coherent sequence of development and change which is parallel to the sequences from the three other excavated sites. The anomalies - one incised sherd and two bones which appear to be out of place are too few to set against the overall consistency of the sequence, and can be explained by the minor and irregular surface disturbances which take place on exposed living floors. In Uai Bobo 2 (Chapter VIII) I have tried to estimate the extent of this 'scuffage and treadage' by plotting the location of all sherds which can be joined together. The results showed, as might be expected, that horizontal scattering is common, and that there is some vertical displacement which cannot be explained by the pits and holes recognised during the excavation. Five of the 167 sherds which could be joined were found in non-adjacent horizons. Too few sherds could be joined at Bui Ceri Uato to allow an accurate measure to be made of this sort of disturbance, but the consistency of the sequence is a convincing argument against any recent disturbance of the deposit on a sufficient scale to permit the introduction of the large hearth from which sample ANU-327 was taken.

Sample ANU-325 was taken from Square N6E1(15), Horizon I. Small traces of charcoal only were seen during excavation of the lower deposit, and the sample was collected from the sieves as the artifacts and bones were sorted. Such conditions never allow much certainty about the origin of the charcoal, and its relationship to stratigraphic features.

The possibility of chemical contamination remains. The cave earth over the entire trench was covered by a layer of goat dung which formed Horizon X. The cave is generally dry, but the overhang is shallow, and rainstorms during the northwest monsoon would certainly reach to the back of the cave on occasions. It seemed possible that humic acid had been carried in solution into the lower deposit through the action of rain, thus causing an appreciable contamination of the samples with modern carbon. This was discussed with Polach, Radiocarbon Dating Laboratory, ANU, and a second sample from the hearth in Horizon VI was treated to remove any such contamination. No humic acid was found and the sample, after this treatment, still yielded a modern date.

In order to provide a working chronological framework for Bui Ceri Uato, I have relied on correlations between this site, Uai Bobo 2 and Lie Siri, the two most reliable and mutually consistent sequences.

The surface at Bui Ceri Uato, as at other sites contains recent objects and very little flaked stone. Considering the evidence for the continuing modern occupation of many of these caves, the top horizons are thought to belong to the past 500-1000 years at the most. The incised and impressed pottery at Lie Siri in Horizons VIa-b; Bui Ceri Uato, Horizons VI-VIII; Uai Bobo 1, Horizons IVb-V; and Uai Bobo 2, Horizons X-XI, is dated to about 2000-3500 BP. The appearance of pottery at Lie Siri in Horizon Vc; Bui Ceri Uato, Horizon V; Uai Bobo 1, Horizon IIIa; and Uai Bobo 2, Horizon VIII, is dated to 4000-5000 BP. The shell artifacts and ornaments at Bui Ceri Uato are different in many ways from those at the inland sites, and even fron the single shell disc found at Lie Siri, but they appear in the same relative position in the sequence, and are dated to between 6000 and 2000 BP. The disappearance of the large murids at Lie Siri in Horizon VIb; Bui Ceri Uato, Horizons VI-VIII; Uai Bobo 1, Horizon V; and Uai Bobo 2, Horizon X is dated to about 2000 BP. There is no guide for a date for the earliest occupation at Bui Ceri Uato, but 7000-9000 BP is suggested, based on a correlation with Lie Siri. This chronology is summarised in Table 39.

Horizon	Date BP	Pottery	Incised pottery	Shell artifacts	Large murids	Domesticated animals
X-IX	0-750	x	-	-	-	x
VIII	0-1500	x	x	-	x?	x
VII	0-2500	x	x	x	x	x
VI	0-3500	x	x	x	x	x
V	0-4500	x	-	x	x	-
IV	0-5500	-	-	x	x	?
III	0-6500	-	-	-	x	-
II	0-7500	-	-	-	x	?
I	0-8500	-	-	-	x	-

x indicates presence

Table 39 Bui Ceri Uato: suggested chronology

ANALYSIS OF FLAKED STONE

Distribution

Bui Ceri Uato was the richest site, in terms of flaked stone which I found in Timor. The greatest density (Table 40) was in Horizon IV, where there were local concentrations up to 15,000 flakes per m^3 at the back of the cave in Squares N6E2 and N7E2. To appreciate the difference between Bui Ceri Uato and the other sites this figure should be compared with the maximum densities of 2000 per m^3 at Uai Bobo 1 in Horizon IIIc and 1270 at Uai Bobo 2 in Horizon IX.

During the preliminary sorting, I gained the impression that flakes in the lower horizons were larger than those near the surface. Retouched and utilised flakes were measured, and the

Horizon	Nos	Nos per m^3	%
X	87	435	1
IX	655	799	2
VIII	2,284	3129	8
VII	4,101	2698	7
VI	6,376	4830	12
V	5,714	5494	14
IV	4,837	7329	19
III	4,898	6361	16
II	5,558	4710	12
I	1,803	3680	9
Total	36,313	-	100

Table 40 Bui Ceri Uato: waste flake density

weight of waste flakes in each horizon was divided by the number to give the mean weight. Except for Horizon X, the sample sizes were good and the tendency for flakes to get smaller with time is clear.

Cores (Fig.21)

Not only is the density of stone at Bui Ceri Uato higher than at the other sites, but the proportion of cores is consistently higher. This fact, together with the large number of hammer stones and anvils suggests that stone working had been a more important activity at Bui Ceri Uato than elsewhere.

Horizon	Waste flakes		Cores and trimming flakes		Utilised flakes		Flakes with gloss		Secondary working		Total
	Nos	%	Nos	%	Nos	%	Nos	%	Nos	%	Nos
X	87	70	3	3	29	23	-	-	5	4	124
IX	655	77	26	3	142	17	-	-	28	3	851
VIII	2284	90	56	2	122	5	2	<1	67	3	2531
VII	4101	92	97	2	117	3	12	<1	112	3	4439
VI	6376	93	166	2	119	2	20	<1	195	3	6876
V	5714	93	147	2	159	3	11	<1	132	2	6163
IV	4837	92	143	3	149	3	11	<1	139	2	5279
III	4898	92	149	3	169	3	18	<1	81	2	5315
II	5558	92	157	3	207	3	4	<1	112	2	6038
I	1803	92	77	4	54	2	-	-	35	2	1969
Total	36,313	92	1021	3	1267	3	78	<1	906	2	39,585

Table 41 Bui Ceri Uato: numbers and percentages of the main classes of flaked stone in each horizon

Horizon	Nos	Mean weight (gm)
X	87	1.3
IX	655	1.1
VIII	2284	1.2
VII	4101	1.2
VI	6376	1.6
V	5714	1.5
IV	4837	2.0
III	4898	2.0
II	5558	2.1
I	1803	2.7
Total	36,313	-

Table 42 Bui Ceri Uato: waste flake mean weights

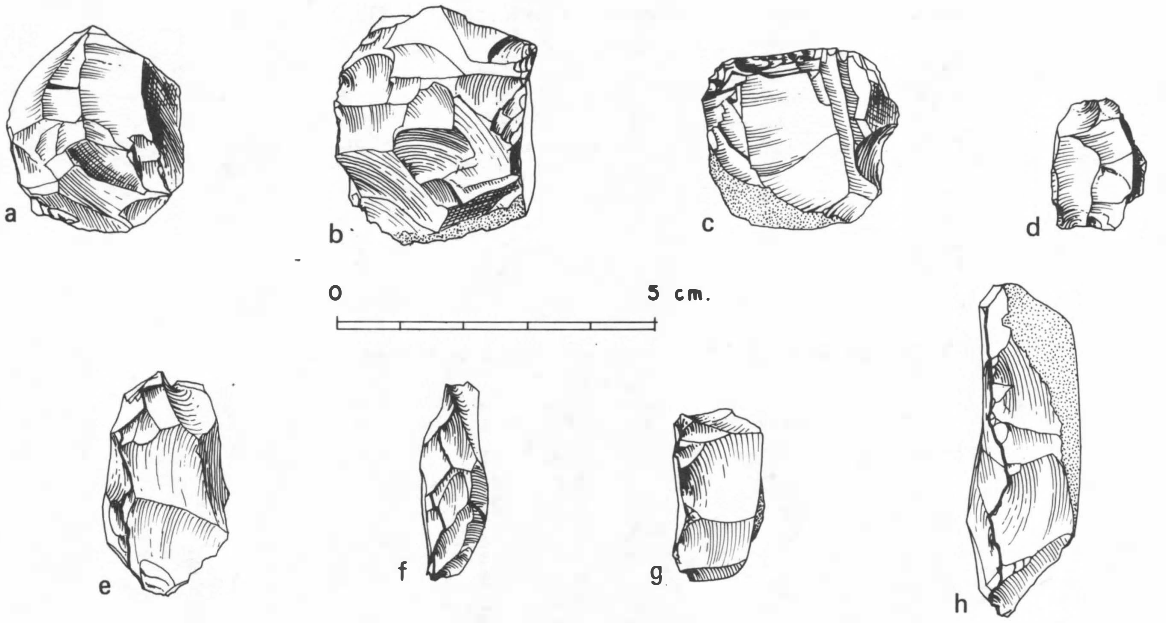


Fig.21 Bui Ceri Uato: flake cores

a 4465, core type 1 (multi-platform), obsidian, Square N5E2(8), Horizon V
b 4659, core type 1 (opposed platforms), Square N7E2(9), Horizon IV
c 6327, core type 1 (multi-platform), Square N6E1(14), Horizon I
d 3823, core type 3 (fabricator), obsidian, Square N6E1(8), Horizon VI
e 5126, core type 2 (disc), Square N6E2(10), Horizon IV
f 3224, core type 2 (disc), Square N7E1(5), Horizon VII
g 6335, core type 2 (disc), Square N6E1(14), Horizon I
h 6326, core type 2 (disc), Square N6E1(14), Horizon I

Figure 50 shows the ratio for the main classes of flaked stone for all the sites.

Among the cores, excluding the trimming flakes, three forms could be recognised (Table 43):

1. Those with two, three and occasionally more platforms, on different planes and at varying angles to each other. These cores are generally rectangular in shape, or close to, and are the most common cores found in all sites (Fig.21a-c).

2. Those with flakes struck off alternate faces of the same edge (Fig.21e-h). These are often nearly circular in shape and I have called them disc cores.

3. There are a very few small thin tools, battered at both ends (Fig.21d), which resemble bipolar cores or fabricators, found widely distributed in stone industries in Europe, Africa, China and Australia (White 1968).

White (1968) has argued that these tools are probably cores in Australia and New Guinea and may be cores elsewhere, and they are provisionally classed as such here. However, the very large ratio of fabricators to waste flakes (1:7) at one Australian site at least, Gymea Bay (Megaw and Wright 1966:31), and the presence of use-polish on similar tools from sites in coastal New South Wales (Lampert pers. comm.) indicates that such artifacts are not all, or always, cores.

In the inland sites, Uai Bobo 1 and Uai Bobo 2, small numbers of cores were found with two opposed platforms on the same face. This type of core was not regularly found at Bui Ceri

Horizon	Multi-platform cores	Disc cores	Fabricators	Trimming flakes	Nos
X	2	-	-	1	3
IX	18	1	-	7	26
VIII	46	2	-	8	56
VII	84	3	-	10	97
VI	132	5	3	26	166
V	95	21	3	28	147
IV	113	7	-	23	143
III	125	7	-	17	149
II	119	-	-	38	157
I	59	6	1	11	77
Total	793	52	7	169	1021

Table 43 Bui Ceri Uato: typological breakdown of cores

Horizon	$\bar{x}$	s	Nos
X-VIII	25.3	5.8	41
VII	27.9	7.4	81
VI	29.5	8.7	121
V	30.0	7.1	91
IV	30.4	7.9	113
III	31.3	9.5	124
II	36.1	8.9	107
I	37.9	9.5	55
Total nos	-	-	733

Table 44 Bui Ceri Uato: core size, mean diameter in mm

Uato; only one example was recognised, which has been included for analysis with the multi-platform cores (Fig.21b). Some of the cores would have provided the occasional blade, but there was no evidence among the cores for the regular manufacture of blades at the site. Some of the side scrapers, however, are made on large blades (Fig.23a-c) and these must have been brought onto the site.

The maximum diameter of all multi-platform cores not obviously broken, was measured (Table 44) to see if there was a change in core size to match that of waste flakes.

The cores in Horizons X-VIII are just two thirds the size, on average, of those in Horizon I, and there is a steady reduction throughout the site. The reduction in waste flake size measured by weight (Table 42) parallels that of cores.

Utilised flakes (Fig.22)

As in all sites excavated, two forms of utilised flakes were recognised, those with lengths of fine flake scars, usually not more than 1-2 mm deep (Fig.22g-h), and those with a glossy, polished surface on and behind the edge, in addition to fine flake scars (Fig.22e-f). The numbers of each type are given in Table 41.

No further analysis of the simple utilised flakes has been made for this site. During the sorting it was not felt that there were any significant differences between the two forms of utilised flakes in terms of size, shape or type of flint used. As with waste flakes, cores and secondary-worked tools, the utilised flakes became progressively smaller over time.

The flakes with gloss, were, however, measured and although proportionately far fewer than in the inland sites, are similar in size, in the length of glossy margin, and in the nature and

Horizon	Length $\bar{x}$	Length s	Breadth $\bar{x}$	Breadth s	Nos	Length of edge-gloss x	Length of edge-gloss s	Nos
VIII-VI	33.1	9.4	22.3	7.3	20	7.6	4.3	24
V-II	37.2	6.7	19.6	5.4	19	8.6	3.3	27

Table 45 Bui Ceri Uato: utilised flakes with gloss, measurements in mm

positioning of the gloss. There are not enough complete flakes to give the measurement for each horizon separately, so they are grouped into two assemblages in Table 45. As in the case of the inland sites, they are not found in the very earliest, or latest levels.

Scrapers (Figs 23-24, 26-28)

Table 46 gives a typological breakdown of flaked stone with secondary working. As in other excavated sites, scrapers predominate at all levels. Despite the greater density and numbers of artifacts at Bui Ceri Uato, there are few really distinctive types other than side scrapers. The absence of any tanged points in such a large sample confirms the opinion put forward by Verhoeven (1959) that these tools are confined to central and southern Timor.

Horizon	Scrapers Side	Thumbnail	Nosed	Misc.	Burins	Broken edges	Other	Nos
X	-	-	-	3	-	2	-	5
IX	18	3	-	4	-	3	-	28
VIII	21	-	-	30	-	15	1	67
VII	76	2	-	15	-	19	-	112
VI	78	1	1	97	1	17	-	195
V	71	2	-	40	-	19	-	132
IV	77	-	2	40	1	17	2	139
III	52	-	-	13	1	15	-	81
II	58	-	8	24	6	16	-	112
I	21	1	1	6	-	6	-	35
Total	472	9	12	272	9	129	3	906

Table 46 Bui Ceri Uato: typological breakdown of flaked stone with secondary working

A noticeable feature of the assemblages at Bui Ceri Uato is the very high proportion of broken tools. Over 60% of all retouched artifacts were broken, and of the 472 side scrapers, only 182 could be measured. The proportion of broken tools does not vary much throughout the site.

Compared with the inland sites, there are fewer double-edged side scrapers made on blades, except in the lower levels, and more irregularly shaped flakes with one or two small working edges. These are included in the miscellaneous and irregular scraper category. But the differences are not enough to allow one to talk about a separate coastal style, or tradition. Most of the long steeply retouched blades (Fig.23a, b) which are found in Horizons I-VIII are made from a grey chert. This material, together with the blades becomes less common towards the surface.

What I have called scrapers includes artifacts of a considerable variety of shapes and sizes (see Chapter IV). Apart from a few small and distinctive thumbnail scrapers, and high-back nosed scrapers (Fig.24a-e, g), I felt any further distinctions would not be justified, and all the other artifacts have been grouped together as side scrapers. Half of the side scrapers have concave working edges, a quarter straight, and a quarter convex edges. There is not much variation over time in these proportions. In Table 47 the main dimensions of these scrapers are given. Edge length and edge height refer to the principal or longest edge; only about 20% have two working edges, and only one artifact has three.

Horizon	Length $\bar{x}$	Length s	Breadth $\bar{x}$	Breadth s	Thickness $\bar{x}$	Thickness s	Edge-length $\bar{x}$	Edge-length s	Edge-height $\bar{x}$	Edge-height s	Edge-angle $\bar{x}$	Edge-angle s	Nos
IX-VII	35.0	10.9	24.9	6.5	11.2	3.4	21.7	5.9	5.4	1.4	86°	6°	39
VI-V	39.5	12.3	25.9	7.2	12.2	3.4	25.4	10.3	4.8	2.3	84°	12°	56
IV-III	41.3	14.4	28.5	8.0	13.2	3.8	24.6	10.7	5.2	2.7	87°	10°	51
II-I	44.0	18.7	28.7	9.1	15.0	5.2	24.7	12.2	5.3	2.2	83°	14°	36

Table 47 Bui Ceri Uato: side scrapers, measurements in mm

As with waste flakes, cores and utilised flakes, the scrapers become progressively smaller with time. Not all the differences are significant at the 1% level of probability when a *t* test is

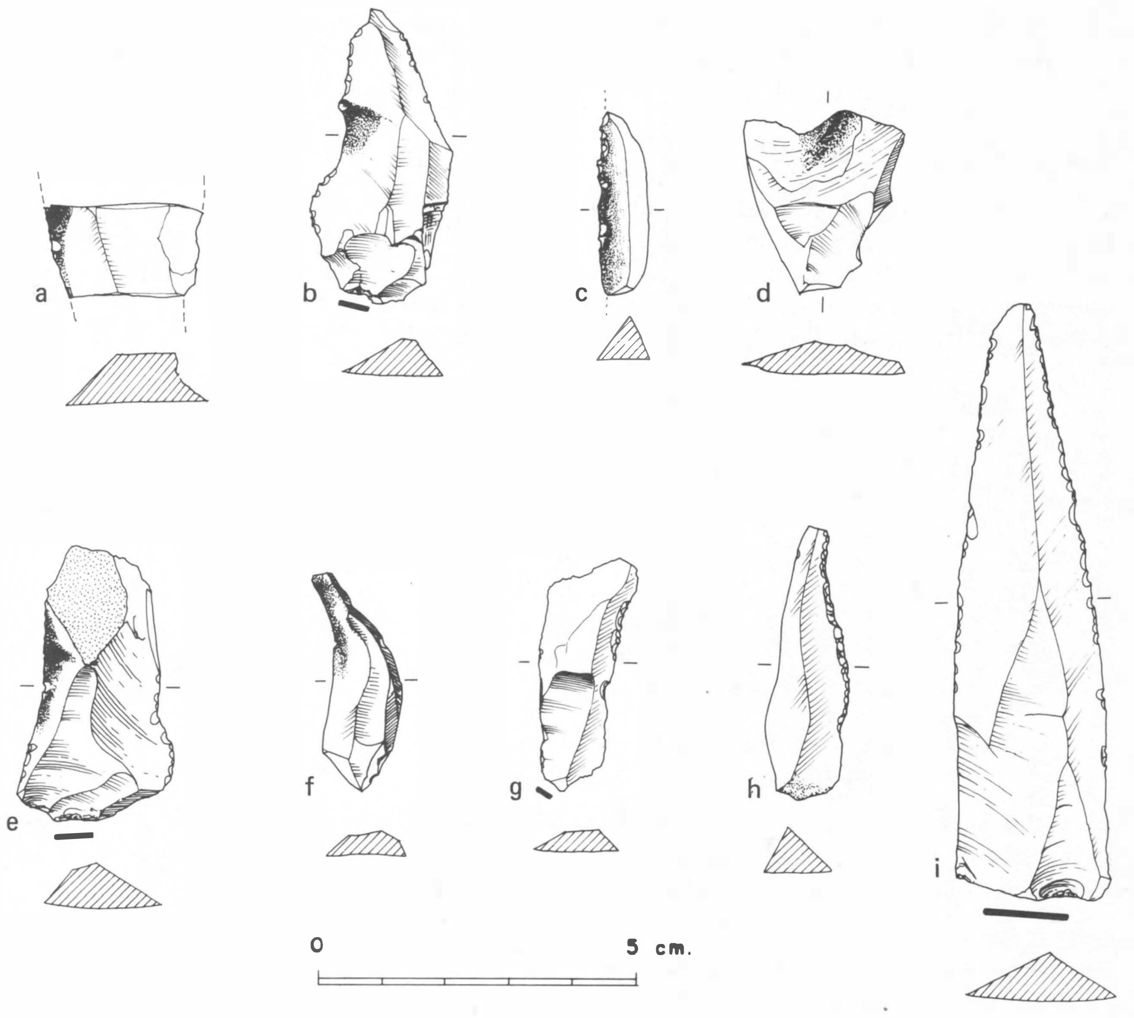


Fig.22 Bui Ceri Uato: utilised flakes

a 3244, broken flake with silica gloss on edge, Square N7E2(4), Horizon VII
b 3270, flake with silica gloss on edge, Square N7E2(5), Horizon VII
c 4245, broken flake with silica gloss on edge, Square N7E2(8), Horizon V
d 5201, broken flake with silica gloss on edge, Square N5E2(10), Horizon IV
e 5408, flake with silica gloss on edge, Square N6W1(9), Horizon III
f 5321, flake with silica gloss on edge, Square N7E2(10), Horizon III
g 5439, utilised flake, Square N6E0(11), Horizon III
h 5438, utilised flake, Square N6E0(11), Horizon III
i 6043, pointed blade, utilised on both edges, Square N6E2(13), Horizon II

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

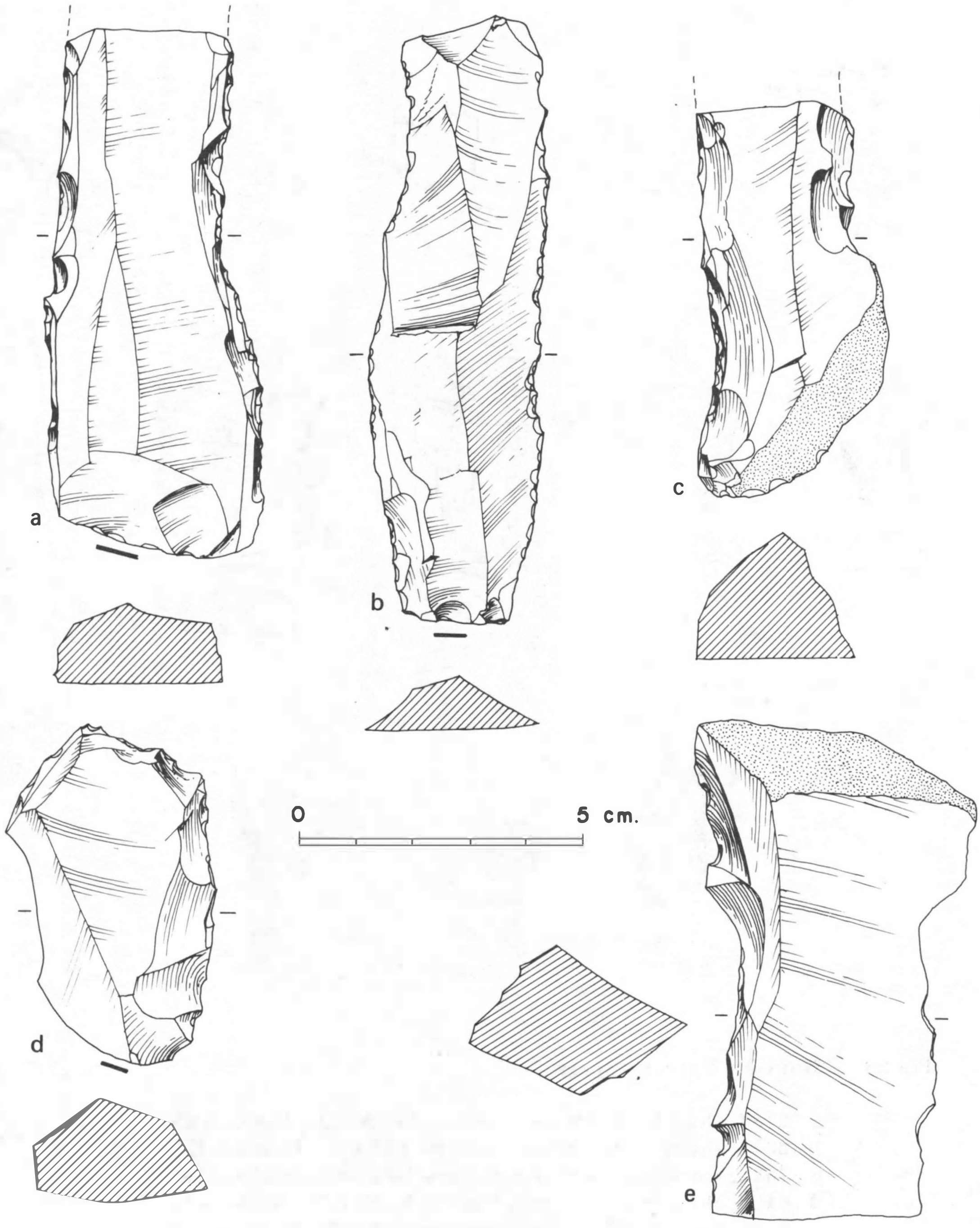


Fig.23 **Bui Ceri Uato: scrapers**

a 5977, side scraper, two worked edges, broken, Square N6E2(12), Horizon II
b 5882, side scraper, two worked edges, broken, Square N6E0(12), Horizon II
c 5979, side scraper, two worked edges, broken, Square N6E2(12), Horizon II
d 6425, side scraper, two worked edges, broken, Square N6E1(16), Horizon I
e 6403, side scraper, two worked edges from alternate faces, Square N6E1(15), Horizon I

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

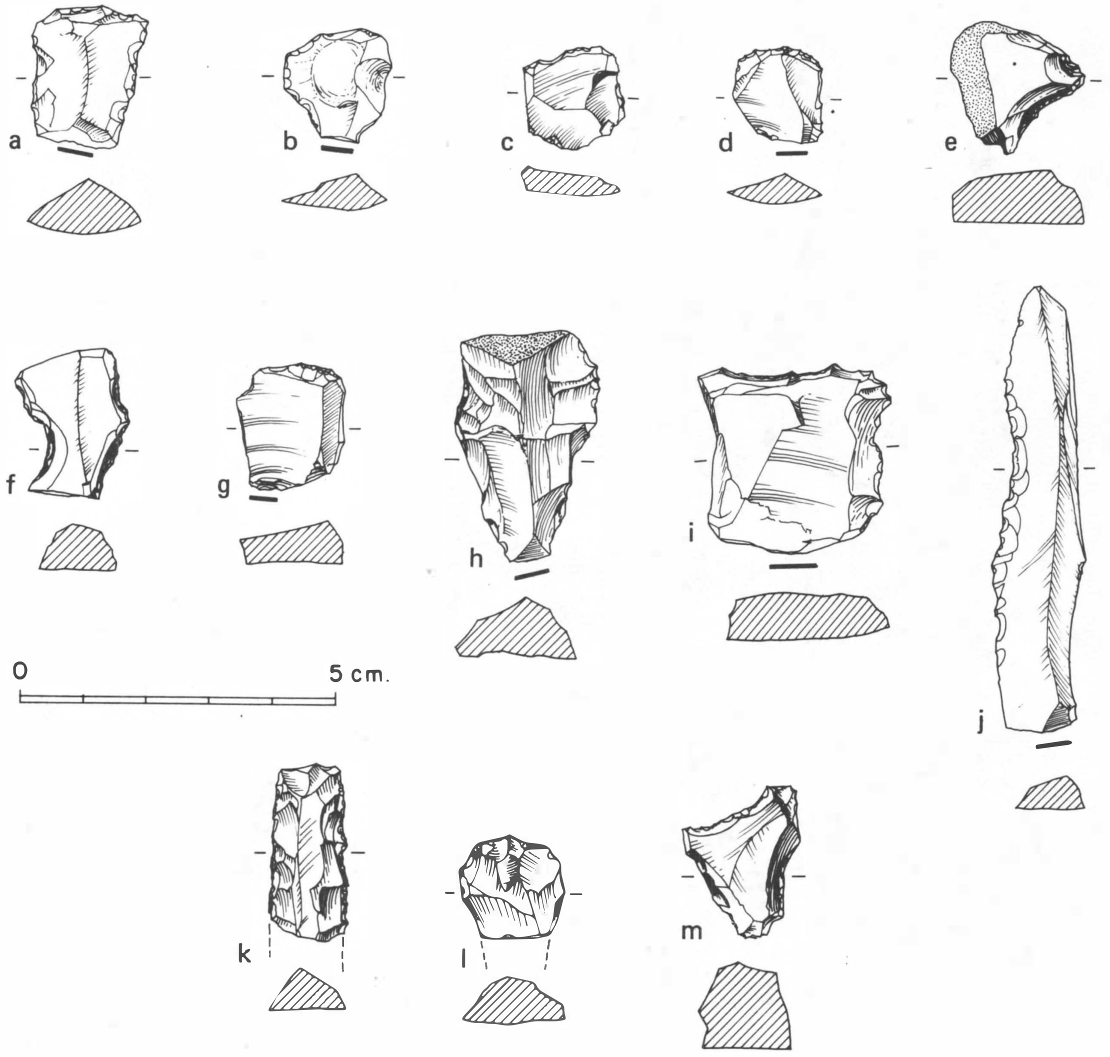


Fig.24 Bui Ceri Uato: scrapers

a 2784, thumbnail scraper, Square N6W1(2), Horizon IX
b 2845, thumbnail scraper, Square N6E1(2), Horizon IX
c 2822, thumbnail scraper, Square N6E0(3), Horizon IX
d 6103, thumbnail scraper, Square N5E2(12), Horizon II
e 2958, thumbnail scraper, Square N7E1(3), Horizon VIII
f 3009, small side scraper, broken, Square N7E2(3), Horizon VIII
g 3003, thumbnail scraper, Square N7E2(3), Horizon VIII
h 3411, side scraper, two worked edges, Square N6E2(5), Horizon VII
i 3480, side and end scraper, Square N5E1(4), Horizon VII
j 3229, blade scraper, one worked edge, Square N7E1(5), Horizon VII
k 3998, side and end scraper broken, Square N5E2(6), Horizon VI
l 3897, thumbnail scraper broken, Square N6E2(8), Horizon VI
m 4051, small high scraper, three worked edges, Square N5E2(7), Horizon VI

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

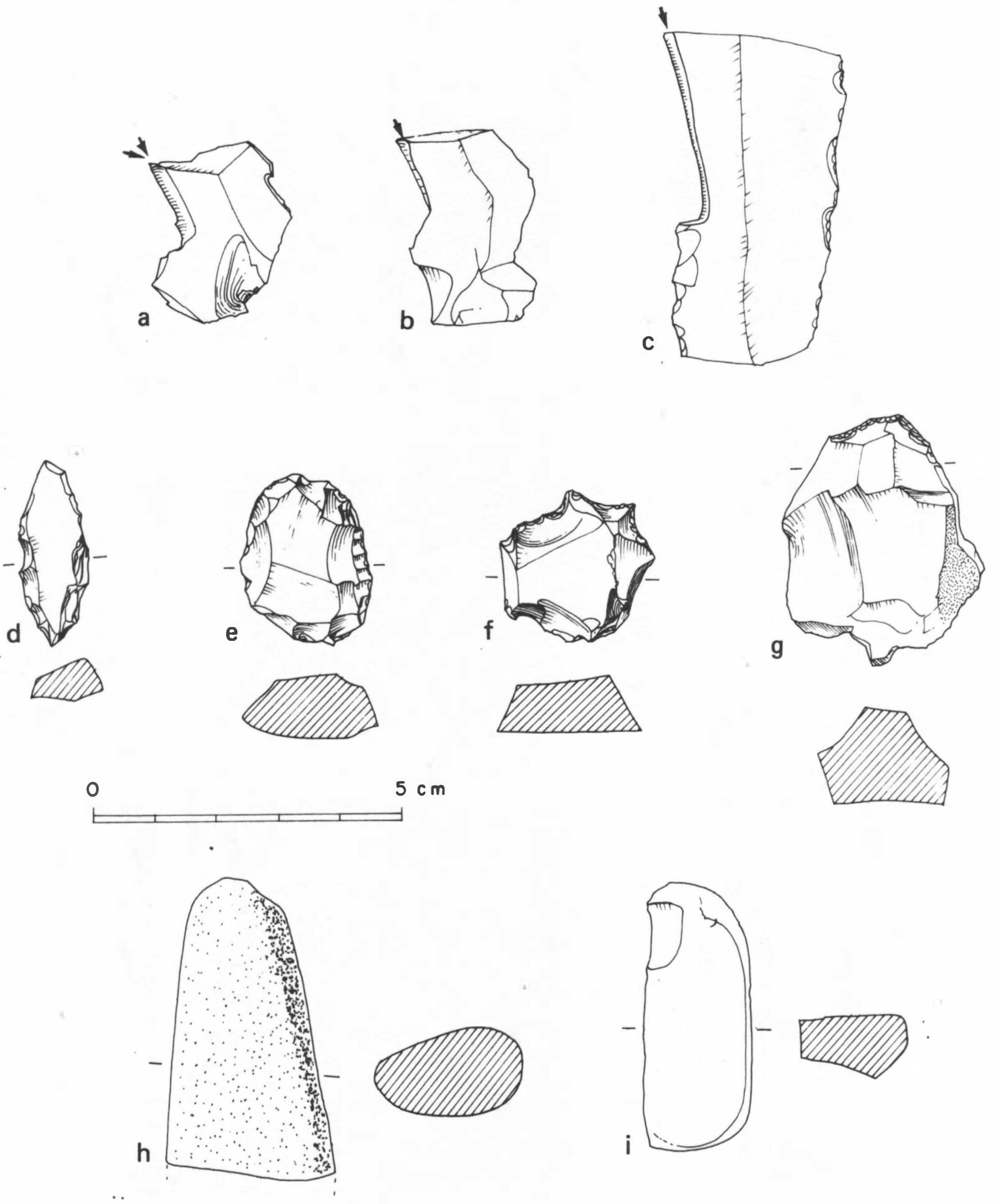


Fig.25 Bui Ceri Uato: stone tools

a 5553, burin, four spalls removed from the left edge and one across the top, Square N6E2(11), Horizon III
b 6108, burin, single blow, Square N5E2(12), Horizon II
c 5978, burin, single blow down the edge of a broken scraper, Square N6E2(12), Horizon II
d 5062, backed point or borer, left edge worked from one face, right from both faces, Square N6E0(10), Horizon IV
e 3010, bifacial disc, Square N7E2(3), Horizon VIII
f 5984, round scraper, Square N6E2(12), Horizon II
g 5897, steep, nosed scraper, Square N6E1(12), Horizon II
h ?Fish-hook file, Square N5E2(5), Horizon VII
i 2980, possible butt of broken quadrangular axe, Square N7E2(3), Horizon VIII

Flaked artifacts are shown bulbar face down where this can be recognised. The striking platform is absent in all cases

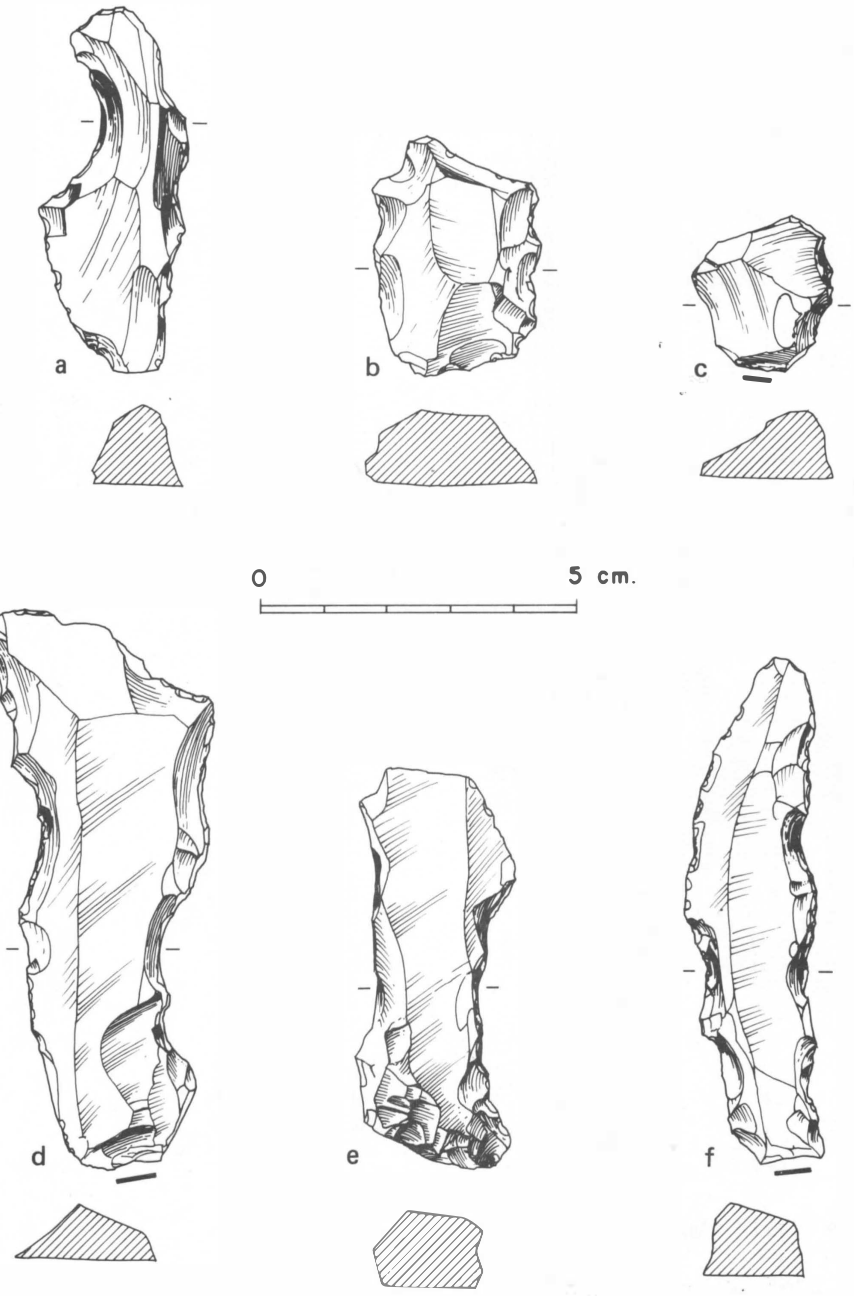


Fig.26 Bui Ceri Uato: scrapers

a 3716, side scraper, two worked edges, Square N6WI(6), Horizon VI
b 3999, side scraper, two worked edges, Square, N5E2(6), Horizon VI
c 3800, side scraper, one worked edge, Square N6E1(7), Horizon VI
d 3584, side scraper, two worked edges, Square N7E1(6), Horizon VI
e 3997, side scraper, two worked edges, Square N5E1(6), Horizon VI
f 4044, side scraper, two worked edges, Square N5E2(7), Horizon VI

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

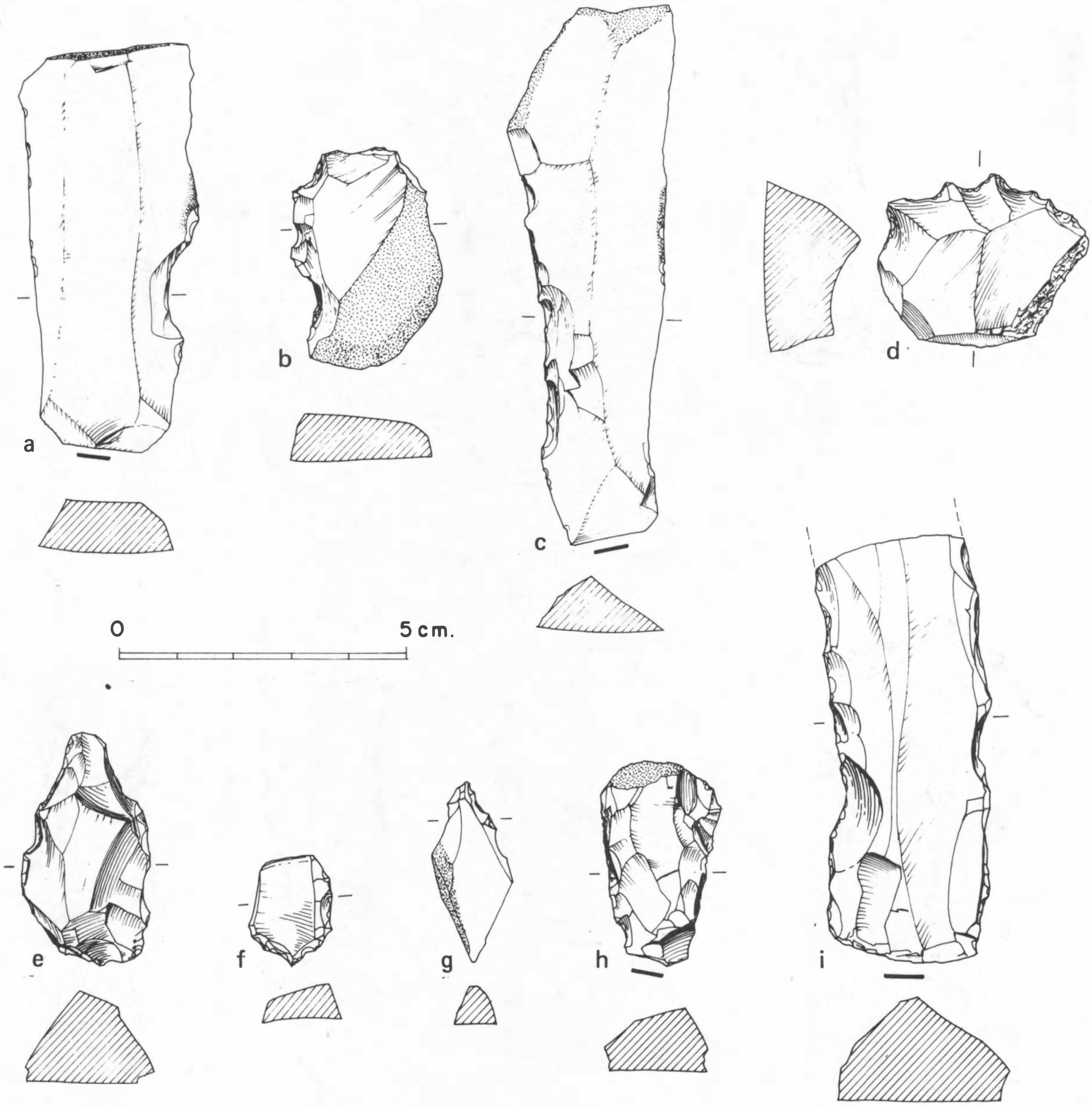


Fig.27 Bui Ceri Uato: scrapers

a 4607, side scraper, one worked edge and silica gloss, Square N7EI(9), Horizon IV
b 4692, side scraper, one worked edge, Square N7E2(9), Horizon IV
c 4687, side scraper, one worked edge and silica gloss, Square N7E2(9), Horizon IV
d 5157, side scraper, one worked edge, Square N6E2(10), Horizon IV
e 4398, high-backed side scraper two worked edges, Square N6E2(9), Horizon V
f 4432, thumbnail scraper, Square N6E2(9), Horizon V
g 4613, small nosed scraper, broken, Square N7E1(9), Horizon IV
h 4399, side scraper, two worked edges, Square N6E2(9), Horizon V
i 4522, side scraper, two worked edges, broken, Square N5E2(9), Horizon V

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

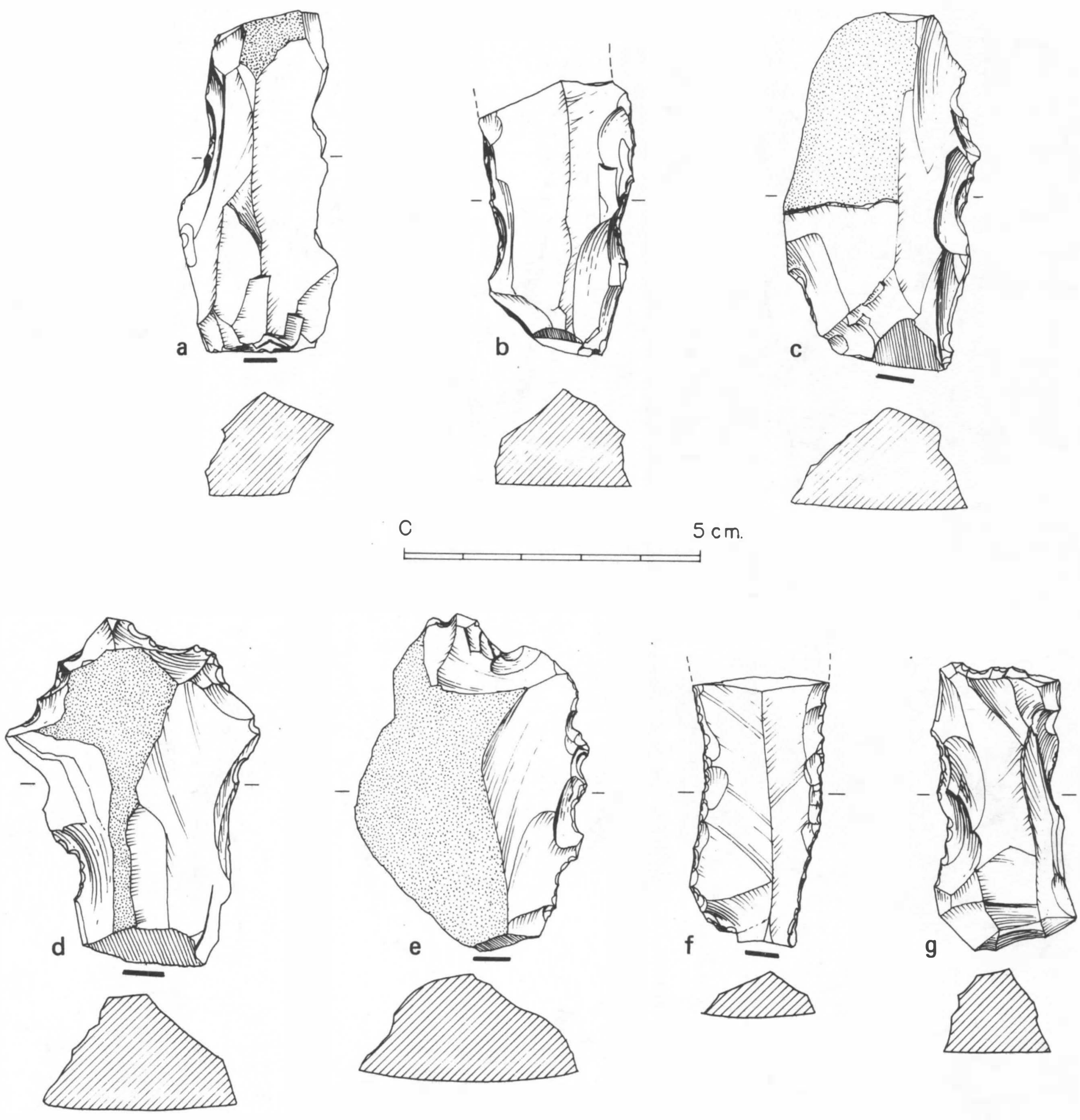


Fig.28 **Bui Ceri Uato: scrapers**

a 5639, side scraper, two worked edges from alternate faces, Square N5E2(11), Horizon III
b 5641, side scraper, two worked edges, broken, Square N5E2(11), Horizon III
c 5469, side scraper, two worked edges, Square N6E1(11), Horizon III
d 5470, end scraper, Square N6E1(11), Horizon III
e 5323, side scraper, one worked edge, Square N7E2(10), Horizon III
f 5937, side scraper, two worked edges, Square N6E1(13), Horizon II
g 5933, side scraper, two worked edges, Square N6E1(13), Horizon II

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

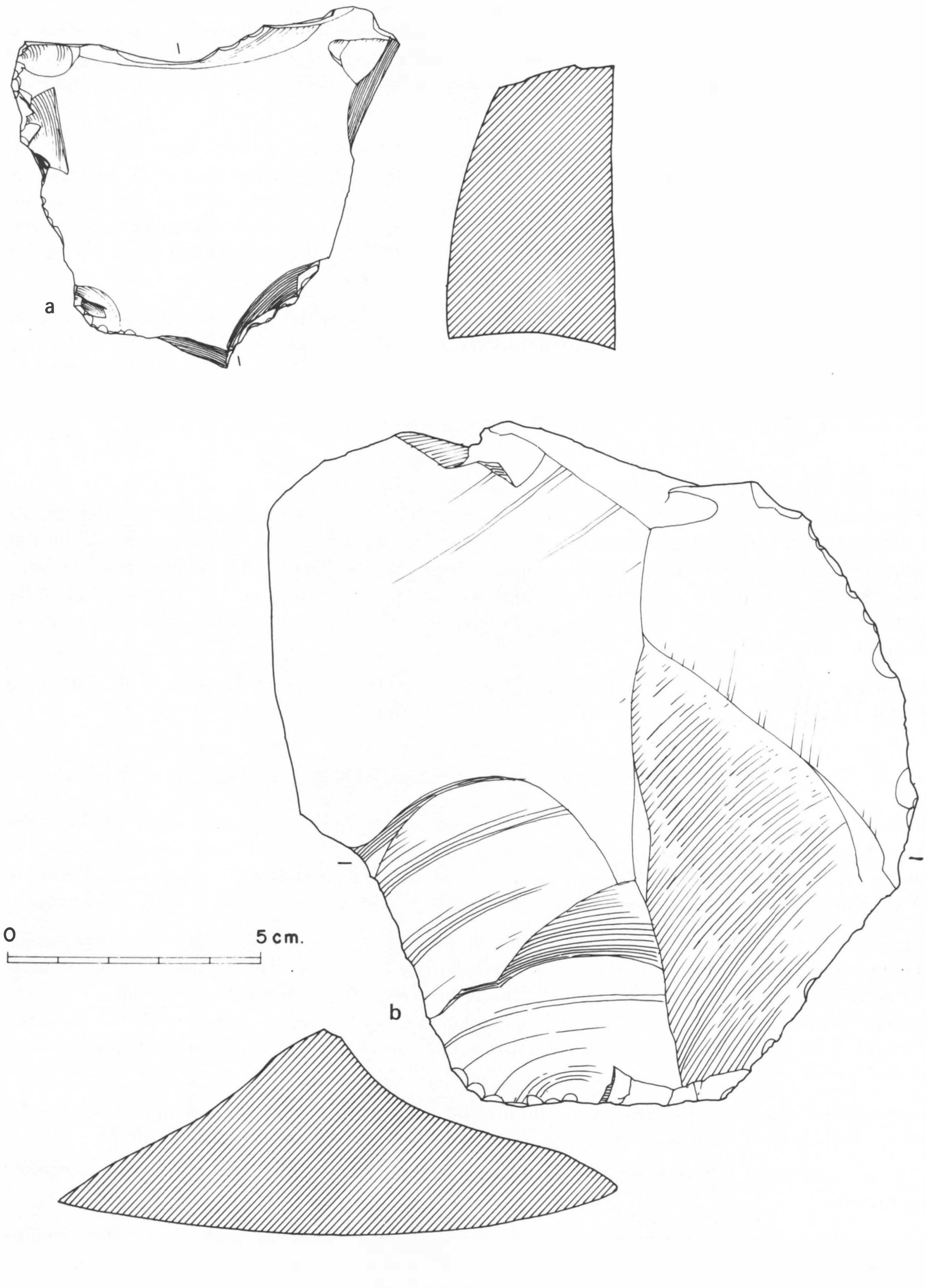


Fig.29 Bui Ceri Uato: stone tools

a 5152, core chopper, Square N6E2(10), Horizon IV
b 3862, large flake, no secondary working, Square N6E0(8), Horizon VI

made, but the reduction is consistent and in all three dimensions.

The reduction in the density of artifacts, and in the size of all classes of flaked stone is accompanied by a decline in the technical expertise in stone flaking towards the top of the deposit. Not only are the long blade scrapers absent, but the other tools are more irregular in form and less carefully worked.

Table 46 lists nine burins. These share the same characteristic in that a single spall has been removed from one edge of the flake, struck from the distal end where this can be recognised, to leave an angular 'beak'. However, not all nine are regarded as burins in the functional sense, with the same degree of confidence. Figure 25a-c shows two tools from Horizon II and one from Horizon III which correspond closely to the Old World, single blow burins (Burkitt 1933:Fig.4), and on which the cutting angles show signs of use.

Figure 25d illustrates a small backed point from Horizon IV which I believe, is an awl or drill point. The right margin is steeply retouched from both faces, the left from one face only. No sign of wear can be seen on the narrower point, but in shape, size and working, it resembles presumed drill points from an archaeological collection made on Motupore Island, Papua New Guinea (Lampert 1969:413). Presumably one end was trimmed to fit into a wood or bamboo shaft.

Figure 25e illustrates a small bifacially flaked disc from Horizon VIII, measuring 28 x 21 x 10 mm. It is too regularly made to be accidental but its function is difficult to determine. The edge is too battered and blunt to be much use as a cutting tool, but has none of the flat scalar flake scars of the fabricator, or bipolar core (White 1968). The suggestion has been made that it is a strike-a-light and this seems the best explanation. It is more regular in shape than any I have seen in use in Timor, but the battered bifacially flaked edge is consistent with such a use.

Figure 29a illustrates a large crudely-made scraper, which I have called a chopper, following Movius (1949:36) terminology.

POUNDERS, ANVILS AND GRINDSTONES

More pounders and pitted anvil stones were found in Bui Ceri Uato than in any of the other sites. Considering the greater density there of flaked stone, together with the distribution of the pounders and anvils, it is difficult to avoid the conclusion that they are principally stone working implements. None were found in Horizons IX and X where there is little flaked stone.

The anvils are commonly made of flattish oval-shaped pebbles of basalt or other tough igneous rock (Plate 28) with a shallow pecked depression in the centre of one, or both sides. The pounders are generally rounder in section, and weigh from 50 gm to over 1 kg. They are irregularly pitted on one, or both ends, and sometimes on the sides. Many of the anvils have also served as pounders, and such a large proportion of both were broken that measurements were of no value.

Some pebbles stained with ochre were found, and also seven sandstone and basalt slabs with flat, or slightly hollow, ground faces (Plate 28c). All the above are listed in Table 48.

A few other ground, or pecked stone artifacts were found which do not fit into the categories mentioned.

Horizon IX: a large broken basalt stone from Square S2E1(2), with two deep circular depressions on one side, and a ground surface on the reverse (Plate 28e). The depressions, which are 5 cm across by 2 cm deep, are more pronounced than on the other pitted stones, and it seems likely that this stone was used for crushing hard nuts such as candlenut (*Aleurites moluccana*) and *Areca*. The reverse looks as if it has been used for sharpening a metal tool rather than for grinding food.

Horizon VIII: in addition to one complete ground *Tridacna* shell adze from Horizon VII, the

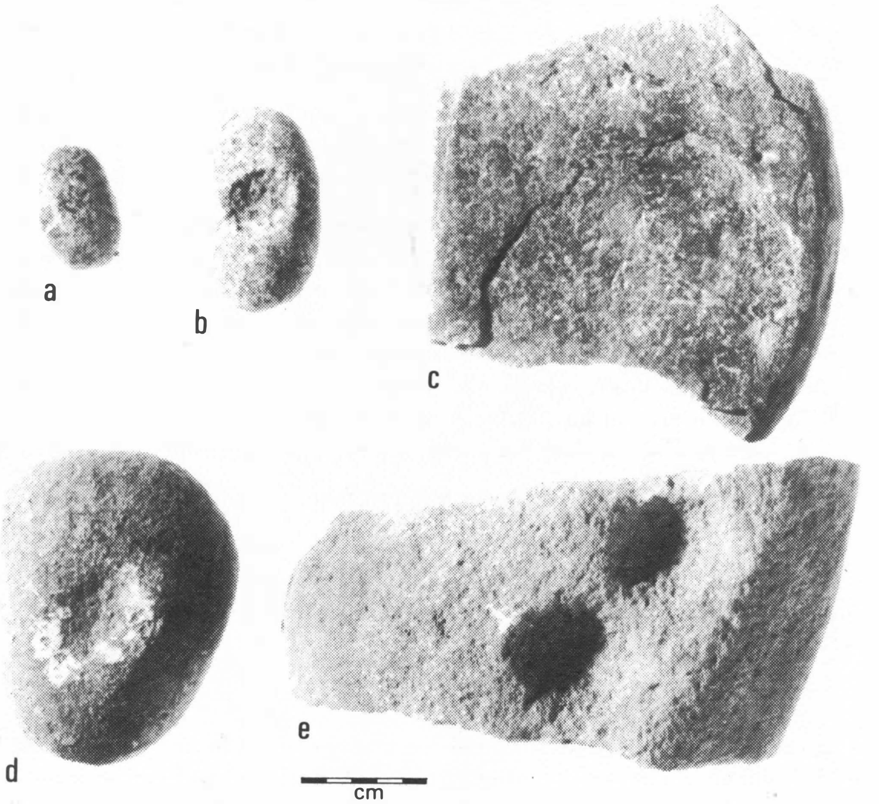


Plate 28 Bui Ceri Uato: pounders, anvils and grindstone

- a 5286, hammer, 63 gm, bruised at both ends, Square N6E2(11), Horizon III
- b Anvil/hammer, deeply pitted on both sides, Square N5E2(11), Horizon III
- c Grindstone, shaped on right edge, Square N7E1(9), Horizon IV
- d Anvil, pitted on one side only, Square N6W1(6), Horizon VI
- e Anvil, ? for opening candlenut shells, Square S2E1(2), Horizon IX

Horizon	Pounders	Anvils	Grind-stones	File
X	-	-	-	-
IX	-	-	-	-
VIII	1	-	1	-
VII	2	1	1	1
VI	12	9	2	-
V	6	8	2	-
IV	5	10	1	-
III	6	4	-	-
II	12	-	-	-
I	6	2	-	-
Total	50	34	7	1

Table 48 Bui Ceri Uato: numbers of pebble pounders, anvils and grindstones

possible butt end of a ground stone axe or adze was found in Square N7E3(3). It is too small to be identified with certainty, but may be from a plano-quadrangular tool such as the small adzes from Java and Sulawesi illustrated by Heekeren (1958a:47, Pl.55).

Horizon VII: a smooth triangular piece of sandstone in Square N5E2(5) (Fig.25h) resembles the fish-hook files of the Australian east coast (McCarthy 1967:Fig.49). However, it is too large to have been used to make the one complete fish-hook found in the excavation.

Horizon VI: a slightly polished fragment of coral, and a large struck flake of quartzite, which looks quite foreign to the flaked stone assemblage in the cave (Fig.29b). It is difficult to say much on the evidence of a single flake but I am inclined to think that it belongs to a much older cultural tradition and was brought into the cave as a chance find in the past. A rather similar flake was found at Uai Bobo 2 in Horizon IX. Some Pleistocene flake tools from Timor which resemble this flake in size and proportions have been discussed in Glover and Glover (1970). Although no similar artifacts have been found in the Ainaro gravel formations in eastern Timor, I am confident that they will be once a proper search is made.

Horizon IV: a small pumice pebble with one ground face.

Horizon I: one basalt pebble, with one face slightly polished, and two flint pebbles such as might have provided the raw material for the stone flaking. On one of these the cortex is broken off, and the common chocolate-brown coloured flint can be seen.

OCHRES

Small pieces of red ochre and broken manganese nodules were found scattered throughout the lower half of the deposit. The weight of ochre in each horizon, and the number of pieces with ground surfaces, are given in Table 49 and some of these ground pieces are illustrated in Plate 32. One flake was found in Horizon II with ochre covering one broad, rough edge. Presumably it was used to scrape the ochre lumps in order to produce fine dust for making paint. Among the hammer stones listed in Table 48 are nine pebbles with traces of red ochre pigment.

Horizon	Weight (gm)	Nos of ground pieces
X	-	-
IX	-	-
VIII	-	-
VII	-	-
VI	57	-
V	156	1
IV	118	2
III	129	3
II	300	14
I	52	2
Total	812	22

Table 49 Bui Ceri Uato: ochre and manganese, weight in gm

ANALYSIS OF POTTERY

Distribution

Small quantities of pottery were found in all horizons from V-X with the maximum density occurring in the goat dung of Horizon X. In Table 50 the numbers of diagnostic and plain body sherds are listed by horizons.

The pottery was badly broken; none of the incised or impressed sherds, and only a dozen or so rim sherds could be joined together. Not much can be learned about possible disturbances to account for the anomalous radiocarbon dates, except that they were not sufficiently

Horizon	Rims	Ring bases	Incised and impressed sherds	Paddle-stamped body sherds	Burnished body sherds	Angular shoulders	Plain body sherds	Nos	No. per m^3 Nos	%
X	6	1	1	15	7	-	202	232	1160	33
IX	21	5	-	9	5	-	526	566	690	20
VIII	25	-	2	1	8	-	592	628	860	25
VII	31	-	16	2	47	4	820	920	605	17
VI	5	-	1	2	5	1	179	193	146	4
V	-	-	-	-	1	-	19	20	19	1
Total	88	6	20	29	73	5	2338	2559	3480	100

Table 50 Bui Ceri Uato: distribution of pottery

widespread to affect the associations of most of the decorated sherds. These came from a possible nine different vessels all of which probably belonged to Horizon VII. The one decorated sherd (5508) in Horizon X, appears to come from the same vessel as 5725 in Horizon VII, although they were found four spits apart and at opposite ends of the trench. And one of the two decorated sherds in Horizon VIII (5616), may belong with 5707 also from Horizon VII. On the other hand, all nine sherds (Plate 33e-m) which are thought to come from yet another vessel were found in Horizon VII, scattered among six spits and four squares. The horizontal scattering is more apparent than vertical displacement.

One almost complete vessel was found on the surface behind the stone wall near the northwestern end of the trench. It is a small, round-based cooking pot with painted red and white decoration on the upper body (Plate 29). Such pots are occasionally offered for sale in the Baucau market and are made in *suco* Tekinamata, on the north coast near Laga, about 22 km to the east across the Baucau Plateau. Most probably it was left behind after the corn harvest earlier in the year.

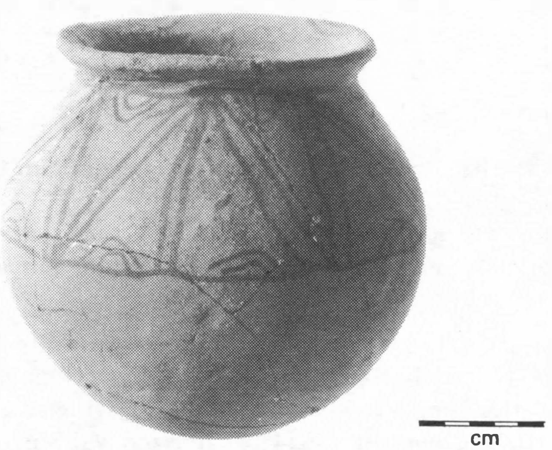


Plate 29 Small painted pot found on surface, possibly from Tekinamata

Decoration

The distribution of sherds decorated with impressions, incisions and relief has already been discussed, and all but the very smallest of these are illustrated in Plate 33. The decorative motifs, where they can be recognised, are fully consistent with those from other excavated sites - adjacent cross-hatched triangles and applied fillets or nubbins, squeezed or obliquely slashed. Two sherds (5616, 5707) show broad, shallow incised grooves, more or less square in section, and there is one small fragment (5701) of the rim of a dish or bowl with red slip, and incised on the outside just below the rim. In Horizon IX there is a single rim sherd (5552) of a bowl with a direct rim bevelled on the inside, above a simple painted design in reddish-brown (Plate 33s). Not enough is preserved to identify the motif.

In all horizons there are a small number of paddle-stamped sherds. This technique is rare in eastern Timor today as far as I know. I have seen it only on the pottery from Uai Tami *suco* in Quelicai *posto*, on the northwest slopes of Mt Mata Bea and on some sherds from Ili Kere Kere near Tutuala. The women of Uai Tami regularly bring their pottery to the Baucau market (Plate 4) walking the 20 km with net bags on their backs, each containing six or more cooking pots. These find a ready sale in Baucau where they are thought to be more durable than the local pottery from Buruma. A number of these vessels find their way into the villages on the western side of the Baucau Plateau, and on the coastal plain below. Paddle-stamped sherds are certainly more common in the upper horizons, but given the small sample it is unwise to interpret this as reflecting changes in the popularity of the Uai Tami wares in the villages of the plateau.

Small quantities of burnished sherds occur throughout the site, belonging mainly to bowls or dishes. Their numbers are too few to permit anything to be said about changes in the proportion of plain to burnished ware, but the presence of burnished pottery in the upper horizons should be noted for this is in contrast to the position in the inland sites at Uai Bobo.

Rim sherds (Fig.30)

With a single exception (5624 in Horizon VII) all rims could be related to the classes discussed in Chapter IV (Table 51), although many are broken and they cannot be classified with certainty. Rims are listed by individual vessels, rather than by sherds. Rim profiles are illustrated in Figure 30.

Horizon	Everted A	Everted B	Direct rims	Indeterminate	Nos
X	2	-	2	2	6
IX	5	-	9	7	21
VIII	6	4	4	7	21
VII	8	5	2	15	30
VI	-	-	1	3	4
V	-	-	-	-	-
Total	21	9	18	34	82

Table 51 Bui Ceri Uato: distribution of rim types

Most of the direct rims are too small to measure, but they appear to come from small steep-sided bowls with a mouth radius of 7-8 cm. Half of these rim sherds are burnished and one, 5701, is incised through a burnished red slip.

Reliable observations and measurement could be made on only 25 everted rims. For ease of comparison, therefore, the six horizons with pottery have been grouped into two assemblages, Horizons X-VIII, and Horizons VII-V in Table 52. There was only one angular cut lip form (5602) in Horizon VIII, and one rim (5624) in Horizon VII with a step, or shelf, on the outer edge (Fig.30). Whether this is decorative, or intended to support a lid cannot be determined.

	Mouth/body angle	Mouth/rim angle	Rim height	Mouth radius	Neck radius	
Horizon	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	Nos
X-VIII	50°	40°	11	8	6	14
VII-V	55°	45°	16	7	6	11
Total nos	-	-	-	-	-	25

Table 52 Bui Ceri Uato: everted rim attributes, measurements in cm

In Horizons VI and VII there were five angular shoulder sherds, all burnished, and in Horizons IX and X there were six fragments of ring bases which appear to come from two and perhaps three separate vessels. Perhaps they all belong in Horizon IX, for the one sherd in Horizon X clearly belongs to the same vessel as some of those in Horizon IX.

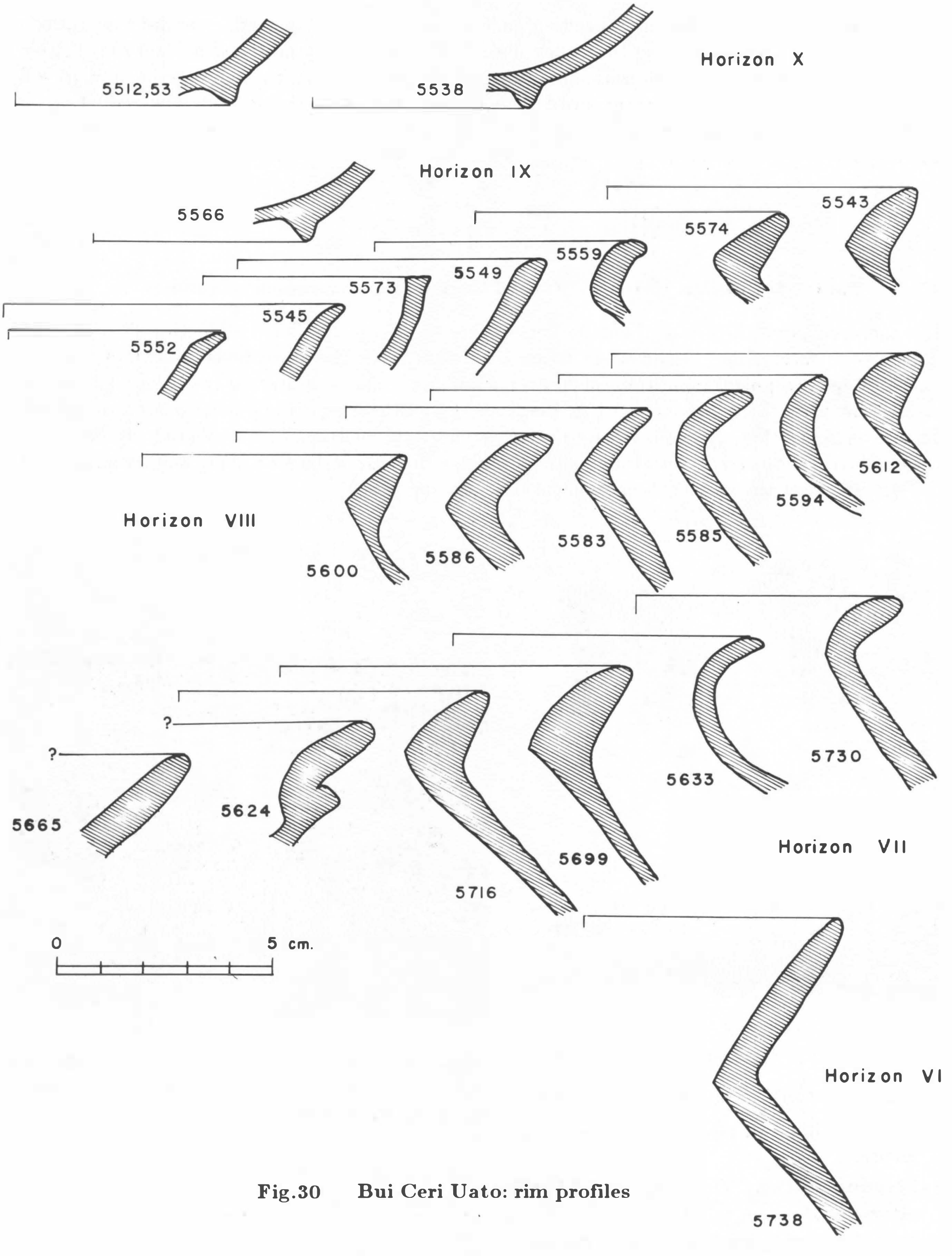


Fig.30 Bui Ceri Uato: rim profiles

Body sherds

All plain body sherds were measured in those horizons where the numbers were small, and samples were taken by quartering, in horizons where there were many sherds.

The maximum thickness was measured on each sherd, and the means and standard deviations were calculated from a grouped frequency distribution with class intervals of 0.50 mm (Table 53). The thickness range was from 1.5-9.5 mm. To obtain better sized samples and to aid calculations, the horizons were grouped into three. A *t* test showed that the reduction in thickness between the earliest and most recent pottery, though small, was significant at the .1% level.

Horizon	$\bar{x}$	s	Nos
X,IX	3.6	1.0	483
VIII	4.3	1.1	288
VII,VI,V	4.3	1.4	533

Table 53 Bui Ceri Uato: body sherd thickness, measurements in mm

The more variable thickness of the earlier pottery, and the significant reduction in body wall thickness in later times would seem to be consistent with the slow development of a single stylistic and technical tradition of pottery making. This supports the more subjective assessment that there was no marked break in the cultural traditions of this area of eastern Timor, as far as they are reflected by pottery styles, after pottery first appeared. It should be remembered that there is no evidence for a change in pottery forms during the occupation of the site and that the sherds all come from comparable vessels.

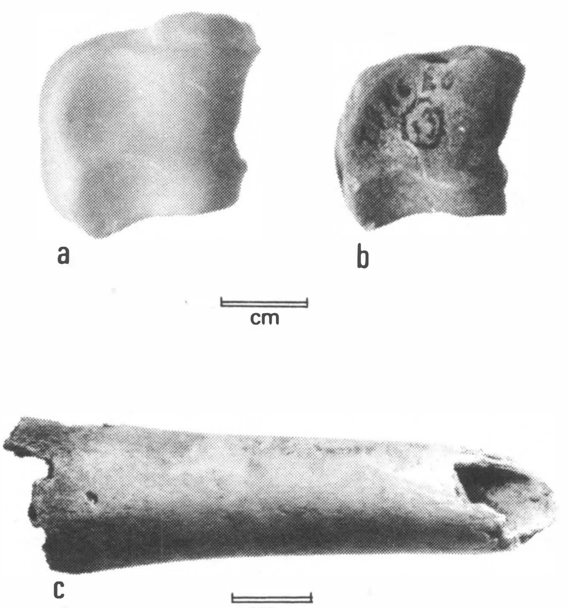


Plate 30 Bui Ceri Uato: caprovine bones

- a Magnum of adult female rusa deer, modern
- b Magnum of *Capra/Ovis*, Square N6E0(13), Horizon II
- c Distal end of *Capra/Ovis* radius, cut and polished, Square N6E1(9), Horizon IV

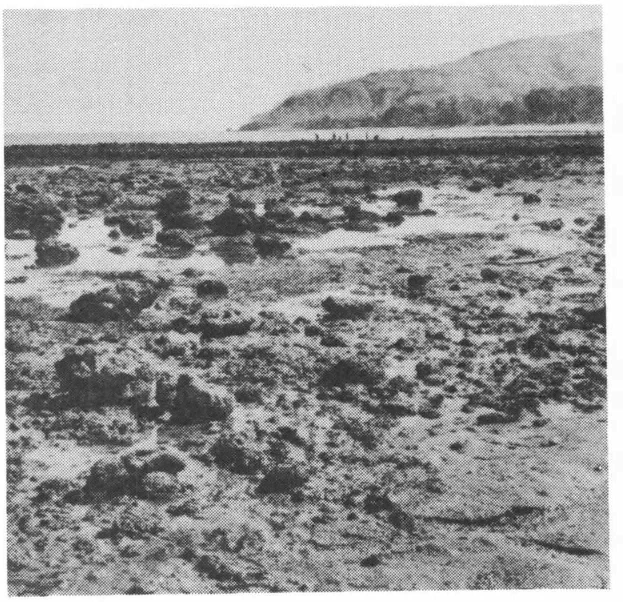


Plate 31 Fringing reef exposed at low tide west of Uai Ono. The Baucau Plateau can be seen in the right background

SHELL ARTIFACTS

In addition to the large number of shell food remains a few shells were found which had been modified, or merely used, for ornaments and tools.

In Horizon VII a small adze made from *Tridacna* shell was found in Square N6E1(5) (Fig.31; Plate 32f). This is the only certain example of an edge-ground cutting tool found in any of the excavations. The adze is 44.2 mm long x 34.4 mm wide at the cutting edge, narrowing to 24.8 mm at the butt end, and 12.4 mm thick. It is lenticular in cross-section and the cutting edge, which is sharp and slightly curved, is bevelled, principally from one face, and is asymmetric to the long axis of the tool. Under a low-power microscope, parallel striations can be seen at about 40° to the cutting edge. These are in opposite directions on both faces and they must represent edge-grinding, rather than utilisation.

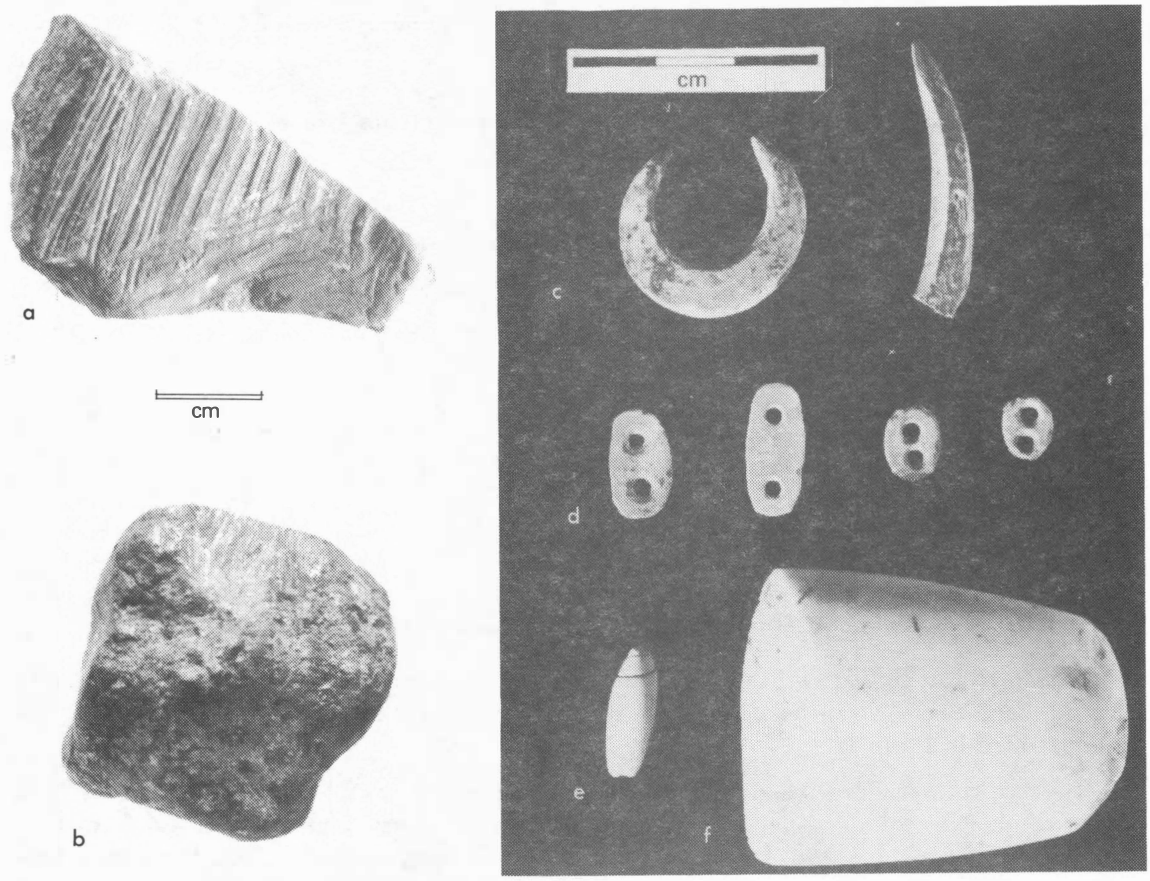


Plate 32 Bui Ceri Uato: ground ochre and shell artifacts

- a 5285, ground ochre, Square N7E1(10) Horizon III
- b 6014, manganese nodule with ground surface, Square N6E2(12), Horizon II
- c *Trochus* shell fish-hooks
  Left, Square N5E2(7), Horizon VI
  Right, Square N5E2(8), Horizon B
- d *Nautilus* shell ornaments
  From left:
  Square N6W1(8), Horizon IV
  Square N6E1(8), Horizon VI
  Square N5E2(8), Horizon V
  Square N5E2(8), Horizon V
- e Pierced olive shell, Horizon IV
- f Ground adze of *Tridacna* shell (Fig.31)

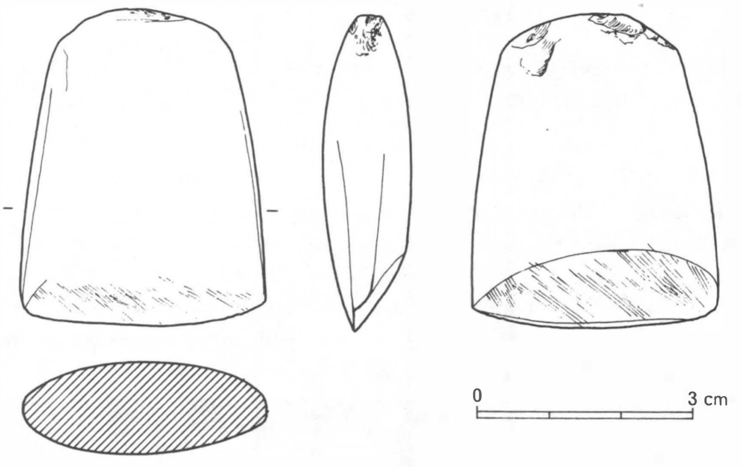


Fig.31 **Bui Ceri Uato: polished adze made from *Tridacna* shell, Square N6E1(5), Horizon VII**

Horizon	*Tridacna* adze	*Trochus* fish-hooks	*Nautilus* beads	*Nautilus* fragments	Olive shells
X	-	-	-	-	-
IX	-	-	-	-	-
VIII	-	-	-	-	-
VII	1	-	-	-	-
VI	-	1	1	2	2
V	-	1	2	-	-
IV	-	-	1	1	-
III	-	-	-	-	-
II	-	-	-	-	-
I	-	-	-	-	-
Total	1	2	4	3	2

Table 54 Bui Ceri Uato: distribution of shell artifacts

In addition to the adze, two fish-hooks, four pierced *Nautilus* shell beads, some fragments of *Nautilus*, and two olive shells were found in the middle levels of the deposit (Table 54). They are illustrated in Plate 32.

The pierced *Nautilus* shell beads (Plate 32d) are different from all the others found in Timor in that they have two holes, not one. They look identical to one found by Verhoeven at Liang Toge, Flores (Heekeren 1967) and they can also be compared with the three-hole bead, probably of *Nautilus*, from Sodong Cave, Puger, Java (Heekeren 1972:Pl.50).

The varying lengths and distances between the holes (Table 55) suggest that, except perhaps for the two in Horizon V, the beads were not all from a single string. It seems more likely that they were sewn separately onto some other object as ornaments.

Horizon	Length	Breadth	Hole diameter	Hole spacing
VI	13.0	7.3	1.9	6.4
V	9.2	6.1	1.8	4.0
V	7.7	6.0	1.8	4.3
IV	15.7	6.9	1.8	9.5

Table 55 Bui Ceri Uato: *Nautilus* shell bead, measurements in mm

Of the two fish-hooks, only the one in Horizon VI is complete. It is a simple crescentic jabbing hook, about 22 mm in diameter, without any notch for line attachment. I have been unable to find any other prehistoric fish-hooks illustrated from Indonesia, and there seems little point in comparing a single specimen with hooks from other regions. The fish-hook in Horizon V is broken, but was probably larger, or it may be part of a composite hook. Both are made of *Trochus* shell, probably *T. niloticus*.

Of the two olive shells, only one appears to be pierced by removing the apex. The surfaces on both are too damaged to be sure of species, but they are probably *Oliva brettinghami*.

MISCELLANEOUS ARTIFACTS

Only 12 undoubtedly modern objects were found in the excavation; one iron nail, nine pieces of bottle glass, and two pieces of glazed pottery.

The pottery, nail and four glass fragments were in Horizon X. Four further pieces of glass were found in Horizon IX and one piece of the bottom of a square, green, Dutch gin bottle was found near the base of the filling of the large posthole in Square N6E2, shown in Plate 26.

Apart from this one piece from a recognised disturbance, the absence of any modern objects below Spit 2 is supporting evidence for the integrity of the deposit.

One piece of pottery is a blue and white Chinese glazed stoneware, but is too small to identify the shape or design. The other has a white glaze, and is probably from a European-made cup.

Other objects found include three fossil sea urchin spines, one of which, from Square N7E2(11), Horizon II, has slight traces of wear, and may be a file, in addition to the sandstone file noted above.

ANALYSIS OF FAUNAL REMAINS

The procedure for sorting and analysis is outlined in Chapter IV, and Appendices 1-3.

Murids

The minimum numbers of individual murid rodents are set out in Table 56.

As in all sites except Lie Siri, large murids are not found in the top of the deposit. The greater number of unidentifiable large murids in Bui Ceri Uato, compared with the other sites, is due to the degree of breakage, and chemical erosion of the remains. The single specimen in Horizon VIII, and one of the two in Horizon VI, are based on postcranial bones only, and there are postcranial bones of at least one small murid in each of Horizons X, VII and VI.

	LARGE MURIDS						SMALL MURIDS				
Horizon	*Coryphomys*	A	B	C	Not identifiable	Nos	*Melomys* sp. incl. *Pogonomelomys* Small	Large	*Rattus exulans*	Other *Rattus* sp.	Nos
X	-	-	-	-	-	-	-	-	-	1?	1
IX	-	-	-	-	-	-	-	-	-	-	-
VIII	-	-	-	-	1	1	-	-	-	-	-
VII	-	-	-	-	1	1	-	-	-	1?	1
VI	-	-	-	-	2	2	-	-	-	1?	1
V	-	-	-	-	5	5	-	-	-	1	1
IV	-	1	-	-	2	3	-	1	-	2	3
III	-	-	-	-	3	3	-	-	-	2	2
II	2	-	1	-	4	7	-	1	-	3	4
I	-	-	-	-	1	1	-	-	-	-	-
Total	2	1	1	-	19	23	-	2	-	11	13

Table 56 Bui Ceri Uato: minimum numbers of murids

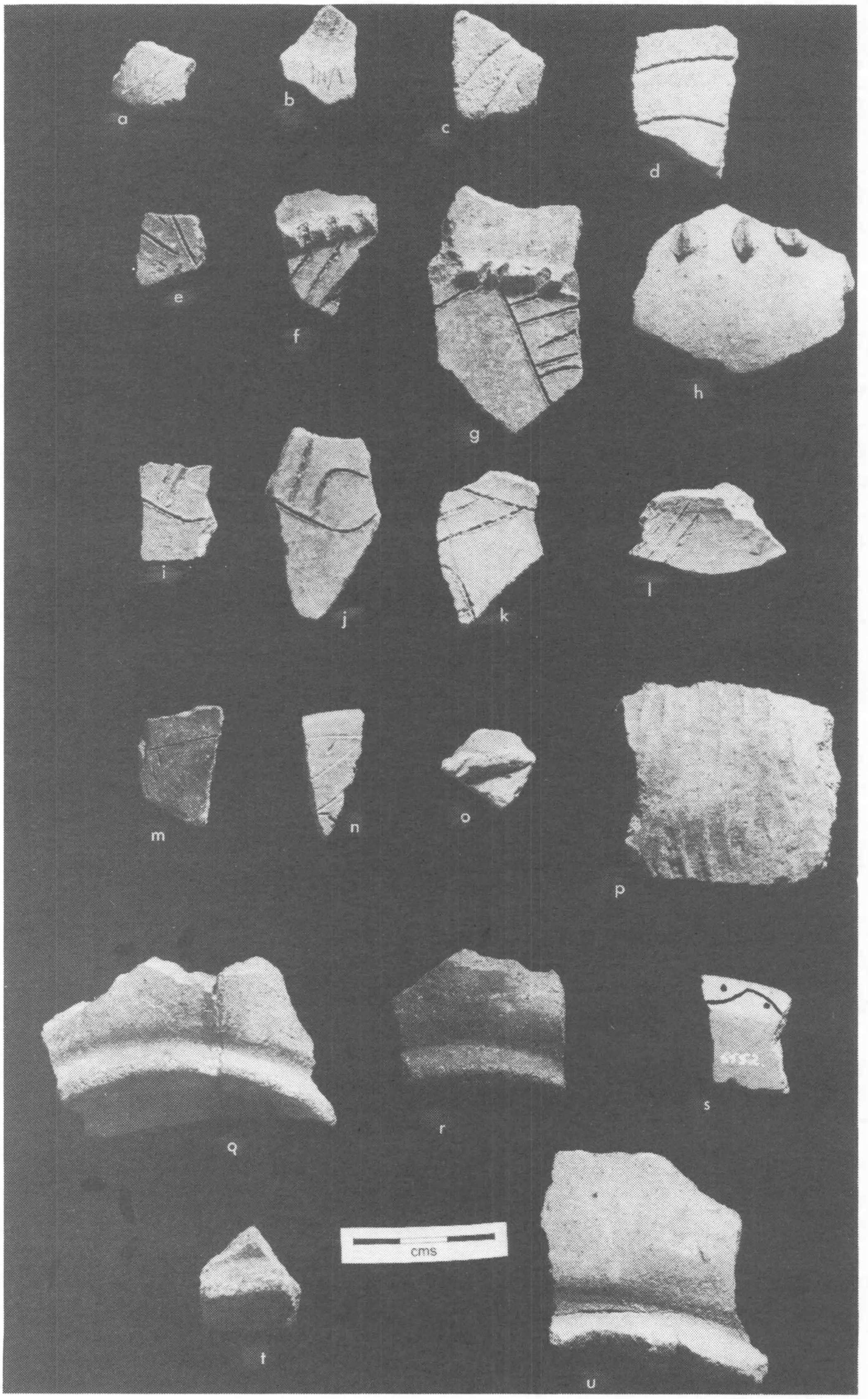


Plate 33

Plate 33 Bui Ceri Uato: decorated pottery

- a 5508, body sherd, Square N6W1(1), Horizon X
- b 5591, body sherd, Square N6W1(3), Horizon VIII
- c 5616, body sherd, Square N5E1(3), Horizon VIII
- d 5707, body sherd, Square N5E2(4), Horizon VII
- e 5727, body sherd, Square N5E2(5), Horizon VII
- f 5667, body sherd, Square N6E2(5), Horizon VII
- g 5656, body sherd, Square N6E1(5), Horizon VII
- h 5685, body sherd, Square N6E2(6), Horizon VII
- i 5626, body sherd, Square N7E1(4), Horizon VII
- j 5709, body sherd, Square N5E2(4), Horizon VII
- k 5625, body sherd, Square N7E1(4), Horizon VII
- l 5668, body sherd, Square N6E2(5), Horizon VII
- m 5725, body sherd, Square N5E2(5), Horizon VII
- n 5701, direct rim, incised, Square N5E1(4), Horizon VII
- o 5666, body sherd, Square N6E2(5), Horizon VII
- p 5749, paddle-stamped body sherd, Square N5E2(7), Horizon VI
- q 5512 and 5553, ring base, Squares N6E0(1) and N6E0(2), Horizons X and IX
- r 5566, ring base, Square N5E2(2), Horizon IX
- s 5552, direct rim painted on inner lip (photograph retouched), Square N6E0(2), Horizon IX
- t 5540, ring base, Square N7E1(2), Horizon X
- u 5538, ring base, Square N7E1(2), Horizon X

Chiroptera

Only two identifiable bat mandibles were found; one of *Acerodon? mackloti*, and one of *Rousettus amplexicaudatus*, both in Horizon IV.

Domesticated and large land mammals

Descriptions of the identified bones are given in Appendix 3, and the minimum numbers of individuals recognised from these bones are listed in Table 57. Compared with the other excavated sites, bones were few at Bui Ceri Uato, but nevertheless these present some problems of interpretation.

Horizon	*Canis*	*Sus*	*Capra/Ovis*	*Bos*	*Macaca*	*Cervus*
X	1	-	1	-	-	-
IX	1	1	1	-	1	1
VIII	1	2	1	2?	1	-
VII	1	2	-	1	-	-
VI	1	-	-	1	-	-
V	-	-	-	-	-	-
IV	-	-	1?	-	-	-
III	-	-	-	-	-	-
II	-	-	1	-	-	-
I	-	-	-	-	-	-
Total	5	5	5	4	2	1

Table 57 Bui Ceri Uato: minimum numbers of domesticated and large land mammals

Dog bones are found in all horizons down to VI although there are never more than two bones in any one horizon. Some bones in different horizons, of course, may belong to the same individual but the artifactual evidence is against any extensive disturbance of the deposit and it is certain that several animals are represented.

Pig occurs down to Horizon VII, and *Capra/Ovis* to Horizon VIII, except for two bones, one each in Horizons IV and II, which are illustrated in Plate 30. The bone from Square N7E1(9) in Horizon VI, is a fragment of radius, cut, with one facet polished towards the distal end. It was identified by Higham as probably *Capra/Ovis*. In Horizon II there is a magnum from Square N6EO(13) which Higham definitely identifies as *Capra/Ovis*. Both these bones are from different squares, and neither are from Squares N6E2 or N7E2 where there was evidence of disturbance from postholes. When the evidence from other sites is considered it is difficult to accept the presence of caprovines in Timor before the introduction of pigs and pottery, and since there are only two bones, it seems best to place them in a suspense account for the time being, and to suspect them of coming from an unrecognised disturbance.

Bovid bones were confined to Horizons VIII-VI.

In Horizon VIII there was a well worn M^1 and M_1, and an unworn lower molar fragment, so two individuals are represented. In Horizon VII, a single Phalanx 1 fragment, and in Horizon VI, a vertebra fragment. In the provisional chronology (Table 39) these horizons are dated from about 3500-1500 BP. Although there are few bovid bones compared with those of *Sus* and *Capra/Ovis*, it is unreasonable to dismiss them all as disturbed, or coming from the one individual in say Horizon VIII, merely because there is no other evidence for the introduction of bovids into Timor at such a time. Because they are so few, however, it is best to regard it as not quite proven. In Uai Bobo 1 comparatively early bovid bones were also found, and the matter is discussed further in Chapter VII.

Very few bones of monkey and deer were found, the only point to make is that they were near the top of the deposit.

Human bones

Fragmentary human remains were found in Horizons II, V and VIII. The descriptions are supplied by A.G. Thorne.

Horizon VIII	Portion of an adult right zygomatic. It displays a marked malar tuberosity and a rounded border which, Thorne says, are marked Australian Aboriginal characteristics. Phalanx 2.
Horizon V	Thoracic vertebral body, advanced age. Parietal fragment, juvenile.
Horizon II	Maxillary permanent right second molar. Possibly human long-bone shaft fragments.

From these remains it would appear that at least four individuals are represented, of which two are in Horizon V. The fragmentary and scattered nature of the human remains limits what can be said about them. Though few, they represent cranium, axial skeleton, a limb and either a hand or foot. Similar finds were made in Lie Siri and Uai Bobo 2, and the interpretation offered is that the bones represent a few burials, perhaps made in shallow graves as in the Osso Ua burial cave (Glover 1972a:3.4.1, Pl.3:37), which have been scattered and partially destroyed by predatory dogs, pigs, and human occupation of the cave.

Thorne's mention of the Aboriginal characteristics of one bone in Horizon VIII raises a problem which must remain unresolved until Timorese skeletal material has been studied in greater detail. Many of the anthropometrists who have worked in Timor have commented on the Australoid element in some Timorese groups, but the prevalence of malar tuberosity does not appear to be one of the characteristics which they recorded. It may be just as much a Timorese as an Australian characteristic.

PLANT REMAINS

As mentioned in Chapter IV a soil sample from Horizon IX was examined for pollen but only a few fungal spores were found. The most common plant remains in this site, as in all othes, were broken, and occasionally charred, candlenut shells (*Aleurites moluccana*). These were found in about half of the spits excavated down to Horizon VII; the weights are given in Table 58..

Horizon	(gm)
X	17
IX	31
VIII	15
VII	11
Total	74

Table 58 Bui Ceri Uato: weight of candlenut shells

Appendix 4 lists the plant remains identified by Dr Yen and other workers in Hawaii. In Horizon VII, there was one fragment of wood, possibly of *Cocculus* sp. and one *Areca* seed, both from Square N6W1(5). Pieces of wood in Horizon VI and a seed in Horizon IV were too fragmentary and eroded to identify. *Cocculus* is a small genus of climbers of the family Menispermaceae distributed throughout the tropics. Its most common use seems to be as a fish poison, and the bitter extract of the roots of some species is used by the Chinese of Singapore as a medicine. The *Areca* seed is probably *A. catechu*, the areca- or betel-palm. The use of *Areca* together with burnt lime and the leaves of *Piper betel* as a stimulant is widespread in Timor today, and Burkill (1935:225-30) believes that Southeast Asia is the original home of these plants, and of betel chewing. Today virtually all *Areca* trees are planted and privately owned and there can be no doubt that they have been cultivated for a long time. *Areca* was found in Horizon VII, and *Piper* both at Uai Bobo 1, Horizon I and Uai Bobo 2, Horizon II. The evidence, fragmentary though it is, indicates that *Piper* at least, has been used in Timor for the last 10,000 years although it cannot be said that it has been a cultivated plant for that length of time.

ANALYSIS OF MOLLUSCA

Shell samples were collected according to the method set out in Chapter IV. Seventeen kilograms was collected from 0.6 m^3 or about 7% of the excavation. Although the samples looked bulky in the field, they have not proved adequate for a reliable analysis to be attempted of the relative contributions of the different species in each horizon to past food supply. The total number of individual shells, 1761, is less than half the number from Lie Siri. Nevertheless, the proportional densities of shell have been listed in Table 59, the number of individuals and percentage frequency appears in Table 60 and the relative numbers and percentage of individuals of each of the habitats is contained in Tables 61-62.

The greatest density of shell is in Horizon III, just before the peak of flaked stone density but the two distributions are similar. Molluscs were still commonly present after the introduction of pottery but the amount diminishes in later times. Whether this reflects a reduction in the importance of shellfish in the diet or the less frequent occupation of the site cannot be determined with certainty.

Horizon	Weight (kg)	Volume of deposit collected	Weight per m^3	% of total shell
X	-	-	-	-
IX	0.2	0.05	4	2
VIII	1.3	0.06	22	8
VII	1.0	0.05	20	7
VI	2.1	0.05	42	15
V	1.3	0.05	26	9
IV	3.1	0.06	52	18
III	3.6	0.05	72	25
II	2.5	0.09	28	10
I	1.8	0.10	18	6
Total	16.9	0.56	284	100

Table 59 Bui Ceri Uato: sample weights and density of shell

Table 60 Bui Ceri Uato: molluscs, minimum number and percentage frequency of all species

Species	HORIZON IX n	IX %	VIII n	VIII %	VII n	VII %	VI n	VI %	V n	V %	IV n	IV %	III n	III %	II n	II %	I n	I %	Total
GASTROPODA (marine)																			
Haliotidae																			
Haliotis varia	2	6	5	4	44	27	45	21	46	28	19	9	35	11	41	12	40	21	277
Patellidae																			
Cellana sp.	1	3	-	-	2	1	2	1	2	1	-	-	3	1	3	1	7	4	20
other Patellidae	1	3	3	3	1	1	-	-	-	-	3	1	-	-	-	-	-	-	8
Trochidae																			
Trochus maculatus	-	-	1	1	6	4	7	3	4	2	5	2	3	1	2	*	3	2	31
Trochus niloticus	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Trochus sp.	1	3	5	4	4	2	2	1	2	1	3	1	-	-	4	1	-	-	21
Tectus pyramis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	*	2	1	3
Monodonta labio	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1
Angariidae																			
Angara atrata	-	-	-	-	-	-	-	-	-	-	1	*	-	-	-	-	-	-	1
Turbinidae																			
Turbo argyrostomus	2	6	2	2	1	1	2	1	2	1	7	3	16	5	12	3	5	3	49
Turbo chrysostomus	2	6	6	5	5	3	5	2	5	3	7	3	5	1	5	1	2	1	42
Turbo marmoratus	1	3	1	1	1	1	2	1	1	1	4	2	3	1	3	1	3	2	19
Turbo porphyrites	-	-	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-	-	4
Turbo sp. (several spp.)	3	9	16	14	18	11	20	10	6	4	2	12	-	-	29	8	9	5	127
Neritidae																			
Nerita exuvia	-	-	3	2	-	-	-	-	-	-	3	1	5	1	13	4	30	16	54
Nerita albicilla	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2
Nerita polita	-	-	-	-	-	-	3	1	1	1	3	1	4	1	28	8	-	-	39
Nerita plicata	1	3	11	9	14	8	14	8	2	1	3	1	19	6	19	5	2	1	85
Nerita sp.	1	3	2	2	3	2	5	2	7	4	6	3	34	10	1	*	5	3	64
Littorinidae																			
Tectarius pagodus	-	-	1	1	-	-	3	1	-	-	1	*	13	4	15	4	-	-	33
Melaniidae																			
Melania sp.	-	-	1	1	3	2	-	-	-	-	-	-	-	-	2	*	-	-	6
Potamiidae																			
Terebralia palustris	1	3	8	7	4	2	25	12	30	18	10	5	7	2	3	1	1	*	89
Lambidae																			
Lambis lambis	-	-	6	5	2	1	6	3	-	-	1	*	-	-	1	*	-	-	16
Cypraeidae																			
Cypraea arabica	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Cypraea sp.	3	9	2	2	3	2	6	3	5	3	1	*	2	*	1	*	1	*	24
Tonnidae																			
Tonna sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	*	-	-	1
Muricidae																			
Mancinella sp.	-	-	2	2	1	1	7	3	5	3	6	3	5	1	10	3	8	4	44
Drupa morum	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Drupa rubsidaeus	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Drupa sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	*	-	-	1

	HORIZON																		
	IX		VIII		VII		VI		V		IV		III		II		I		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
Vasidae																			
Vasum turbinellus	-	-	1	1	2	1	-	-	-	-	-	-	1	*	-	-	-	-	4
Volutidae																			
Voluta sp.	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Conidae																			
Conus marmoreus	-	-	3	2	1	1	4	2	2	1	-	-	-	-	-	-	-	-	10
Conus sp.	5	16	18	16	8	5	20	10	10	6	3	1	2	*	5	1	6	3	77
Architectonidae																			
Architectonia perspectiva	-	-	-	-	-	-	-	-	-	-	-	-	1	*	-	-	-	-	1
Siphonaridae																			
Siphonaria sp.	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
BIVALVIA (marine)																			
Arciidae																			
Arca sp.	1	3	1	1	-	-	1	*	-	-	-	-	1	*	-	-	-	-	4
Barbatia sp.	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Ostraeidae																			
Ostrea sp.	-	-	-	-	-	-	2	1	1	1	7	3	6	2	8	2	1	*	25
Chamidae																			
Chama sp.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Corbiculidae																			
Geloina sp.	-	-	3	2	2	1	-	-	6	4	3	1	7	2	2	*	-	-	23
Veneridae																			
Gafrarium tumidum	-	-	1	1	2	1	7	3	9	5	1	*	1	*	-	-	1	*	22
Cardidae																			
Cardium sp.	-	-	1	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2
Gariidae																			
Asaphis deflorata	1	3	-	-	-	-	-	-	-	-	1	*	-	-	-	-	-	-	2
Tridacnidae																			
Tridacna maxima	2	6	3	2	5	3	2	1	3	2	11	5	9	3	3	1	1	*	39
Tridacna gigas	-	-	-	-	1	1	-	-	-	-	-	-	1	*	-	-	-	-	2
Tridacna crocea	-	-	-	-	-	-	1	*	2	1	-	-	-	-	1	*	-	-	4
Hippopus hippopus	-	-	1	1	2	1	2	1	-	-	-	-	1	*	1	*	-	-	7
CEPHALOPODA																			
Nautilus pompilius	-	-	1	1	1	1	1	*	1	1	1	*	1	*	-	-	-	-	6
POLYPLACOPHORA																			
Chiton spp.	1	3	7	6	19	12	12	8	9	6	75	36	144	43	134	38	62	33	463
Total m.n.i.	32		116		161		207		163		211		333		349		189		1761
Species richness of each horizon	19		29		31		27		25		25		25		28		19		

* = <0.5%

Horizon	Total m.n.i.	Mid-lower littoral reef flat nos	%	Upper littoral raised reef nos	%	Sandy intertidal nos	%	Subtidal nos	%	Mangrove nos	%	Estuarine nos	%
IX	32	24	75	6	19	1	3	-	-	1	3	-	-
VIII	116	81	70	20	17	1	1	1	1	11	9	2	2
VII	161	129	80	20	12	-	-	1	1	6	4	5	3
VI	207	147	71	27	13	-	-	1	*	25	12	7	3
V	163	104	64	12	7	1	1	1	1	36	22	9	5
IV	211	176	83	19	9	1	*	1	*	13	6	1	*
III	333	238	71	78	23	-	-	2	1	14	4	1	*
II	349	262	75	79	23	-	-	1	*	5	1	2	1
I	189	143	75	44	24	-	-	-	-	1	*	1	*
Total	1761	-	-	-	-	-	-	-	-	-	-	-	-

* = <0.5%

Table 61 Bui Ceri Uato: molluscs, distribution of minimum number of individuals by habitat, percentage frequency

Horizon	Total no. of species	Mid-lower littoral reef flat nos	%	Upper littoral raised reef nos	%	Subtidal nos	%	Mangrove nos	%	Estuarine nos	%
IX	19	13	68	5	26	-	-	1	4	-	-
VIII	29	19	66	5	18	1	3	2	7	2	7
VII	31	22	71	4	13	1	3	2	6	2	6
VI	27	19	70	5	19	1	4	1	4	1	4
V	25	17	68	4	16	1	4	2	8	1	4
IV	25	15	62	6	23	1	4	2	8	1	4
III	26	16	62	6	23	1	4	2	8	1	4
II	28	18	66	6	21	1	3	2	7	1	3
I	19	13	68	4	21	-	-	1	5	1	5

Table 62 Bui Ceri Uato: molluscs, distribution of species by habitat, percentage frequency. Molluscs from the sandy intertidal habitat listed in Table 61 are, because of their rarity, grouped here within the mid-lower reef flat habitat

Table 60 shows that the most common species were *Haliotis varia*, *Trochus* spp., *Turbo* spp., *Nerita* spp., and chitons with fairly large numbers of *Conus* sp. and *Cypraea* spp.; reef flat species are more abundant than raised reef species throughout the site and in contrast to Lie Siri there seems to be no evidence of a change in the proportions of molluscs from these two habitats, but the samples are very small. None of the molluscs came from deep water beyond the reef edge with the exception of *Nautilus*, but that was probably collected after being washed on to the reef (Plate 31). Among the marine molluscs the low number of bivalves and the exclusively reef flat and raised reef species found at the site indicates that only the reef flat and upper littoral gastropods were regularly exploited. This is consistent with the lack of fish bones in the site and also confirms the evidence from Lie Siri.

Tidal mudflat mangrove molluscs comprise a small but consistent element in the site. There were two main species, *Terebralia* sp. and *Geloina* sp. and they were most abundant in the middle levels.

The small *Melania* sp. which was listed in an earlier publication of this data (Glover 1972a) as a freshwater species is probably more accurately listed as estuarine, as it is able to tolerate conditions of fluctuating salinity. It usually comprised less than 1% of the total number of individuals in any one horizon.

The shell remains from Bui Ceri Uato show a general similarity to those from Lie Siri and most of the comments made following the analysis of molluscs from that site can be applied to Bui Cero Uato and will not be repeated here.

VII EXCAVATIONS NEAR VENILALE: UAI BOBO 1

During a site survey in September 1967 two promising caves were found a few minutes walk above the *povoação* of Uai Bobo (*suco* Bada Ho'o) at about 600 m above sea level in the eastern scarp of Hatu Ariana mountain (Fig.4). These caves have been called Uai Bobo 1 (Plate 34) (TO1) and Uai Bobo 2 (TO2) since they do not appear to have any specific local names. The excavation in Uai Bobo 2 is described in Chapter VIII.

DESCRIPTION AND EXCAVATION

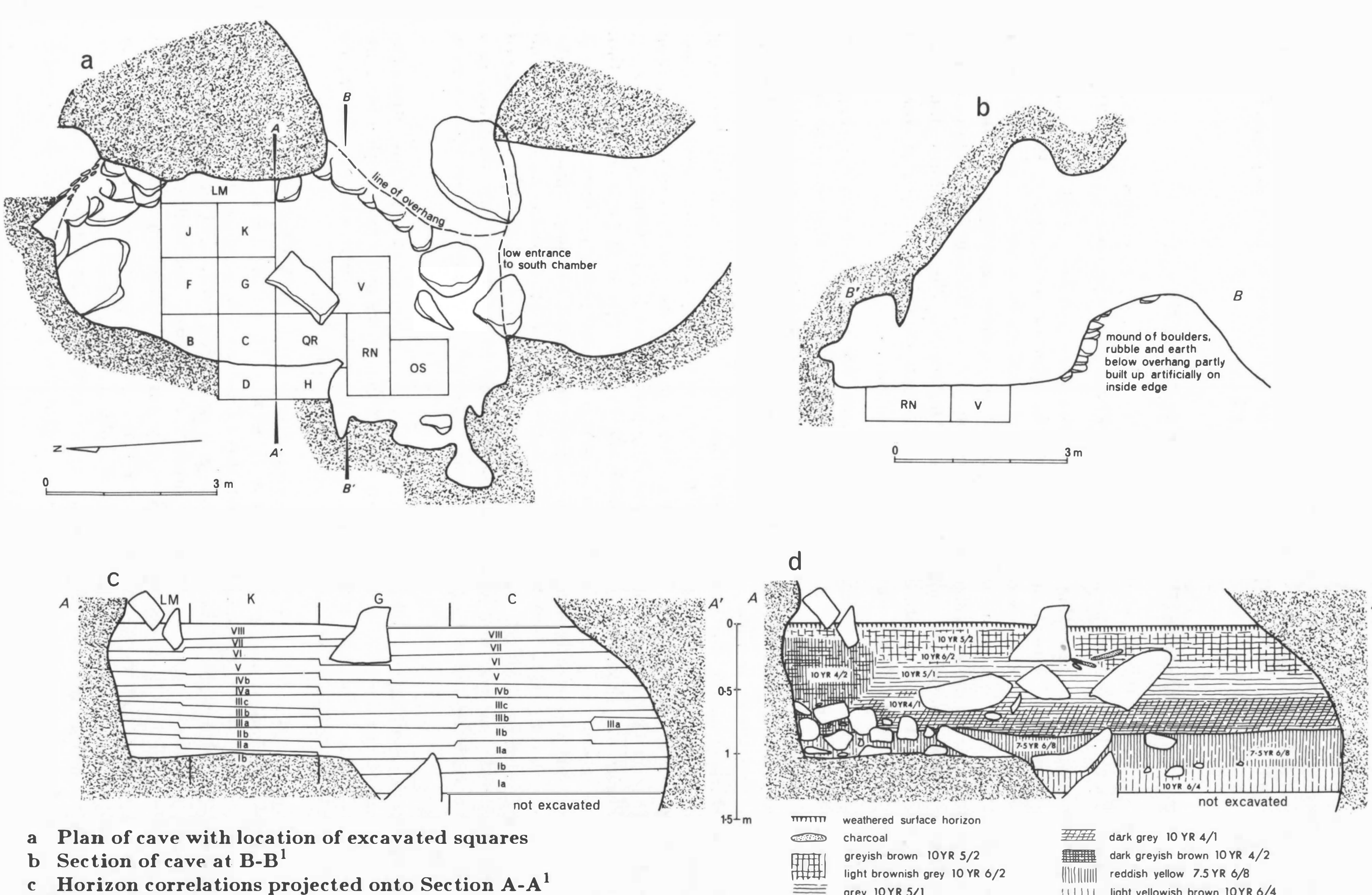
A small trial pit in Uai Bobo 1 yielded a promising quantity of pottery and flaked stone as well as part of a modern pressed metal crucifix at 35-40 cm below the surface (Plate 39).

Local informants told me that this and other nearby caves had been used occasionally by Timorese, Portuguese and Australian troops during the Japanese occupation of 1942-45. The cave is strategically situated overlooking the motor-track from Berecole to Uai Cana spring where a small Japanese contingent had been stationed. In another cave about 300 m south of Uai Bobo 1 we found an old cartridge case, a trouser button and fragments of a cheap edition of a Chinese historical novel, presumably remains of this period. No other information about the use of Uai Bobo 1 could be obtained although a hearth comprising a circle of stones and half-burnt sticks indicated that it was still in occasional use.

The cave (Fig.32a) had two chambers. The front one was well lit by two entrances both partially blocked by stone walls. A low squeeze at the south end of this chamber led to a larger one which was quite dark and which was neither planned nor excavated, although it might offer good prospects if the rubble blocking the entrance were removed. A grid was drawn up covering the entire floor area of the front chamber, with each m^2 labelled with a single letter starting at the northwest corner. But only 13 m^2 were excavated because of subsurface rocks in some areas (Plate 35), and the excavated units in some cases cut across the planned grid, e.g. LM, QR, RN, OS. The methods of excavation and recording have been outlined in Chapter IV. Figure 32d shows the stratigraphic section in Squares LM, K, G, C and D, and Figure 32c shows the way in which the various spits have been correlated into eight main horizons for the analysis of the faunal and artifactual remains. After excavation it could be seen that the stratigraphy dipped slightly from east to west, consequently the horizons have been stepped to take this into account. The excavation unit correlations for all the squares are listed in Table 63. The rock wall at the west side of Squares QR and C sloped outwards as the deposit was dug away. At about 50 cm below the surface, therefore, new squares, D and H, were laid out against the wall. The spit numbers in these squares were started at six.

Five main stratigraphic layers could be seen (Fig.32d), not always sharply defined. From the surface to about 10 cm there was a layer of loose goat dung, sticks and leaves, with a few corn cobs in a matrix of loose brown earth. Below this, to about 25 cm, there was a greyish-brown (Munsell 10 YR 5/2) deposit with occasional lenses of ash and charcoal.

From 25-45 cm there was a layer of lighter brownish-grey earth (10 YR 6/2) which turned to grey (10 YR 5/1), then to dark grey (10 YR 4/1) between 70 cm and 1.0 m, at which point there was a fairly abrupt change to a hard-packed reddish-brown to a yellowish-brown deposit (7.5 YR 6/8-10 YR 6/4) with little charcoal and increasing rocks and limestone rubble. Where the cave floor was exposed to heavy rainstorms at the south and southeastern sides, all visible stratification was lost and a hard crumbly dark greyish-brown soil (10 YR 4/2) developed. The maximum depth reached was 1.4 m in 13 spits, and rock was reached over about one half of the trench at the eastern side of the cave. Excavation at the west side of the cave was abandoned at 1.4 m as unproductive. The hard stony deposit contained very few artifacts, no charcoal, and the small rat bones could not be recovered without excessive breakage.



a Plan of cave with location of excavated squares
b Section of cave at B-B[1]
c Horizon correlations projected onto Section A-A[1]
d Soil stratification in Section A-A[1]

Fig.32 Uai Bobo 1: plan and sections through the cave

Plate 34 Uai Bobo 1: main entrance after clearing vegetation

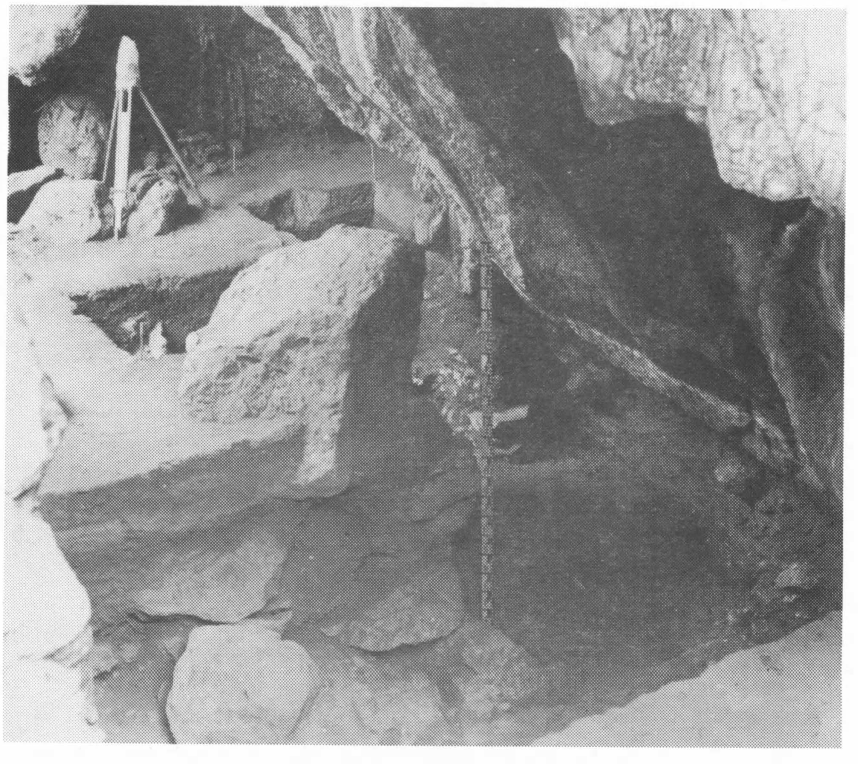


Plate 35 Uai Bobo 1: trench from northern end of cave at the end of excavation

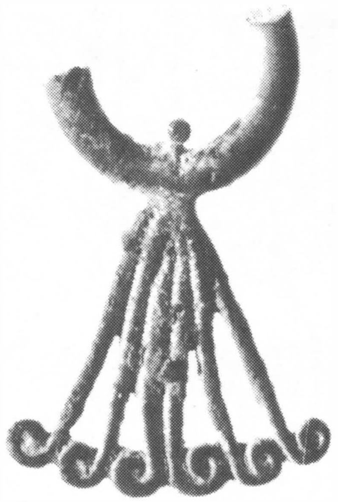


Plate 36 Uai Bobo 1: Horizon IIIc, copper ornament after cleaning. Missing section used for analysis

	Square												
Horizon	LM	J	F	B	K	G	C	D	QR	H	V	OS	RN
VIII	1	1	1	1	1	1	1	-	1	-	1	1,2	1
VII	2	2	2	2	2	2	2	-	2	-	2	3	-
VI	3	3	3	3	3	3	3	-	3	-	-	4	2
V	4	4	4	4	4	4	4	-	4	-	3	5,6	3
IVb	5	5	5	5	5	5	5	-	5	-	4	7	4
IVa	6	6	-	-	6	-	-	-	-	-	-	8	-
IIIc	7	7	6	6	7	6	6	6	6	6	5	9,10	5
IIIb	8	8	7	7	8	7	7	7	7	7	6	11	6
IIIa	9	9	-	-	9	-	-	8	8	8	-	-	-
IIb	10	10	8	8	10	8	8	9	9	9	-	-	-
IIa	11	11	9	9	11	9	9	10	10	10	-	-	-
Ib	12	12	-	-	12	10	10	11	11	11	-	-	-
Ia	-	-	-	-	-	11	11	12,13	-	-	-	-	-

Table 63 Uai Bobo 1: spit correlations

The horizons, numbered from top to bottom, correlate with the main stratigraphic layers as follows:

VIII	comprises the top brown soil;
VII	includes most of the greyish-brown layer (10 YR 5/2);
VI	mostly comprises the light brownish-grey layer (10 YR 6/2);
IV and V	are within the grey layer (10 YR 5/1);
IIIa, b and c	is within the dark grey layer (10 YR 4/1);
IIb	marks the transition from a dark grey layer; and
I and IIa	are within the basal reddish-brown to yellowish-brown layer (7.5 YR 6/8-10 YR 6/4).

The volume of each excavated unit was calculated and the figures were combined to give horizon volumes as shown in Table 64.

Since the volume of deposit represented by each horizon varies it is necessary to compensate for the variation when assessing changes in the density of cultural materials over time. To take this into account the quantity of flaked stone and pottery is expressed as the number per m^3 in the appropriate tables and charts. The number of objects is, of course, given as well. Because it is not possible to measure the accuracy of the volume figures, small apparent changes in density cannot be considered culturally significant. And the sample size must

Horizon	m^3
VIII	1.12
VII	0.78
VI	1.00
V	1.06
IVb	1.15
IVa	0.29
IIIc	1.17
IIIb	1.26
IIIa	0.43
IIb	0.86
IIa	0.87
Ib	0.62
Ia	0.29
Total	10.90

Table 64 Uai Bobo 1: horizon volumes

always be considered. In practice it has been found that where 40 or more objects occur within a single horizon consistent patterns of change in density, or proportional relationships, can be recognised. At the same time, differences in density of less than 10% have generally been disregarded as probably due to uneven sampling, and inaccuracies in measurement.

No structures or postholes were encountered during excavation, but it was clear that some disturbance had taken place. Mention was made of part of a modern crucifix found at 35-40 cm in the test pit which was just to the northwest of the large boulder in the middle of the cave floor. The figure from the crucifix (Plate 39a) was found in the surface dust in Square F. Eleven other modern objects were found, of which 10 were on or close to the surface, and one was in Spit 2. In addition three sherds of what appear to be fairly modern, green glazed, Chinese stoneware were found, all in Spit 1 of various squares, and it seems safe to assume that there has not been any really extensive modern disturbance at the site.

RADIOCARBON DATES AND CHRONOLOGY

The preservation of charcoal was good wherever the cave floor was protected from the weather, that is to say in Squares LM, K, J, G and F. Four samples were submitted to the Radiocarbon Dating Laboratory, ANU.

350 ± 60 BP	ANU-332	Square C(4), Horizon V
2190 ± 80 BP	ANU-237	Square D(6), Horizon IIIc
2450 ± 95 BP	ANU-326	Square K(8), Horizon IIIb
3470 ± 90 BP	ANU-414	Square K(9), Horizon IIIa

It was not possible to collect an adequate sample from either Horizons I or II. In Chapter IV I discuss how the C14 dates have been used to provide a chronological framework which can be used for interpreting changes recognised in the sequence of faunal and artifact remains, and Figure 48 illustrates the proposed chronology for the site.

I believe that ANU-332 had been contaminated by modern charcoal derived from the surface. At Uai Bobo 1, Horizons IVb and V contain all the sherds with incised and relief decoration and though few, they come from 4-7 separate vessels. All the sherds which can be fitted together belong to a single vessel in Horizon IVb so there is some evidence to show that they are in place. At Uai Bobo 2 and Lie Siri small quantities of very similar decorated pottery are found in horizons which are dated to 1500-3500 BP. At Bui Ceri Uato, this pottery cannot be directly dated but it occurs in the same relative place in the sequence. In Figure 49 the principal trends in the faunal and artifact sequences are shown and these are sufficiently consistent I believe, to warrant rejecting ANU-332 as a reliable guide to the age of Horizon V. In Figure 48 and Table 65 I have proposed that Horizons IV-V should cover the period from about 1400-2200 BP each plus or minus about 200 years.

Horizon	Horizon boundaries, range in years BP Minimum	Maximum	Rounded mid-point in years BP
VIII	500	800	? 650
VII	700	1000	? 850
VI	1200	1600	? 1400
V	1600	2000	? 1800
IVa,b	2000	2500	2200
IIIc	2300	3200	2600
IIIa,b	3500	4200	3800
IIa,b	5000	6000	? 5500
Ia,b	7500	9000	? 8200

Table 65 Uai Bobo 1: proposed chronology

The three dates for Horizon III form a consistent sequence which can be related, without too much strain, to dates for the introduction of pottery and domesticated animals at Uai Bobo 2 and Lie Siri. These events are not precisely contemporary at all sites, but I would not expect them to be, given the intermittent and relatively infrequent occupation of the caves. Thus on Table 65 I have dated Horizon IIIa and b where pottery and domesticated animals first appear, to about 2600-3800 BP, again plus or minus a few hundred years at either end. At Uai Bobo 2 and Lie Siri these cultural markers appear rather earlier, but the various horizon dates I have suggested have overlapping ranges.

In an earlier publication (Glover 1969:110) I said that I believed that 2190 ± 90 BP (ANU-237) for Horizon IIIc to be between 800-1000 years too young. Since then the results of ANU-326 and 414 have been received and the three dates form a convincing series, which is difficult to reject. ANU-326 and 414 were taken from adjacent spits in the same square, and ANU-237 from 15-20 cm higher and 2 m away. On this basis I believe ANU-237 and the other two dates should be accepted as reliable estimates of the antiquity of these horizons.

The presence of corn husks, peanut shells, and various modern objects on, or close to the surface of the deposit indicates that occupation of the site continued into recent times. Therefore, I have shown Horizon VIII, the top few centimetres of deposit, to relate to the last 600 or so years, although it probably contains a few sherds and flakes older than this.

The antiquity of Horizons I and II unfortunately depends on very general correlations with other sites. The sequence at Uai Bobo 1 is undoubtedly a little more compressed in the upper levels than at Uai Bobo 2 where a date of 3740 ± 90 BP was obtained from 1 m below the surface. Below Horizon III the compaction of the deposit and the very great concentration of small murid bones suggests that the base of Horizon I may be older than a direct depth/age comparison with Uai Bobo 2 would indicate; that is about 7000 BP. On Figure 48 and Table 65 I have indicated, rather tentatively, that the earliest occupation may go back to between 7500-9000 BP, and comparisons of artifact assemblages between sites are based on this.

DISTRIBUTION OF FLAKED STONE

A few flakes were visible on the surface and on the slope below the main entrance, but during excavation it was soon apparent that they were present in quantity only after the first three or four spits, whereas potsherds became less common below about 50 cm. Furthermore, the easily recognisable tool types were seldom found in the top few spits (Table 70). The stone used was flint distinguishable by colour rather than by texture or flaking properties. Most common was a glossy, chocolate brown variety with black, dark grey and cream, slightly less common. My workmen could not ascribe the variously coloured flints to different sources; it was all to be found, they said, in nearby stream-beds and occasionally in the fields on the slopes of the Seiçal River to the east. This agreed with my own impressions and, given the extremely widespread occurrence in that region of the Bobonaro scaly clay deposit containing large blocks of flint as well as other exotic rocks (Audley-Charles 1968:116-17), there seemed to be no immediate prospect of identifying the particular source of any of the flint.

In Figure 49 and Table 67 the density of waste flakes only, is shown as the number per m^3, and in Table 68 the numbers of waste flakes, cores and core trimming flakes, utilised flakes and artifacts with secondary working are listed.

Waste flakes were not measured, but in order to see if there was any regular change in size over time, such as found at Bui Ceri Uato (Table 42), the weight of waste for each horizon was divided by the number (Table 66). The increase in size in Horizon I is probably spurious, being the result of the small sample. Apart from this, no consistent or significant trend can be seen.

Because there are so few artifacts in Horizons VIII-VI, and Horizons II-I these have been grouped in Table 69 to provide larger samples for the comparison of the proportions of the five main classes of flaked stone.

These proportions are illustrated in Figure 50 where they are compared with assemblages from other sites.

Table 70 presents a typological breakdown of the worked and utilised stone tools and the groups listed there are discussed in the subsequent sections.

Horizon	Nos	Mean weight (gm)
VIII-VI	187	1.6
V	288	1.2
IV	1163	1.4
III	4273	1.2
II	997	1.8
I	43	3.8
Total nos	6951	-

Table 66
Uai Bobo 1: waste flake mean weights

Horizon	Nos	Nos per m^3	% per m^3
VIII	45	40	1
VII	41	53	1
VI	101	101	1
V	288	272	3
IVb	764	664	8
IVa	399	1376	17
IIIc	2073	1772	21
IIIb	1533	1217	15
IIIa	667	1551	18
IIb	698	812	10
IIa	299	344	4
Ia,b	43	47	1
Total	6951	8249	100

Table 67 Uai Bobo 1: waste flake density

Horizon	Waste flakes Nos	%	Cores and trimming flakes Nos	%	Utilised flakes Nos	%	Flakes with gloss Nos	%	Secondary working Nos	%	Total Nos
VIII	45	83	1	2	-	-	-	-	8	15	54
VII	41	77	1	2	5	10	-	-	6	11	53
VI	101	92	2	2	6	5	-	-	1	1	110
V	288	85	4	1	22	7	8	2	16	5	338
IVb	764	87	8	1	67	7	13	1	30	4	882
IVa	399	89	10	2	13	3	8	1	20	5	450
IIIc	2073	89	20	1	139	6	30	1	70	3	2332
IIIb	1533	89	19	1	87	5	28	2	54	3	1721
IIIa	667	89	12	1	38	5	12	2	23	3	752
IIb	698	88	5	1	48	6	9	1	31	4	791
IIa	299	94	5	1	10	3	4	1	2	1	320
Ib	39	92	1	3	2	5	-	-	-	-	42
Ia	4	37	-	-	4	36	-	-	3	27	11
Total	6951	89	88	1	441	6	112	1	264	3	7856

Table 68 Uai Bobo 1: numbers and percentages of the main classes of flaked stone in each horizon

Horizon	Cores and trimming flakes Nos	%	Utilised flakes Nos	%	Flakes with gloss Nos	%	Secondary working Nos	%	Total nos
VIII-VI	4	13	11	37	-	-	15	50	30
V	4	8	22	44	8	16	16	32	50
IVb	8	7	67	57	13	11	30	25	118
IVa	10	20	13	25	8	16	20	39	51
IIIc	20	8	139	53	30	12	70	27	259
IIIb	19	10	87	46	28	15	54	29	188
IIIa	12	14	38	45	12	14	23	27	85
IIb	5	5	48	52	9	10	31	33	93
IIa-I	6	19	16	52	4	13	5	16	31
Total	88	9	441	49	112	12	264	30	905

Table 69 Uai Bobo 1: numbers and percentages of worked and utilised flaked stone

Horizon	Cores	Trimming flakes	Utilised	Gloss	Tanged points	Side scrapers	Thumbnail scrapers	Nosed scrapers	Adzes	Burins	Backed blades	Broken edges	Miscel-laneous	Total nos
VIII	1	-	-	-	-	2	2	-	-	-	-	-	4	9
VII	1	-	5	-	1	-	-	-	-	-	-	1	4	12
VI	1	1	6	-	-	-	1	-	-	-	-	-	-	9
V	4	-	22	8	1	6	-	-	-	-	-	-	9	50
IVb	8	-	67	13	2	15	-	-	-	2	-	-	11	118
IVa	5	5	13	8	3	9	-	1	-	-	1	1	5	51
IIIc	15	5	139	30	3	43	-	-	1	-	1	6	16	259
IIIb	19	-	87	28	-	40	-	-	-	-	-	5	9	188
IIIa	12	-	38	12	-	19	-	-	-	-	-	1	3	85
IIb	5	-	48	9	-	23	-	-	-	-	-	2	6	93
IIa	5	-	10	4	-	1	-	-	-	-	-	1	-	21
Ib	1	-	2	-	-	-	-	-	-	-	-	-	-	3
Ia	-	-	4	-	-	3	-	-	-	-	-	-	-	7
Total nos	77	11	441	112	10	161	3	1	1	2	2	17	67	905

Table 70 Uai Bobo 1: typological breakdown of worked and utilised flaked stone

Analysis of cores (Tables 71-74)

In most cases cores were not difficult to differentiate from retouched stone tools on account of the larger negative flake scars which covered much of the artifact surfaces; also edge-crushing was generally limited to a single point behind each flake scar and most cores had two or more platforms on different planes and at varying angles to each other. It was possible to put all but a very few cores into one of three types:

1. Cores with two or more platforms on different planes and at varying angles to each other. These cores are generally squarish in proportions (Fig.33a-e). A few cores of the same appearance but with one striking platform only have been included in this category. Among these cores were a few, clearly designed for producing blades with one or two longitudinal ridges. These were noted, but not recorded as a separate type.

2. Disc cores with flakes struck off the same edge but off alternate surfaces leaving a characteristic scalloped margin (Fig.33f).

3. Those with two opposed platforms on the same face and close together (Fig.33g) which appear to be intended to produce short, squarish flakes. These cores tend to be rather long in proportion to breadth and thickness, and are not dissimilar to adze flakes.

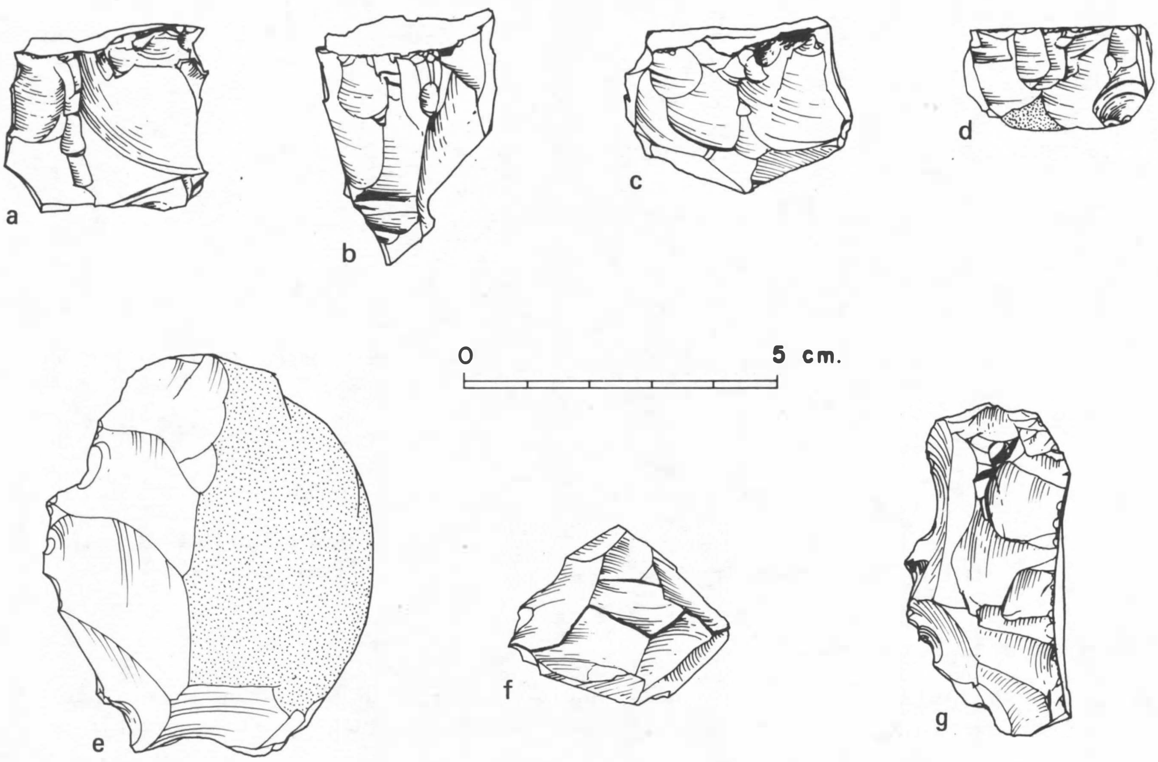


Fig.33 Uai Bobo 1: flake cores

a 1594, core type 1 (one platform), Square LM(7), Horizon IIIc
b 2162, core type 1 (one platform), Square H(7), Horizon IIIb
c 1563, core type 1 (two platforms), Square OS(11), Horizon IIIb
d 1121, core type 1 (one platform), Square OS(4), Horizon VI
e 2281, core type 1 (one platform), Square H(7), Horizon IIIb
f 1404, core type 2 (disc core), Square J(6), Horizon IVa
g 1995, core type 3 (opposed platforms), Square D(6), Horizon IIIc

The number of striking platforms on each core was counted and the maximum diameter was measured to see if there was a uniform size at which cores were discarded as being too small to work further. This was found to be so to a surprising extent.

A *t* test between mean core diameters from Horizons IV-VIII and Horizons I-IIIa, showed that this difference was not significant at the 5% probability level.

The majority of cores throughout the site have two or three striking platforms.

The small number of waste flakes and cores considering the 8000 or so years of occupation suggests that the manufacture of flaked stone tools was never an important activity at the site. Table 74 shows that the ratio between cores and waste flakes, ranges from 1:54 to 1:138. The variation between squares in the same horizon is sometimes as great as this, but it does appear that tool preparation was rather more important in Horizon IIIc, that is to say about 2000-2500 years ago.

Horizon	Type 1	2	3	Nos	Blade cores	Trimming flakes
VIII	1	-	-	1	-	-
VII	1	-	-	1	1	-
VI	1	-	-	1	-	-
V	4	-	-	4	1	1
IVb	6	-	2	8	-	-
IVa	3	1	1	5	1	-
IIIc	13	-	2	15	-	5
IIIb	16	2	1	19	2	5
IIIa	12	-	-	12	1	-
IIb	5	-	-	5	-	-
IIa	4	1	-	5	-	-
Ib	1	-	-	1	-	-
Ia	-	-	-	-	-	-
Total	67	4	6	77	6	11

Table 71 Uai Bobo 1: distribution of cores

Horizon	Nos	Diameter $\bar{x}$	s
VIII-IV	20	35.4 ±	6.5
IIIc-b	34	38.7 ±	11.8
IIIa-I	23	39.9 ±	9.7
Total	77	-	

Table 72 Uai Bobo 1: core dimensions, measurements in mm

Horizon	Cores	Waste flakes	Ratio
VIII-V	7	475	1:68
IV	13	1163	1:89
IIIc	15	2073	1:138
IIIb	19	1533	1:81
IIIa	12	667	1:56
II-I	11	1040	1:95
Total	77	6951	1:90

Table 73 Uai Bobo 1: number of striking platforms on cores

Platforms	Cores
1	17
2	32
3	24
4	3
5	0
6	1
Total cores	77

Table 74 Uai Bobo 1: ratio of cores to waste flakes

Analysis of utilised flakes

Two forms of utilisation were recognised, flakes with areas of high gloss on and near the edges, (Fig.34f-i), and those with regular lengths of flake scars which are too small to be the result of deliberate edge modification prior to use. A total of 553 utilised flakes were recovered; the numbers and proportions in various horizons are given in Tables 68 and 69. Of the 441 without gloss, 307 or 70% were complete flakes and their measurements are given below.

Looking at Table 75 it might appear that the utilised flakes become smaller towards the top of the deposit. However, a *t* test between mean flake lengths from Horizons VII-V and Horizons IIIa-I, and between Horizons VII-V and Horizons IVa-b showed that none of these differences were significant at the 5% probability level, and the variations could be due to chance alone.

Horizon	Length $\bar{x}$	s	Breadth $\bar{x}$	s	L:B ratio >2:1 %	Nos
VII-V	31.5 ±	11.5	18.5 ±	5.6	37	30
IVa,b	36.1 ±	13.7	23.1 ±	7.5	25	72
IIIc	34.7 ±	9.9	23.8 ±	8.6	18	94
IIIb	33.1 ±	8.8	23.6 ±	7.7	26	58
IIIa-I	34.6 ±	9.7	23.6 ±	7.7	21	53
Total	-		-		22	307

Table 75 Uai Bobo 1: size and proportions of simple utilised flakes, measurements in mm

The number of blade flakes with one or two longitudinal ridges was also recorded and agreed well with the number of flakes with length/breadth ratios of 2:1 or greater, although they were not always the same flakes.

One hundred and twelve flakes were found with short lengths of highly polished or glossy edges (Fig.34f-i), which we can recognise as phytolith polish (Kamminga 1979). The mean dimensions of these flakes are given in Table 76.

The flakes with utilisation gloss are only a little bigger than the other utilised flakes, suggesting that there was not much difference in the scale of the work performed by them. The variation in the extent of the gloss on these flakes ranges from 3-24 mm. Ninety seven out of the 112 flakes have gloss on both dorsal and bulbar surfaces of the cutting edge, but the larger area is always on the ventral surface.

Only 7% of the flakes with gloss are also retouched which indicates a different function for the two sorts of tool. I suggest that these small flakes have been used for cutting silica-rich materials such as rattan and palm leaf; unfortunately, it has not been possible to verify this either by examination of sectioned surfaces, which was attempted, or by experiments.

Horizon	Length $\bar{x}$	s	Breadth $\bar{x}$	s	Glossy edge length $\bar{x}$	s	Nos
V-IV	46.6 ±	16.2	26.0 ±	9.9	9.3 ±	5.0	13
IIIc	41.5 ±	11.8	24.3 ±	7.2	8.6 ±	4.0	23
IIIb	39.3 ±	9.6	25.3 ±	7.9	7.4 ±	2.8	21
IIIa-II	43.0 ±	3.8	24.0 ±	5.6	7.1 ±	3.5	22
Total nos	-		-		-		79

Table 76 Uai Bobo 1: flakes with gloss utilisation, only complete flakes, measurements in mm

Tanged points and blades (Fig.35a-j)

Although rare in all assemblages in Timor, these are highly distinctive implements which, together with flaked adzes, are the only common stone artifacts which appear to have been shaped to a predetermined size and form before use.

Timor points have varying degrees of pointedness and some are, indeed, fairly blunt, while others have what look to be utilisation scars along the margins of the blade. However, it seems easier to regard them as projectile points with perhaps occasional other uses. For instance, I have seen a Timorese use a hafted metal spear blade to cut, split and scrape bamboo in order to make meat spits. Many points are battered on the ends or broken below the tip and it does look as if the tip was the main working edge.

The distribution of these tools in the site is given in Table 70 and measured attributes of all the tanged points and blades from my excavations and from Nikiniki 1 are recorded in Glover 1972a.

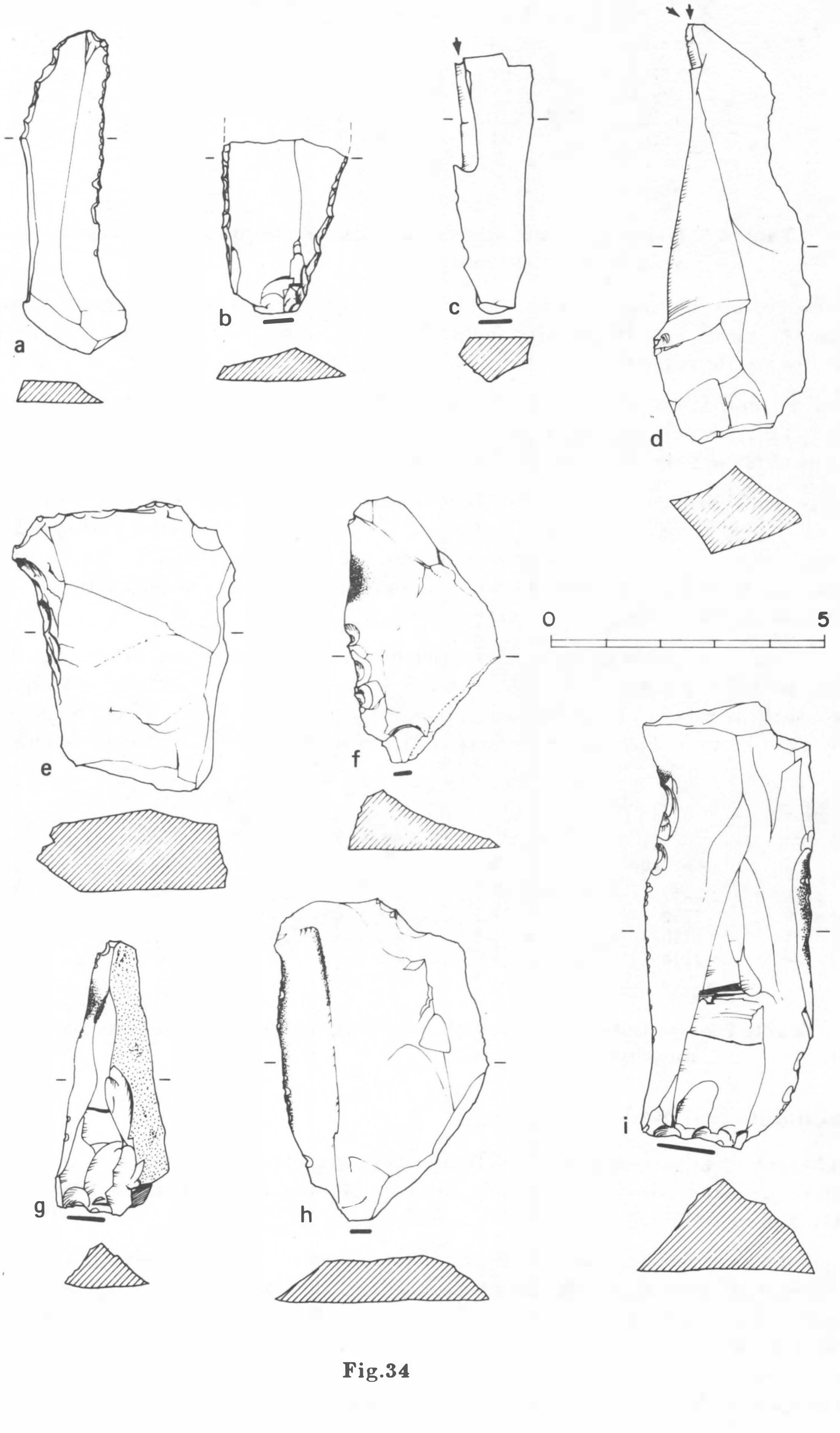


Fig.34

Fig.34 Uai Bobo 1: flaked stone tools

a 1377 blade, backed on part of left margin, utilised on right, Square LM(6) , Horizon IVa
b 1669, broken butt end of blade, backed on both margins, Square F(6), Horizon IIIc
c 1533, single blow burin made on a broken blade, Square QR(5), Horizon IVb
d 1531 double blow burin made on a broken scraper, Square QR(5), Horizon IVb
e 1341, flaked adze with bifacial working on left and top margins, Square OS(10), Horizon IIIc
f 2200, flake with steep working on lower left margin and silica gloss above, Square H(8), Horizon IIIa
g 1871, blade with silica gloss on left margin, Square K(7), Horizon IIIc
h 1682, flake with silica gloss on left margin and on central ridge, Square F(6), Horizon IIIc
i 1373, blade with silica gloss on both margins, Square LM(6), Horizon IVa

Bulbar face is uppermost for burins (c and d), other artifacts are shown bulbar face down and butt end towards the bottom of the page

Despite the small number of these tools so far recovered from sites in Timor, it is possible to see three variant forms which can be differentiated by shape, and proportions of the blade and tip. These I have provisionally called subtypes, although the distinctions may not be of much value when larger numbers are available.

Subtype 1	tang worked back, forming distinct shoulders, the blade is triangular in plan;
Subtype 2	blade oval or heart-shaped in plan, broader in proportion to length, less pronounced tang; and
Subtype 3	point is transverse or oblique, but otherwise the same as Subtype 1.

The artifacts are described briefly below.

Figure 35a: the broken end, almost certainly of a tanged point or blade. Since the others are confined to Horizons V-IIIc it is possible that this artifact has moved up in the deposit through past disturbance.

Figure 35b: All the characteristic features of Timor or Maubesi points (Verhoeven 1959) are shown in this artifact; a steep blunting retouch from the bulbar face only at the proximal end of both margins to form the tang, a triangular shaped blade with no secondary working past the shoulders, and the striking platform still visible in the centre of the tang, which comprises 40% of the length of the complete tool.

Figure 35c: the tip is broken and the tang is thick and worked from both bulbar and dorsal faces. The left margin is again steeply worked from both faces so that it resembles a backed microlith. Blunting retouch on small blades is rare in Timorese stone assemblages and it cannot be seen as marking the presence of the microlithic backed blade tradition in Timor.

Figure 35d: the tang is rather longer and more pointed than is usual, the bulb has been removed by secondary working which extends along the right margin to the tip.

Figure 35e a blade with a tang worked on both dorsal and ventral faces. It has no point and may be an unfinished implement, or an elongated form with a transverse cutting edge.

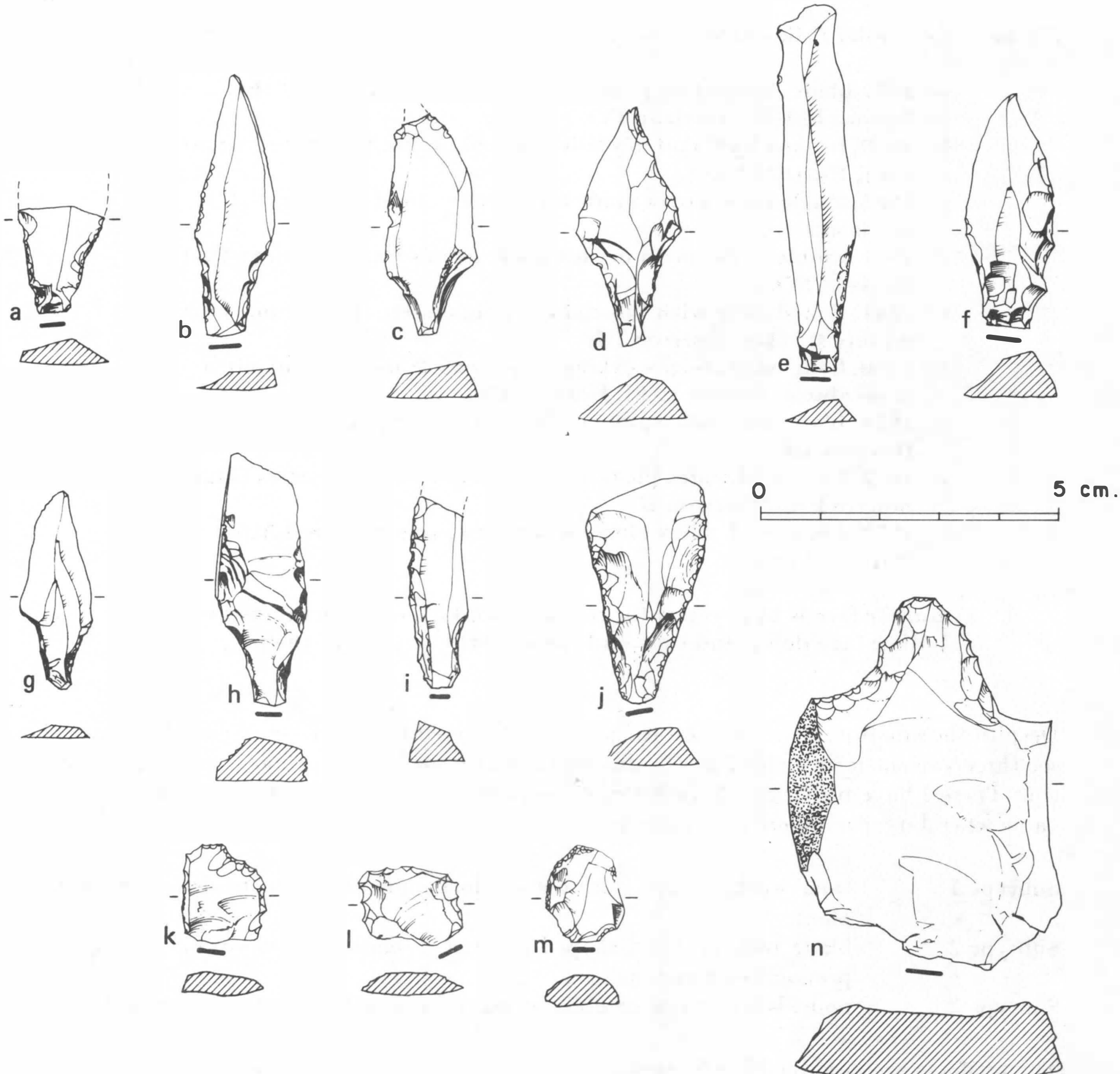


Fig.35 Uai Bobo 1: flaked stone tools

a 1075, broken butt end of tanged point, Square LM(2), Horizon VII
b 1278, tanged point, Subtype 1, Square K(4), Horizon V
c 1523, tanged point, Subtype 1, Square C(5), Horizon IVb
d 1467, tanged point, Subtype 1, Square B(5), Horizon IVb
e 1371, blade with bifacial working at butt end, Square LM(6), Horizon IVa
f 1491, tanged point, Subtype 1, Square K(6), Horizon IVa
g 1396, tanged point, Subtype 1, Square J(6), Horizon IVa
h 1621, tanged point, Subtype 3, Square J(7), Horizon IIIc
i 1335, tanged point, broken and steeply worked on left margin, Square OS(10), Horizon IIIc
j 1698, tanged point, Subtype 3, Square F(6), Horizon IIIc
k 1024, thumbnail scraper, Square K(1), Horizon VIII
l 1041, thumbnail scraper, Square V(1), Horizon VIII
m 1165, thumbnail scraper, Square G(3), Horizon VII
n 1372, nosed scraper, Square LM(6), Horizon IVa

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

Figure 35f: secondary working along two thirds of the right margin from butt, but none at the tip.

Figure 35g: only 2.5 mm thick x 12.2 mm broad, this is the only point which is small enough to be considered as a possible blow-pipe point.

Figure 35h: square in section and with an oblique point and abrupt trimming on the right margin; together with 1698 and 1371 this tool belongs to Subtype 3 - transverse points.

Comparing these artifacts with the tanged points from Nikiniki 1 in western Timor (Glover 1972c) the similarities are worth noting despite the small size of both samples.

		Uai Bobo 1	Nikiniki 1
Subtype 1		5	12
Subtype 2		0	3
Subtype 3		3	0
Total length	$\bar{x}$	43.5 mm	43.8 mm
Blade length	$\bar{x}$	26.0 mm	28.7 mm
Tang length	$\bar{x}$	16.8 mm	15.0 mm
Tang width	$\bar{x}$	5.1 mm	7.1 mm
Tang thickness	$\bar{x}$	4.7 mm	5.7 mm
Unifacial working		6	13
Bifacial working		4	2

Unfortunately the points found by Verhoeven (1959) in his excavations in West Timor have not been published in enough detail to make comparisons possible with the artifacts from Nikiniki and Uai Bobo 1.

Side scrapers (Figs 36-38)

The main distinguishing characteristics and the methods of analysis for this class of tool are outlined in Chapter IV. It was difficult to arrange scrapers into subgroups in any consistent or useful way, except by taking one or two attributes independently. Thus it was possible to separate those with one edge, from those with two or more, and those with notched step-flaked margins, from those with convex or straight edges. But when sorting the artifacts, no correlations could be found between size, convexity, the number of edges and so on. It seemed better to regard these tools as belonging to a single type, with the variations due to use rather than to initial manufacture. The distributions of various attributes over time were examined to see if there were progressive changes in the values for individual attributes. Horizons were grouped in various ways to test for the differences between sites and over time, and attribute correlations were produced. It was thought that if no marked changes over time could be recognised, this would lend support to the hypothesis that the tools did belong to both a single typological and functional class. Furthermore, consistency in both the form and proportions of these tools over a long period at the site would be consistent with a hypothesis that there was no marked change in the nature of activities taking place in the cave despite the probable introduction of agriculture to the area during the period of occupation.

Side scrapers comprised by far the largest class of retouched artifacts in the site (Table 70), occurring from the base of Horizon I to the surface. To obtain large enough samples for this analysis, some of the horizons have been grouped to give four sequential assemblages of side scrapers (Table 77), which are compared one against the other (Table 78) to see whether there are significant changes over time in the values for the attributes listed in Chapter IV. In addition to these attributes, ratios were calculated for $\frac{\text{breadth}}{\text{length}}$ and $\frac{\text{thickness}}{\text{breadth}}$ and these have been treated as independent variables. Many of the artifacts are broken, reducing the number on which all attributes could be recorded. But some attributes could be measured on many of the broken scrapers. Edge-height and edge-angles (Table 79) refer to the principal working

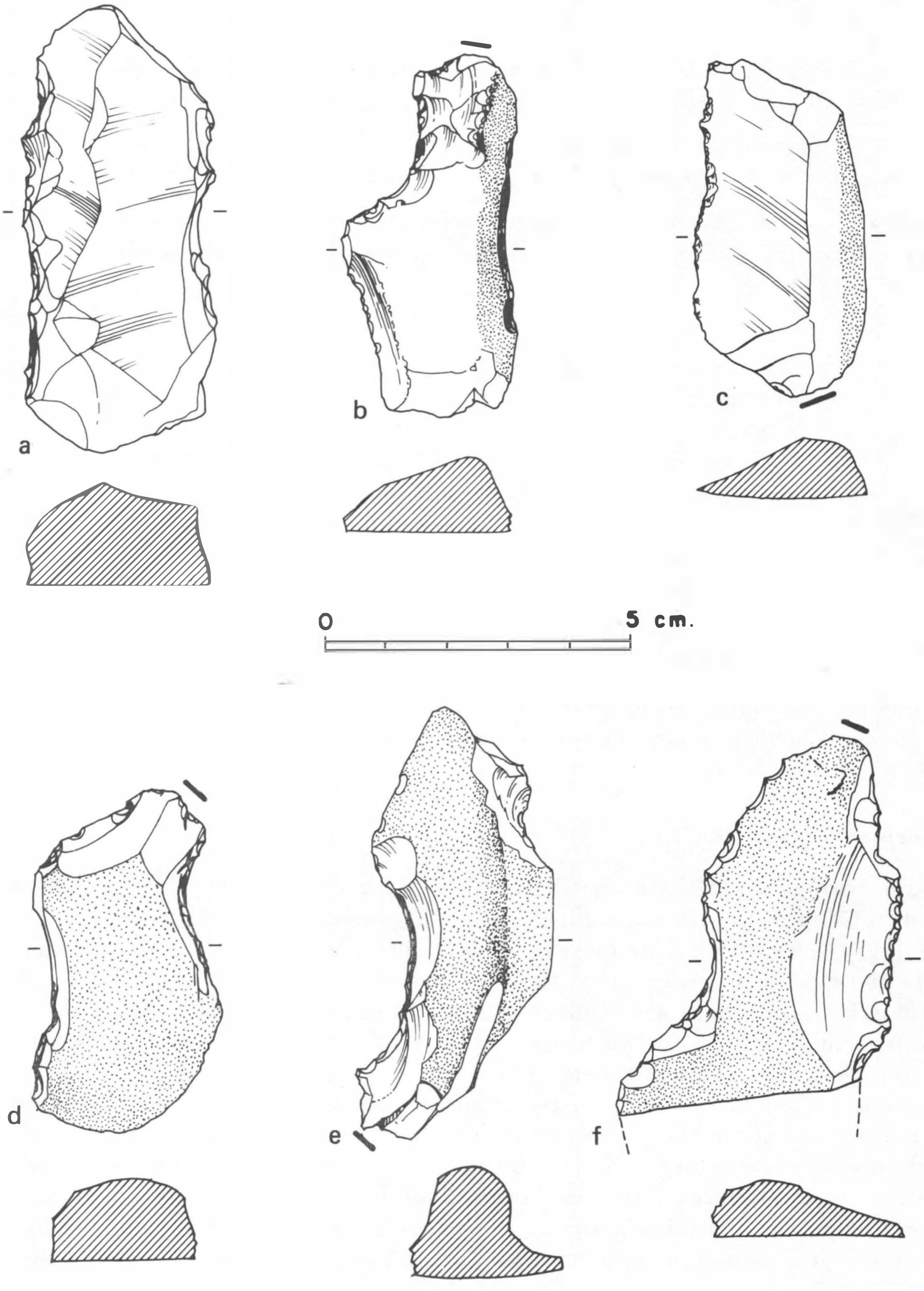


Fig.36 Uai Bobo 1: flaked stone tools

a 1275, side scraper, both margins worked, Square K(4), Horizon V
b 1406, side scraper, both margins worked, Square J(6), Horizon IVa
c 1434, side scraper, early stage of use with a little working on one margin only, Square F(5), Horizon IVb
d 1439, side scraper, both margins worked, Square F(5), Horizon IVb
e 1462, side scraper, both margins worked, Square B(5), Horizon IVb
f 1376, side scraper, both margins broken, Square LM(6), Horizon IVa

All artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

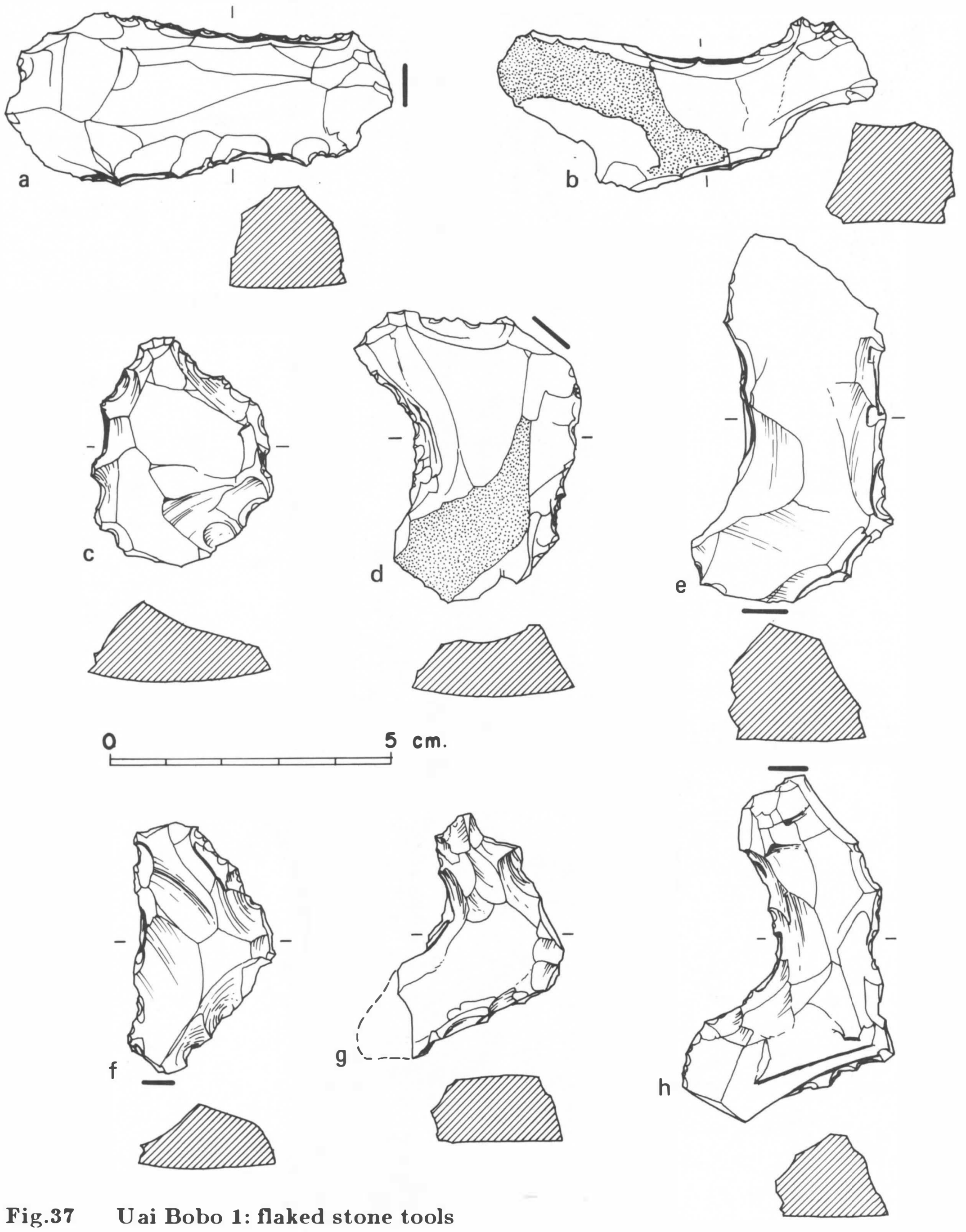


Fig.37 Uai Bobo 1: flaked stone tools

a 1556, side scraper, two worked edges, Square V(5), Horizon IIIc
b 1593, side scraper, two worked edges, Square LM(7), Horizon IIIc
c 2153, round scraper, Square H(7), Horizon IIIb
d 2103, side scraper, three worked edges, Square QR(7), Horizon IIIb
e 1899, side scraper, two worked edges, Square G(6), Horizon IIIc
f 2043, side scraper, three worked edges, Square D(8), Horizon IIIa
g 2037, side scraper, three worked edges, broken, Square QR(7), Horizon IIIb
h 1574, side scraper, three worked edges, Square RN(6), Horizon IIIb

All artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

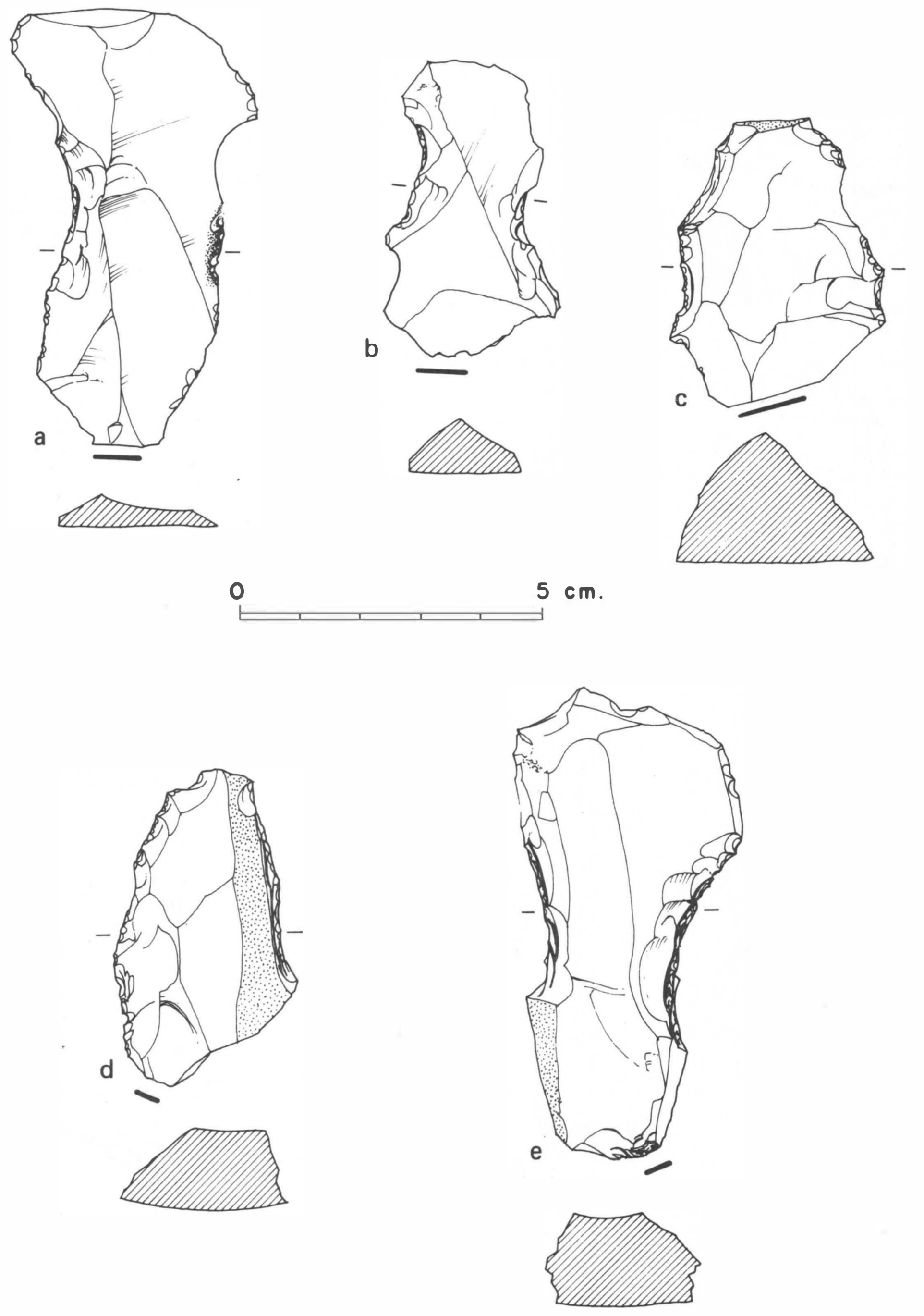


Fig.38 Uai Bobo 1: scrapers

a 2303, side scraper, one worked edge and with silica gloss opposite, Square F(8), Horizon IIb
b 2423, side scraper, two worked edges, Square C(8), Horizon IIb
c 2321, side scraper, two worked edges, Square B(8), Horizon IIb
d 2595, side scraper, two worked edges, Square D(13), Horizon Ia
e 2246, side scraper, two worked edges, Square D(9), Horizon IIb

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

Assemblage	Horizon	No. of side scrapers	% of secondarily worked artifacts
1	VIII-IV	32	81
2	IIIc	43	70
3	IIIb	40	54
4	IIIa-I	46	59
Total nos	-	161	-

Table 77 Uai Bobo 1: side scrapers grouped for attribute analysis

Assem-blage	Length			Breadth			Thickness			Weight		
	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos
1	54.7	18.0	18	28.6	8.2	18	13.1	6.3	31	28.9	40.7	20
2	52.3	11.8	20	32.8	9.2	18	13.7	5.7	41	36.7	32.6	18
3	52.2	14.9	20	30.6	6.6	21	14.4	5.2	36	30.0	28.4	21
4	54.4	10.9	25	30.6	7.8	29	12.2	4.1	41	26.4	22.4	24

Table 78 Uai Bobo 1: side scraper dimensions; linear measurements (mm), weight (gm)

Assem-blage	$\frac{B}{L}$ ratio*			$\frac{T}{B}$ ratio			Edge-height			Edge-angle		
	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos
1	5.4	1.5	18	0.5	0.5	17	7.1	4.4	32	75^{o}	20	32
2	6.4	2.0	18	0.3	0.5	18	5.8	2.8	41	82^{o}	17	42
3	6.3	1.9	20	0.4	0.5	20	6.1	2.6	36	83^{o}	16	38
4	6.1	2.4	25	0.3	0.5	29	6.2	3.0	45	80^{o}	15	45

* $\frac{B}{L}$ ratio has been multiplied by 10 for computing purposes

Table 79 Uai Bobo 1: side scrapers, proportions and edge attributes (continuous)

	Greatest difference between assemblages	Value for Student's *t*	Degree of freedom	Difference significant at probability levels of 5%, 1% and 0.1%
Length	1:2	0.491	36	not significant
Breadth	1:2	1.446	34	not significant
Thickness	3:4	1.920	75	not significant
$\frac{B}{L}$ ratio	1:2	1.697	34	not significant
Edge-height	1:2	1.536	71	not significant
Edge-angle	1:3	1.859	68	not significant

Table 80 Uai Bobo 1: significance of side scraper attribute mean differences

Assem-blages	No. of edges on each scraper 1 %	2 %	3 %	No. of scrapers	Edge-shape Concave %	Straight %	Convex %	No. of edges
1	63	27	-	32	50	34	16	44
2	70	30	-	43	64	16	20	56
3	68	29	3	40	43	33	24	54
4	61	28	11	46	52	30	18	69

Table 81 Uai Bobo 1: side scraper edges, discrete attributes

edge only. Second and third edges were too few to justify separate analysis. The length of working edge has been omitted because it appeared to be dependent on the total length of the artifact.

The differences between attribute means for some of the variables were tested by calculating the values for Student's *t* (Simpson *et al.* 1960:176) and the significance of these differences is summarised in Table 80. Weight and $\frac{T}{B}$ ratio were too variable within each assemblage to warrant testing the significance of differences between assemblages.

Some of the non-parametric tests such as the Kolmogorov-Smirnov or Mann-Whitney test (Siegel 1956) would show a few more small differences between the assemblages which are not revealed by the *t* test, since they are more sensitive for small samples and skewed distributions such as these. But the analysis demonstrates that the main dimensions, proportions, and edge characteristics of side scrapers (Table 81), as with cores and utilised flakes, remained remarkably constant over time. Comparisons between the assemblages from Uai Bobo 1 and from Uai Bobo 2 are made in Chapter VII and between the inland and coastal sites, in Chapter IX.

The profile shapes and numbers of scraper edges were recorded as set out earlier and the results are summarised in Table 80.

Correlations between all combinations of attributes were not calculated for the scrapers from Uai Bobo 1 separately because of the relatively small samples. Data from Uai Bobo 1 and Uai Bobo 2 were combined, and attributes correlated within each of four larger sequential assemblages. These attribute correlations are presented in Chapter VIII.

Other retouched flaked stone tools (Figs 34 and 35)

There are a small number of tools which are worked in a careful and regular way but which do not fit into any of the categories already mentioned.

Figure 34a: a partially backed blade with fine utilisation scars on the opposite margin. The working is similar to that on the tang of a tanged point, although it is doubtful if this was ever intended to be made into one. Another possible backed blade (1669) occurred in Horizon IIIc; in this case the broken butt end of a blade is abruptly retouched from the bulbar face on both margins.

Figure 34c-d: these two artifacts are, in the strict technical sense, burins (Burkitt 1933:62), although, given their rarity in the industry and the absence of worked bone in the deposits, there must be some doubt whether they ever actually functioned as such. On 1531 the 'beak' makes an angle of about 40° and is formed by three blows. On 1533 the angle is nearly 80° and is formed by a single vertical blow. Both implements also have steeply retouched scraper margins and have broken, presumably in use before being converted to burins.

Figure 35k-m: three small flakes with fine unifacial invasive working round most of the margins. They are close to what, in Australian and South African microlithic industries, are called 'thumbnail' scrapers (McCarthy 1967:235-37, Fig.25; Clark 1959:Fig.38) and this term is used for want of a better one.

Figure 35n: a carefully made nosed scraper made on the distal end of a broad flake. The notch to the right of the nose does not have any secondary working, which suggests that the finely worked 'nose' was the main functional edge.

In all horizons there are also a few artifacts with occasional small worked edges irregularly distributed around the margins. These have merely been counted and the numbers are given in Table 70. There are also a few broken edges of worked tools which are also listed in Table 70.

ANALYSIS OF POTTERY

Distribution of pottery

Sherd count rather than sherd weight has been used to measure the frequency of pottery over time (Chapter IV), although it is realised that slightly different relative figures would be obtained if either sherd weight or surface area were used. Table 82 gives the number and density of sherds in each horizon, and Figure 49 shows the proportional distribution of pottery over time compared with that of flaked stone and with the distribution of both large and small murids.

The presence of some modern objects, and three glazed Chinese sherds in Horizons VIII-VII suggests that occupation of the cave has continued, although not necessarily uninterruptedly, until the present day. Pottery first appears in Horizon IIIa which is dated to between 2600-3800 years ago (Table 65). It is slightly later than I have suggested at Lie Siri and Uai Bobo 2, but the difference is not so great as to affect the correlations between the sites which are summarised in Chapter IX.

As in all sites, the bulk of the pottery comprised plain body sherds from simple, restricted vessels with round bases and everted rims. One vessel from Horizon V (Plate 37l) has a more complex shape, with a double neck, but not enough can be reconstructed to be certain about the shape of the lower part of the body. A few of these vessels had angular shoulders. There is at least one shallow dish or plate with a ring base of which two sherds were found (4852 and 4932), one of each in Horizons VII and V. It is not certain that they are from the same vessel, but it seems probable.

There are possibly eight small bowls, about 12-14 cm in diameter, with simple direct rims, of which one, from Horizon III, has a fine, burnished, red slipped surface. Table 83 gives the distribution of various sherd categories.

Horizon	No. of sherds	No. per m³	% per m³
VIII	1650	1477	26
VII	933	1190	21
VI	867	871	15
V	1069	1011	18
IVb	559	487	8
IVa	124	432	7
IIIc	209	178	3
IIIb	48	38	1
IIIa	17	40	1
IIa,b	-	-	-
Ia,b	-	-	-
Total	5476	5724	100

Table 82 Uai Bobo 1: numbers and density of pottery

Horizon	Plain body sherds	Burnished body sherds	Incised, impressed and relief decoration	Painted	Angular shoulders	Rims	Ring bases	Nos
VIII	1607	2	-	3	2	36	-	1650
VII	907	2	-	-	2	21	1	933
VI	841	7	-	-	-	19	-	867
V	1006	38	8	-	1	15	1	1069
IVb	486	42	6	-	3	22	-	559
IVa	108	10	-	-	2	4	-	124
IIIc	183	16	-	-	2	8	-	209
IIIb	40	6	-	-	-	2	-	48
IIIa	16	1	-	-	-	-	-	17
Total	5194	124	14	3	12	127	2	5476

Table 83 Uai Bobo 1: distribution of diagnostic sherds

Rim sherds (Fig.39)

All rim sherds which could be joined, or which certainly came from the same vessel, were grouped, and the various attributes recorded and measured. A total of 86 possible separate vessels was recognised, although many rims were too broken or too small for measurements to be taken. With such a sample size, the numbers in any single horizon were too small to allow valid comparisons between them all, therefore, in Table 84 the horizons have been grouped into two groups to see if there are any major changes over time in the forms and sizes of the rims.

The only noticeable difference between the earlier and later pottery lay in the higher proportion of everted B type rims in the lower levels; these rims are generally taller and are not quite so acutely everted (Table 85).

Horizon	Direct	Everted A	Everted B	Nos
VIII-VI	3	31	14	48
V-III	7	11	20	38
Total	10	42	34	86

Table 84 Uai Bobo 1: distribution of rim forms

Horizon	Lip form Rounded Nos	Lip form Angular Nos	Mouth/body angle $\bar{x}$	Mouth/rim angle $\bar{x}$	Rim height $\bar{x}$	Mouth radius $\bar{x}$	Neck radius $\bar{x}$	Nos
VIII-VI	42	3	54°	50°	8	7	5	45
V-III	29	2	62°	51°	22	8	7	31

Table 85 Uai Bobo 1: everted rim attributes, measurements in cm

Decorated pottery

Only 17 decorated sherds were found, which belong to between five and eight separate vessels; some of the sherds are too small to be certain on this point. The larger of these sherds are illustrated in Plate 37, and described briefly below.

Plate 37a-c: three sherds, possibly from the one vessel with painted reddish-brown decoration of dots and crosses, and converging lines on a buff coloured surface.

Plate 37d-f, i: four sherds from the same vessel with a horizontal band of raised nubbins below hatched triangles.

Plate 37g-h, j: three small incised sherds on which the motif cannot be determined.

Plate 37l: six sherds from a single vessel with incised 'fish bone', or 'pine tree' motifs, alternating with vertically placed nubbins. The overall shape of this vessel is difficult to reconstruct but there is a double constriction below the rim with decoration placed on the swelling between the two necks.

In addition to the above, three sherds of Chinese green celadon were found, one in Horizon VIII and two in Horizon VII. Sherd 4807, from Horizon VIII, is the everted lip of a small bowl, and 4859, from Horizon VII, has a blue painted design on the outer surface. To judge from the colour of these sherds the three belong to different vessels, but this is not certain.

Body sherds

The thickness of plain body sherds was not measured at Uai Bobo 1, but the pottery was not noticeably different from that at Uai Bobo 2. However, it would not be justified, on this assessment alone, to extend the very small reduction in body thickness found in the upper levels of Uai Bobo 2 and Bui Ceri Uato to this site also.

No sherds showed traces of any technique of manufacture and finishing other than by paddle

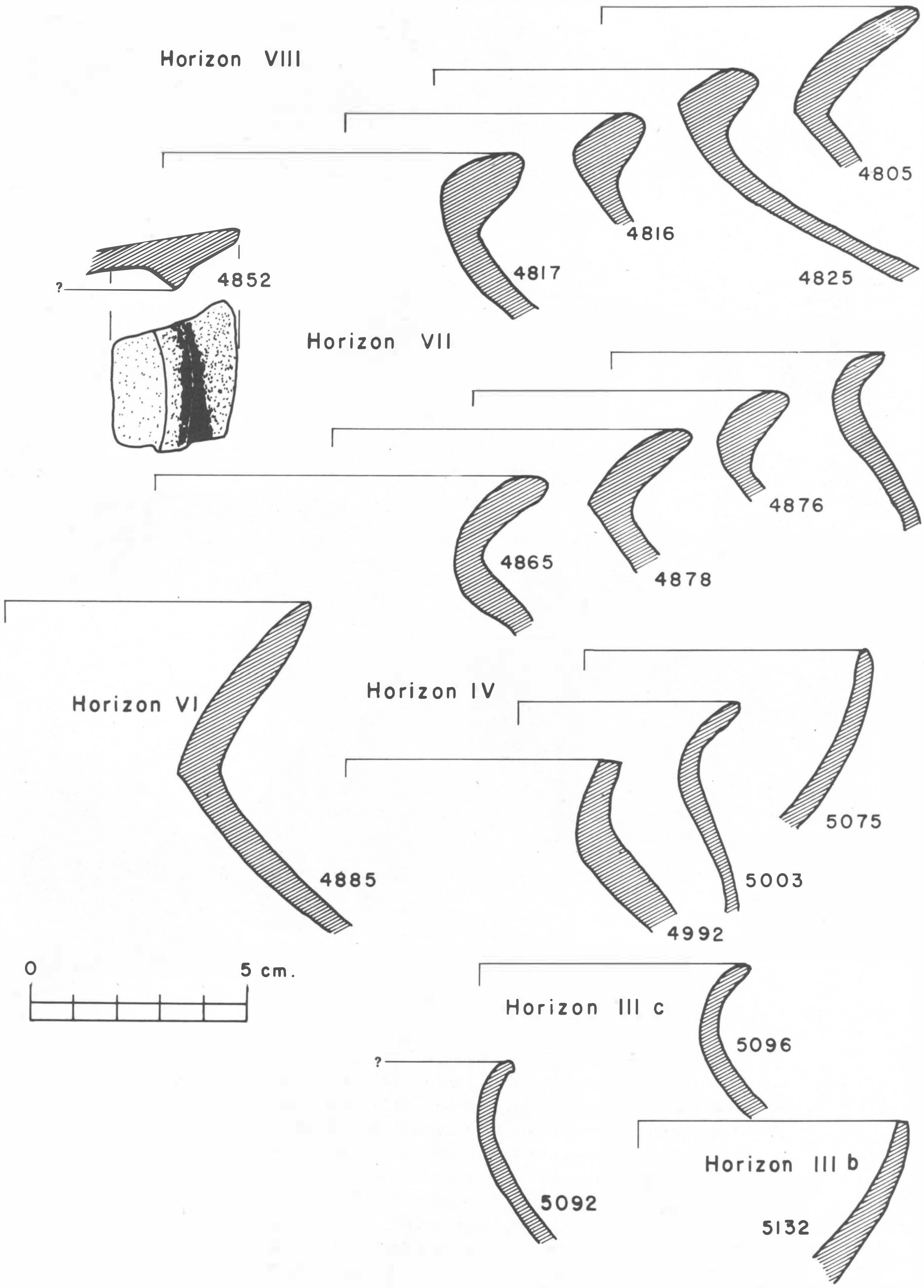


Fig.39 Uai Bobo 1: rim profiles

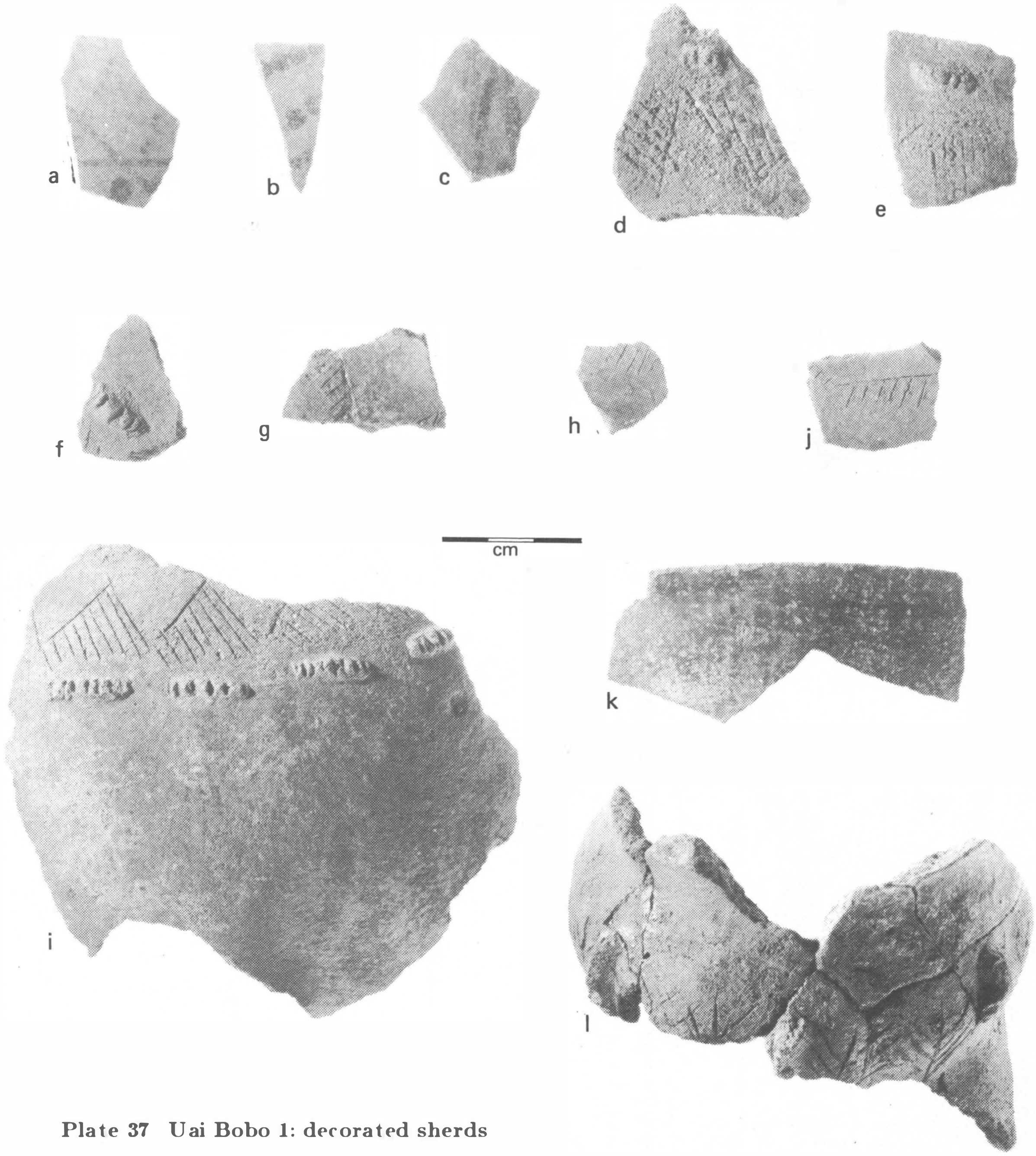


Plate 37 Uai Bobo 1: decorated sherds

a 4835, painted body sherd, Square B(1), Horizon VIII
b 4808, painted body sherd, Square V(1), Horizon VII
c 4836, painted body sherd, Square B(1), Horizon VII
d 4926, incised body sherd, Square QR(4), Horizon V
e 4925, incised body sherd, Square QR(4), Horizon V
f 4947, incised body sherd, Square C(4), Horizon V
g 4944, incised body sherd, Square F(4), Horizon V
h 5070, incised body sherd, Square QR(4), Horizon V
i 4955, incised body sherd, Square QR(4), Horizon V
j 4942, incised body sherd, Square G(4), Horizon V
k 5001 and 5131, direct rim burnished over red slip, Squares LM(5) and G(7), Horizons IVb and IIIB
l 5023, 5024, 5026-29, neck of gourd-shaped vessel, with relief and incised decoration, Squares B(5) and QR(5), Horizon V

and anvil (Glover 1968). Colour varied from black, through grey, to buff, but was not recorded for the reasons outlined in Chapter IV.

Surface burnishing (Table 86) is never found on more than a small minority of sherds. The 11 burnished sherds in the top three horizons may well be derived from lower in the deposit since at Uai Bobo 2 (Table 117) no burnished pottery at all was found in the top two levels. Whether or not this is so, the tendency for burnishing to become less common with time is clearly shown.

In Horizons III-V there are a few sherds from perhaps 5-8 vessels with a burnished red slip. The rim of only one such vessel was found, a small bowl about 14 cm in diameter with a direct, almost vertical rim (Plate 37k). Apart from these sherds, it is difficult to know whether the burnished ware was slipped, or whether polishing the leather-hard clay produced a like result by bringing the fine clay particles to the surface.

A single sherd from Square RN(2), Horizon VII was sectioned by Mr C. Key, formerly of the Department of Prehistory, RSPacS, ANU, for mineralogical examination. Key's report indicated that it was indistinguishable from modern pottery made in the nearby *suco* of Uato Haco, and from sherds examined from Uai Bobo 2, Horizons XIII, IX and VIII.

Horizon	Total body sherds	Burnished body sherds	Burnished %
VIII	1609	2	<1
VII	909	2	<1
VI	848	7	1
V	1044	38	4
IVa,b	646	52	8
IIIa-c	262	23	9
Total	5318	124	-

Table 86 Uai Bobo 1: percentage of burnished body sherds

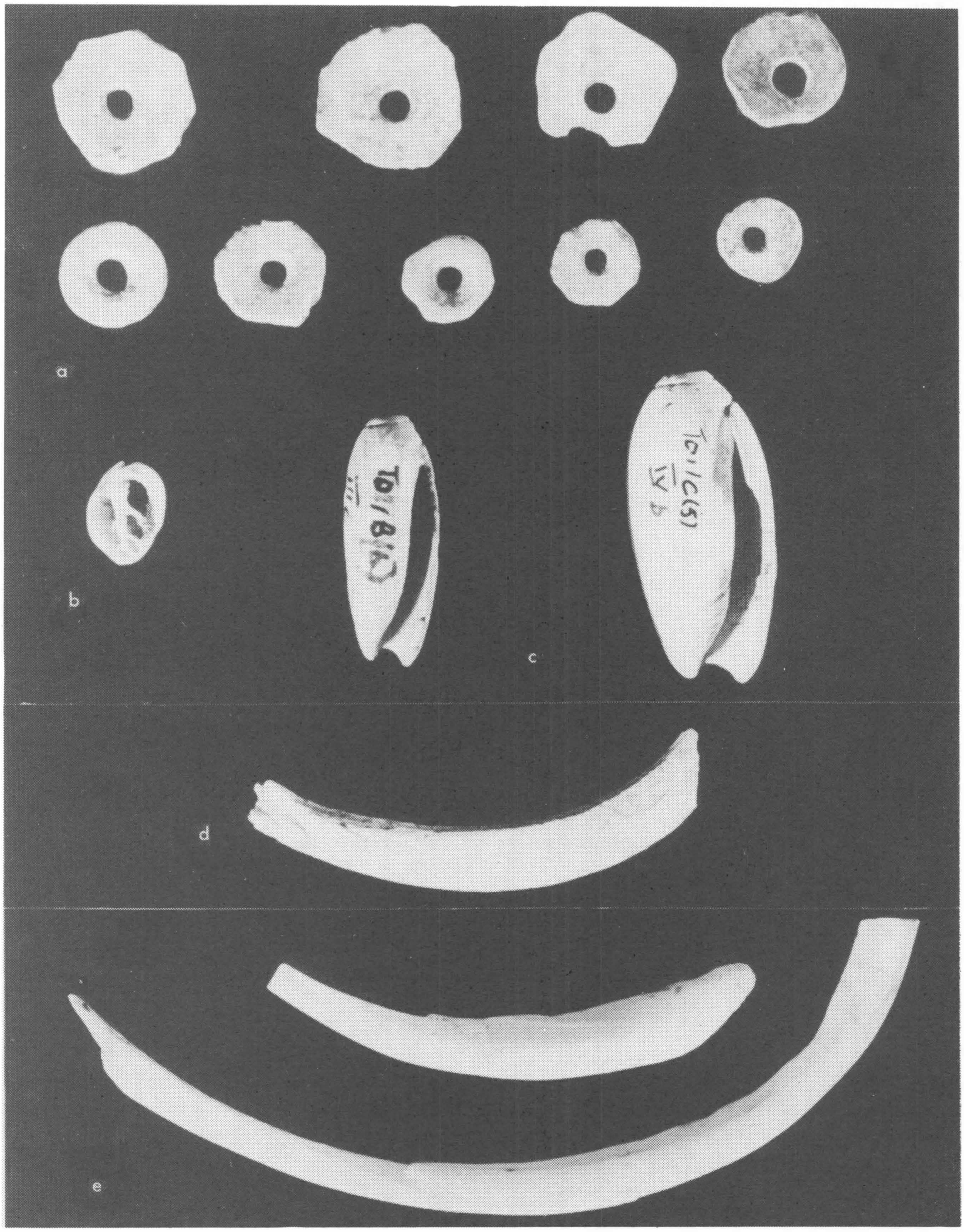
SHELL ARTIFACTS (Plate 38)

A number of shell artifacts was found in the middle levels of the site. They are listed below, and the distribution is summarised in Table 87.

Horizon	Pierced shell discs	Olive shells	Cockles	*Trochus* sp.	*Nassa* sp.
VIII	-	-	-	-	-
VII	-	-	-	-	-
VI	-	-	-	-	-
V	1	-	-	-	-
IVb	-	1	-	-	-
IVa	-	-	-	-	-
IIIc	11	1	1	-	1
IIIb	8	1	-	2	-
IIIa	-	-	-	-	-
IIb	-	1	-	-	-
IIa	-	-	-	-	-
Ib	-	-	-	-	-
Ia	-	-	-	-	-
Total	20	4	1	2	1

Table 87 Uai Bobo 1: distribution of shell artifacts

Of the shells, only the *Geloina* could be a food shell, although they are rare in the shell samples collected from Bui Ceri Uato (Table 60). In Lie Siri, elsewhere in Indonesia, and in northern Australia, many of the *Geloina* sp. found in archaeological deposits have edges broken, and occasionally even polished from use, (Willems 1939; White 1967b:Pl.IV, 10). A single broken *Geloina* shell was also found in Uai Bobo 2 and although neither of these show



0 2 cm

Plate 38 Uai Bobo 1: shell ornaments

a Pierced discs of *Nautilus* shell, Horizon IIIc
b *Nassarius* sp. with the top broken off and edges slightly worn, Horizon IIIc
c Olive shells pierced at top for threading, Horizons IIIc and IVb
d Broken edge of *Geloina* shell, Horizon IIIb
e Broken sections of two *Trochus* shell armlets, Horizon IIIb

definite signs of use, it is probable that they were brought into the cave as tools, perhaps to scrape root vegetables. All these shells are saltwater species, and must have been traded from, or acquired directly from the coast.

Because of their great variability in size, I think that the pierced *Nautilus* discs (Table 88) served as ornaments rather than as 'money'. This problem is discussed further in the next chapter.

	Range	$\bar{x}$	s	Nos
External diameter	0.49-1.27	0.82	0.25	16
Internal diameter	0.17-0.29	0.23	0.04	16

Table 88 Uai Bobo 1: dimensions of unbroken pierced shell discs

OCHRES

Throughout the site small numbers of ochre and manganese fragments were found (Table 89), of which the weights are given below. Six pieces of ochre with ground surfaces were found in Horizons II and IV, which suggests that some ochre paint preparation took place in the cave.

Horizon	Ochre (gm)	Manganese (gm)	Ground ochre pieces
VIII	-	-	-
VII	-	-	-
VI	1	-	-
V	-	-	-
IV	27	-	1
IIIa-c	101	13	2
IIa,b	79	-	3
Ia,b	2	-	-
Total	210	13	6

Table 89 Uai Bobo 1: distribution of ochre and manganese

MISCELLANEOUS ARTIFACTS

Local manufacture

Only one prehistoric metal object was found in any of the excavations in Timor, a small ornament of soldered copper-bronze wire which is illustrated in Plate 36. It was found in Square D6, Horizon IIIc and in close association with charcoal dated to 2190 ± 80 BP (ANU-237). Although I have previously said (Glover 1969:110) that I believed this date to be too young, subsequent dated samples from the site have provided a convincing sequence for Horizon IIIa-c. Unfortunately a single object is always subject to disturbance and I do not believe that this find can be used to support either the traditional dating for the introduction of metal into Southeast Asia (Heekeren 1958:95-96), or the new, and older chronology, proposed by Solheim (1968).

Analysis of a sample of the metal by the atomic absorption process, taken from the thick ring at the top of the ornament gave the following composition: Cu 87%, Pb 6.3%, Sn about 6%, Ag 0.003%, Zn 0.01%, Fe - -, Ni 0.09%. When it was found, the metal was extensively corroded and it was not clear whether the object was made of a number of wires soldered together, or cast in one piece. After cleaning (Plate 36) it was evident that each of the six lower wires had been soldered together and then joined to the ring above. The small projection at the base of the ring appears to be the end of one of these wires. It is not possible to say what sort of ornament it was, although from the shape, an ear-ring appears to be a good guess.

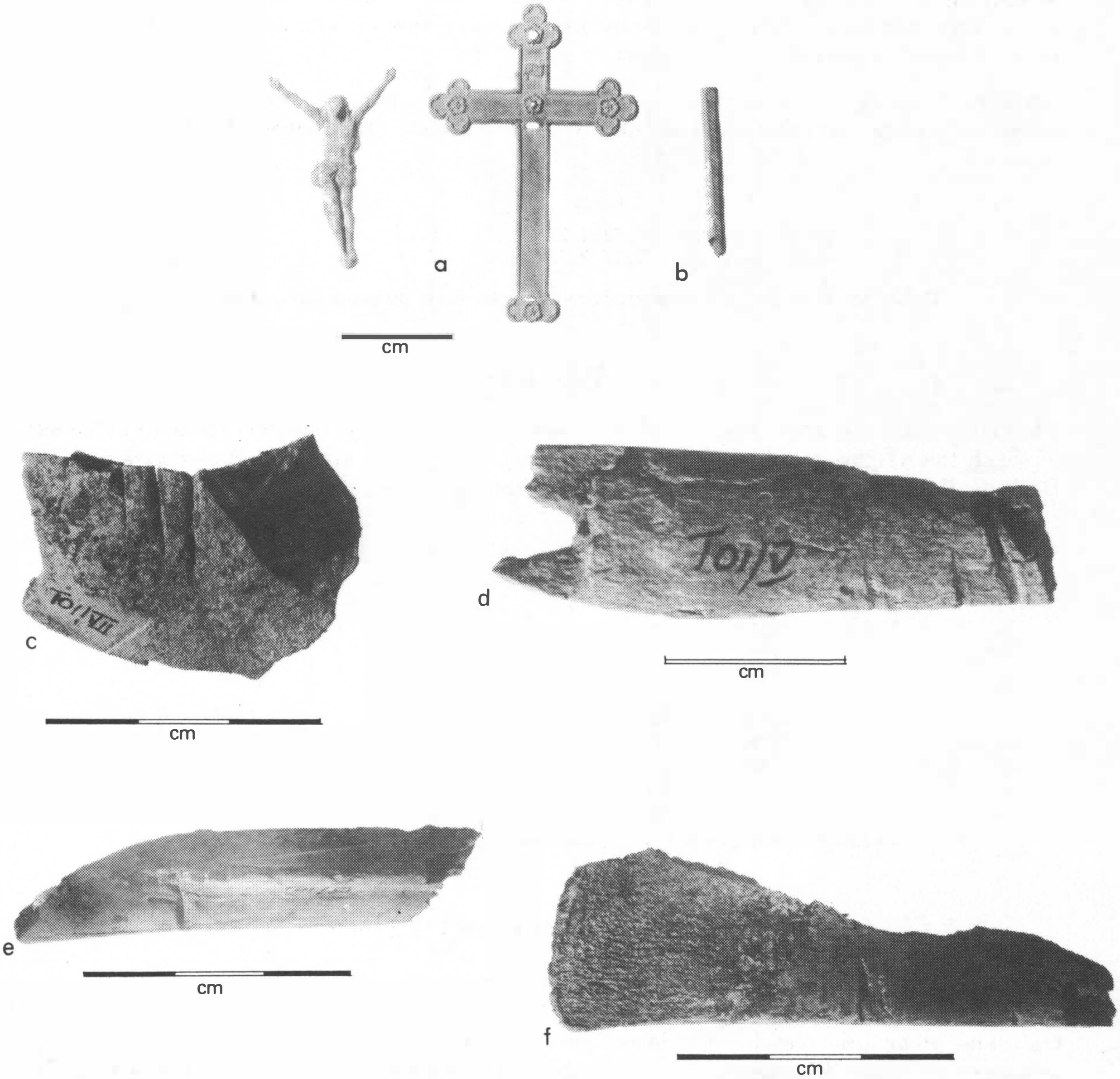


Plate 39 Uai Bobo 1

Top: artifacts and bones

a Crucifix; figure was found in Square F(1), Horizon VIII and cross in Square G(4), Horizon V

b Slate pencil, Square C1, Horizon VIII

Lower: long bones with butchering marks

c Cranial fragment of pig, Horizon VII

d *?Capra/Ovis*, radius, Horizon VI

e *?Capra/Ovis*, scapula fragment, Horizon V

f Unidentified ?rib, Horizon V

I have not been able to find any very similar prehistoric metal ornaments from Southeast Asia in the archaeological literature. The nearest ones are the bronze fragments found by Hoop (1932:Pl.172) in a cist grave on the Pasemah Plateau, south Sumatra. Heekeren (1958:Pl.15d, e) illustrates spiral wire ornaments from Bali, and spiral wire is a common decorative technique on various cast figures and ornaments from Sumatra (Hoop 1958:Pl.9).

The broken half of a carefully made coconut shell ladle was found in the surface dust of Square OS(1), Horizon VIII. Such ladles are commonly used in Timor today, even though most families possess some European steel or aluminium cutlery. Pieces of coconut ladles were found at the surface of a number of caves, and one complete ladle was found in the small shelter which I called Baucau 1.

Industrial manufacture

The various modern European objects found in the cave are listed below with their locations, and a brief description.

Horizon VIII: five rusty iron nails, two iron staples, two other iron fragments, the figure from a modern pressed metal crucifix (Plate 39a) and one slate pencil (Plate 39b).

Square LM(2), Horizon VII, produced a small section of rubber piping and Horizon V the cross part of the crucifix.

All of these objects may have come into the cave during the wartime occupation mentioned earlier. The slate pencil cannot, at present, be identified to place of origin, but in colour and texture it resembles the slate from Llanberis, Wales. But Portugal produces its own slate (North 1946:102) and it is probable that slates brought to Timor for use in schools, came from there.

North (1946:85) writing of the decline of the use of writing slates in Europe, pointed out their potential value in 'parts of Africa, India and the East Indies, ... where humidity and insect pests place paper at a disadvantage'. The truth of the statement is demonstrated by this find of a slate pencil in a cave in Timor. To an archaeologist looking at these deposits from the vantage point of 1000 years hence, and with as little knowledge of the cultural level in 20th century Timor as we have of the region 1000 years ago, this find, together with the INRI inscription on the crucifix, would be the only evidence for the knowledge or writing. And they would both be foreign, imported objects.

In Square G(3), Horizon VI, a small fragment of pumice was found. This could not have originated in Timor itself and was probably found on a north coast beach after the northwest monsoon winds had driven it there from one of the active volcanic islands of Indonesia. I have never seen pumice in use in Timor, and its purpose can only be guessed at.

ANALYSIS OF FAUNAL REMAINS

The methods of processing the faunal remains have been outlined in Chapter IV and more detailed descriptions and identifications of most of the mammalian remains are given in Appendices 1-3.

Conditions in all the limestone caves generally favoured the preservation of bone but by far the best collections of mammals come from the inland sites of Uai Bobo 1 and Uai Bobo 2. This probably reflects differences in the availability of various species as well as differences in site use between the two areas.

Murids (Appendix 2)

The final sorting and identification of all murids was made by Mr J. Mahoney and the distributions of the different genera and species identified by him are given in Table 90.

LARGE MURIDS

Horizon	*Coryphomys*	A	B	C	Not identifiable	Nos
VIII	-	-	-	-	-	-
VII	-	-	-	-	-	-
VI	-	-	-	-	-	-
V	-	-	1	-	-	1
IV	1	2	3	1	1	8
III	4	3	13	1	1	22
II	1	2	3	3	3	12
I	-	-	2	-	-	2
Total	6	7	22	5	5	45

SMALL MURIDS

Horizon	*Melomys* sp. incl. *Pogonomelomys* Small	Large	*Rattus exulans*	Other *Rattus* sp.	Not identifiable	Nos
VIII	-	-	1	1	-	2
VII	-	1	-	1	-	2
VI	-	-	-	3	-	3
V	-	1	-	5	-	6
IV	1	8	-	23	2	34
III	3	15	-	28	-	46
II	7	58	-	140	34	239
I	10	58	-	349	168	585
Total	21	141	1	550	204	917

Table 90 Uai Bobo 1: minimum numbers of murids

To make the interpretation of the table easier, the large and small murids have been totalled separately, since it is believed that *most* of the large murids are food remains and *most* of the small ones are not. This belief is based on various grounds:

1. That in all sites, large murids are not found in the most recent levels whereas some of the small murids continue, although in small numbers, to the top of all deposits excavated.
2. That many of the large murid bones are broken to a greater extent than the small ones, and a higher proportion show signs of burning. Unfortunately there are no figures for this, but both Mahoney and myself noted it while sorting the material.
3. The absence of any large land mammals to serve as food in Timor before the introduction of various domesticated and wild animals found there today.
4. The use of the large rats as food in parts of Melanesia today, where, in many indigenous taxonomic systems, they are often distinguished from small rats which are not so commonly eaten (Drs M. Plane and A. Chowning pers. comm.).

Of the small murids, it is the *Rattus* sp. rather than the *Melomys* sp. which continue up to the surface, and this is also the case in Uai Bobo 2 (Table 120). *Melomys* has never been recorded for Timor whereas *R. rattus* and *exulans* have, but it is difficult to explain the extinction of such a small animal as *Melomys* by hunting, clearing or other man-induced ecological disturbances. In Melanesia, *Melomys* thrives even in urban areas (J. Mahoney pers. comm.), and it may be that the introduction of a civet cat predator, *Paradoxurus hermaphroditus*, has contributed towards the extinction of the large murids, and of *Melomys*, either locally or throughout Timor.

The high proportion of unidentifiable small murids in Horizon I is due to breakage during excavation of the hard-packed deposit at the base of the trench, as well as to chemical erosion of tooth enamel.

The other *Rattus* sp. column includes two species in Horizons I-V, one of which is almost certainly *Rattus rattus*, and one species only from Horizons VI-VIII; again probably *Rattus rattus*.

In summary, it can be said that four genera of large murids, possibly two species of *Melomys* and one of *Rattus* are missing in the upper levels. Some of these, especially the large murids, must be presumed extinct through the agency of man and of a man-introduced predator.

In Table 90 the numbers of individuals are given for each horizon, but the figures are not directly comparable between horizons, because of the unequal volumes. In Figure 49, therefore, the proportional distribution of murids is illustrated, with the horizons corrected for unequal volume. The distributions can be compared with the incidence of human occupation, which is shown by the density of waste flakes and pottery. Most of the small murids (77%), occur in Horizon I, whereas the large murids are spread more evenly over the lower half of the deposit.

Chiroptera

The report on all Chiroptera from the excavations is contained in Appendix 3, and the numbers of identified individual bats from Uai Bobo 1 are listed in Table 91. Uai Bobo 1 has a rather higher proportion of bats recorded as cave dwelling species in Timor than Uai Bobo 2, and although it does not contain a bat colony today, it is possible that one existed there in the past. On the other hand, no bats were found in the upper levels of the site, and considering this, it seems likely that most of the bats were brought into the cave by man as food. In Appendix 3, Professor Goodwin describes how bats are valued for food in Timor today.

Domesticated and other larger land mammals

Identifications of all domesticated and some of the larger, wild land mammals, were made by Professor C.F.W. Higham, after preliminary sorting in Canberra. His list of identified bones and his comments are included in Appendix 1; a list of the minimum numbers of individual animals, based on these identifications, is given in Table 92. Tentative identifications are indicated by a question mark and these are usually occasioned by the fragmentary condition of the bones.

Among the domesticates, *Sus* is the first to appear, in Horizon III, at the same level as the first pottery. In Horizon V, dog and *Capra/Ovis*, were found together with *Bos* which is represented by a single upper premolar. In the same level is a Phalanx 2, tentatively identified as *Cervus*. The appearance of *Capra/Ovis*, *Bos* and *Cervus* at this date requires comment, for it is often thought that *Cervus timorensis*, or rusa deer, has been introduced fairly recently into the many islands of eastern Indonesia where it is common today (Laurie and Hill 1954:85, 90). In Uai Bobo 2, *Cervus* is found only in Horizon XIII, and it is absent from the lower levels at Nikiniki 1 (Sarasin 1936:32), as well as from all the Toalian cave sites in Sulawesi; although rusa is present in the island now (Hooijer 1950:145). In the coastal site, Bui Ceri Uato, deer is found only in Horizon IX, immediately below the surface layer of goat dung. In the light of this negative evidence and the tentative identification from Uai Bobo 1 itself, it is best to regard the introduction of deer before the last few hundred years as unproven, and hope that less ambiguous data will be obtained in future.

The presence of *Bos* in Horizon V also depends on a single bone, although Higham indicates that the identification is secure. No bovid bones were found in Uai Bobo 2, but in Bui Ceri Uato they were found in Horizons VI, VII and VIII. In Nikiniki 1, and the Baguia Cave, Bühler found a number of bovid bones towards the bottom of the deposit (Sarasin 1936:32; Glover 1972a). This evidence is also somewhat ambiguous, but a stronger case can be made for the introduction of bovids (probably buffalo, but note Higham's comment in Appendix 1) into Timor by at least 1500 years ago. In comparing the evidence for deer and buffalo, it is

Horizon	Not cave dwellers				Possibly cave dwellers		Cave dwellers			Nos
	Pteropus sp.	*Pteropus griseus*	*Pteropus vampyrus*	*Nyctimene cephalotes*	*Hipposideros diadema*	*Hipposideros* sp.	*Dobsonia peroni*	*Rhinolophus* sp.	*Taphozous* sp.	
VIII	-	-	-	-	-	-	-	-	-	0
VII	-	-	-	-	-	-	-	-	-	0
VI	-	-	-	-	-	-	-	-	-	0
V	-	-	-	-	-	1	-	1	-	2
IV	-	-	2	1	2	-	-	-	-	5
III	2	1	-	-	-	-	8	2	-	13
II	1	-	-	-	-	-	7	2	3	13
I	-	-	-	-	-	-	3	-	2	5
Total	3	1	2	1	2	1	18	5	5	38

Table 91 Uai Bobo 1: minimum numbers of chiroptera

Horizon	*Canis*	*Sus*	*Capra/Ovis*	*Phalanger*	*Paradoxurus*	*Macaca*	*Cervus*	*Bos*	*Equus*
VIII	-	2	3	-	1?	1	-	2	-
VII	1	1	1	-	1	-	-	1	1?
VI	1	1	3	-	1	-	-	-	-
V	1	1	2	-	1	1	1?	1	-
IV	-	1	-	1	-	-	-	-	-
III	-	2	-	2	-	-	1?	-	-
II	-	-	-	-	-	-	-	-	-
I	-	-	-	-	-	-	-	-	-
Total	3	8	9	3	4	2	2?	4	1?

Table 92 Uai Bobo 1: minimum numbers of larger mammals

necessary to consider the attitude towards the two species, and their use in Timor today. Deer is now the most common game animal; towards the end of the dry season big drives are organised and there must be few Timorese who do not share in a kill at some time or another. Buffalo, on the other hand, are prized as stores of wealth more than for food. Animals are killed only on festive or ceremonial occasions and usually eaten in the villages. It is only rarely that buffalo bones would get into cave deposits, even if they are common in the surrounding communities. The fact that they have been found in a number of sites and at some depth in at least two, suggests to me that this is not an accidental association at Uai Bobo 1.

The position concerning *Capra/Ovis* will be discussed more fully in Chapter IX. Two individuals, comprising some nine bones, were found in Horizon V, not all from the same part of the cave, and the introduction of *Capra/Ovis* at this time must be accepted.

There is a tentative identification of horse in Horizon VII, based on a single upper incisor. This is the only horse bone found in any of my excavations, and the arguments used for *Cervus* apply here too. There is the linguistic evidence in the use of the term *karbau malae* (foreign buffalo), and some negative historical evidence from Pigafetta, to suggest that horse as a comparatively recent introduction, was brought in perhaps about the time of the early European contacts. The find of a single tooth so close to the surface of Uai Bobo 1 would be consistent with this. On the other hand, Sarasin (1936:31) records a lower molar and pelvic bone of horse from the lower level of Nikiniki 1, so perhaps the matter should also be left open, with the weight of evidence against the introduction of horse earlier than the last few hundred years.

Dog is represented in Uai Bobo 1 by a complete pelvis in Horizon VI and a canine, half bored and possibly split, from Horizon V and by a radius of *Capra/Ovis* chewed by a dog in Horizon VI. In Uai Bobo 2 a single fibula tentatively identified as dog was found in Horizon X, and in Bui Ceri Uato, dog is found in each of Horizons VI-X. On this rather fragmentary but consistent evidence, it is possible to suggest a date of not later than 2500 years ago for the introduction of dog. The implications of this for relationships with Australia and Melanesia will be discussed in Chapter IX.

A number of bones showing butchering cuts were recognised (Plate 39c-f). From Horizon VII there is a skull fragment of a pig; from Horizon VI, a scapula fragment of *Capra/Ovis* and one unidentified bone. It is not possible to say whether these cuts were made with stone or metal tools.

Among the wild fauna in the site, there are three individuals of *Phalanger orientalis*, two in Horizon III and one in Horizon IV; a *Macaca* in each of Horizons V and VIII; and civet cats, probably *Paradoxurus hermaphroditus* in each of Horizons V-VIII. The point to emphasise is that none of these larger (and more easily collected and recognised) bones was found among the many thousands of bones recovered from Horizons I and II. The same situation is found in Uai Bobo 2 and Bui Ceri Uato, and there is strong presumptive evidence that these species were introduced into Timor directly by, or through the agency of man, between about 4000-5000 years ago.

BIRDS, REPTILES AND OTHER FAUNA

Among the specimens given to Mr J. McKean for identification were many bird bones, wrongly thought to be postcranial bones of bats. These were sent to Dr A. Wetmore, Smithsonian Institution, Washington, DC, for identification, but appear to have been mislaid.

No identifiable insectivore bones were recovered, and it has not been possible to have the few reptiles identified.

Human bones

Dr A.G. Thorne reports that of the two presumed human teeth sent to him for examination, there is one lower left permanent premolar from Square QR6, Horizon IIIc, and one lower left deciduous lateral incisor from Square H9, Horizon IIb.

PLANT REMAINS

Apart from the few pollen grains from the surface, a number of macro plant remains were found. The identifications of these by Dr D. Yen are given in Appendix 4, and they are summarised in Table 93. The candlenut shells which are also listed in the table were not seen by Yen, but are almost certainly *Aleurites moluccana*. One shell from the Bui Lale Cave (Glover 1972a:59-61), sent for identification, was confirmed as *Aleurites*.

Horizon	*Aleurites* (candlenut shells) (gm)	*Cocos*	*Zea*	*Lagenaria* (gourd)	*Arachis* (peanut)	*Areca*	*Celtis*	*Piper* (betel)	Unidentified seed cases
VIII	577	x	3	x?	-	-	-	-	1
VII	353	-	-	x?	x	1?	-	-	-
VI	231	-	-	-	x	-	-	-	-
V	89	-	-	-	-	-	-	-	-
IV	15	-	-	-	-	-	-	-	-
III	3	-	-	-	-	-	5	-	-
II	1	-	-	-	-	-	4	2?	2
I	<1	-	-	-	-	-	4	1	2
Total wt	1269	-	-	-	-	-	-	-	-

x = present

Table 93 Uai Bobo 1: macro plant remains

The numerical predominance of candlenut reflects the toughness of the shells - *buah keras* as they are called in Indonesian. They were found in all excavated sites, often at a considerable depth. Heekeren apparently also found candlenut in many of the caves which he excavated in Java (R.P. Soejono pers. comm.).

Coconut was found only on the surface, as were corn cobs. The occurrence of *Lagenaria* (bottle gourd), and *Arachis* (peanut) in Horizons VII and VI is most interesting. In Table 65 I have dated these levels to between 650-1600 years ago. Bottle gourd is very widely cultivated in Southeast Asia and Burkill (1935:1296-98) has suggested that it is native to the Old World, and probably to Africa. Other archaeological evidence for its antiquity in Southeast Asia has been provided by Gorman's excavation at Spirit Cave in northwest Thailand (Yen 1977). Peanut shells were found in Horizons VII and VI and unless they were derived from the surface, peanut must be a pre-colonial cultigen in Timor. Another possible specimen of peanut was found at Lie Siri in Horizon IVb. Burkill (1935:205), and many writers on ethnobotany (e.g. Massal and Barrau 1956:30) accept the American origin of peanut, but there are reports of peanut from some Chinese neolithic sites; see Glover (1979:33, Footnote 24) for a discussion of this. No doubt these finds will provide further ammunition for the supporters of regular pre-Columban contacts between the Americas and Asia.

Seed cases of *Celtis* were found in the earlier levels only, of most excavated sites (Appendix 4), and the significance of this is discussed in Chapter IX. *Piper* too, has been found in an early level in Uai Bobo 2. The identification of *Piper*, however, is not quite certain although there seems no reason to question the great antiquity of betel in Southeast Asia (Burkill 1935:1737-39).

VIII EXCAVATIONS NEAR VENILALE: UAI BOBO 2

DESCRIPTION AND EXCAVATION

During the final stage of excavation at Uai Bobo 1 a test pit, 1m^2 x 1 m deep, was dug in the centre of a small fissure in the cliff face (Plate 40a) about 100 m to the south of Uai Bobo 1. The work revealed a deposit more finely and clearly stratified than any so far encountered in Timor and the cave, which has been called Uai Bobo 2 for convenience, clearly warranted more extensive excavation despite its size, approximately 3 x 2 m. The surface was divided into five rather irregular squares (Fig.40a), A-E, with Square B comprising the original test pit. During the excavation of this first square an unrecognised subsurface pit was dug through, and the finds from Square B, Spits 4-8, have been omitted from the analysis. The area affected is shown in Figure 40d.

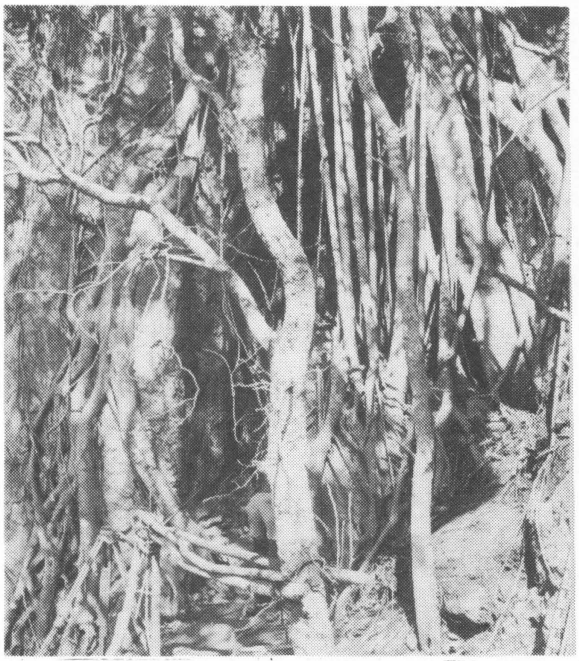


Plate 40a Uai Bobo 2: the narrow entrance was concealed by bushes and the aerial roots of a large fig tree growing on the cliff face

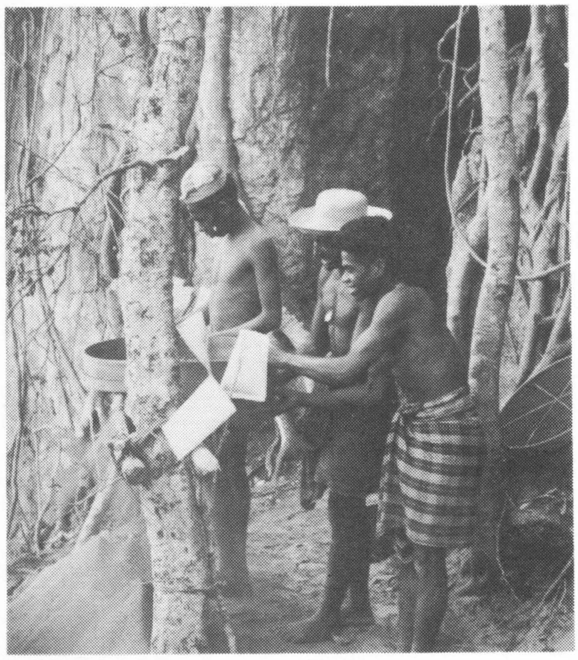


Plate 40b Sieving on the narrow ledge in front of the cave. Most of the spoil heap was lost over the cliff below the cave and the trench was not backfilled

One of the notable features of Uai Bobo 2 was the virtual absence of flaked stone in the top metre of deposit, although pottery was common. As work progressed, it became apparent that the site contained a similar sequence of artifacts and fauna to Uai Bobo 1, and to the sites on the Baucau Plateau, but distributed over a much greater depth of deposit. This allowed a finer separation of the material from different periods. Excavation followed the same procedure already outlined, but because of the small size of the cave and the loose dry deposit, the squares had to be dug back to the cave walls except at the eastern end. The stratification on exposed faces was recorded before the deposit was dug away and composite sections were built up. On one occasion, baulks left standing overnight on both sides of Square A collapsed before they could be drawn. As the excavation progressed, the cave walls receded at the back and at the sides, and the location of the squares had to be changed several times to take account of this. At 1.10 m below the surface, the top of an entrance to a second chamber at the back of the cave was uncovered (Plate 43b), and later the excavation was extended into this and the new squares labelled F-J.

Maximum depth of the trench was 4.9 m at a point below the entrance to the rear chamber.

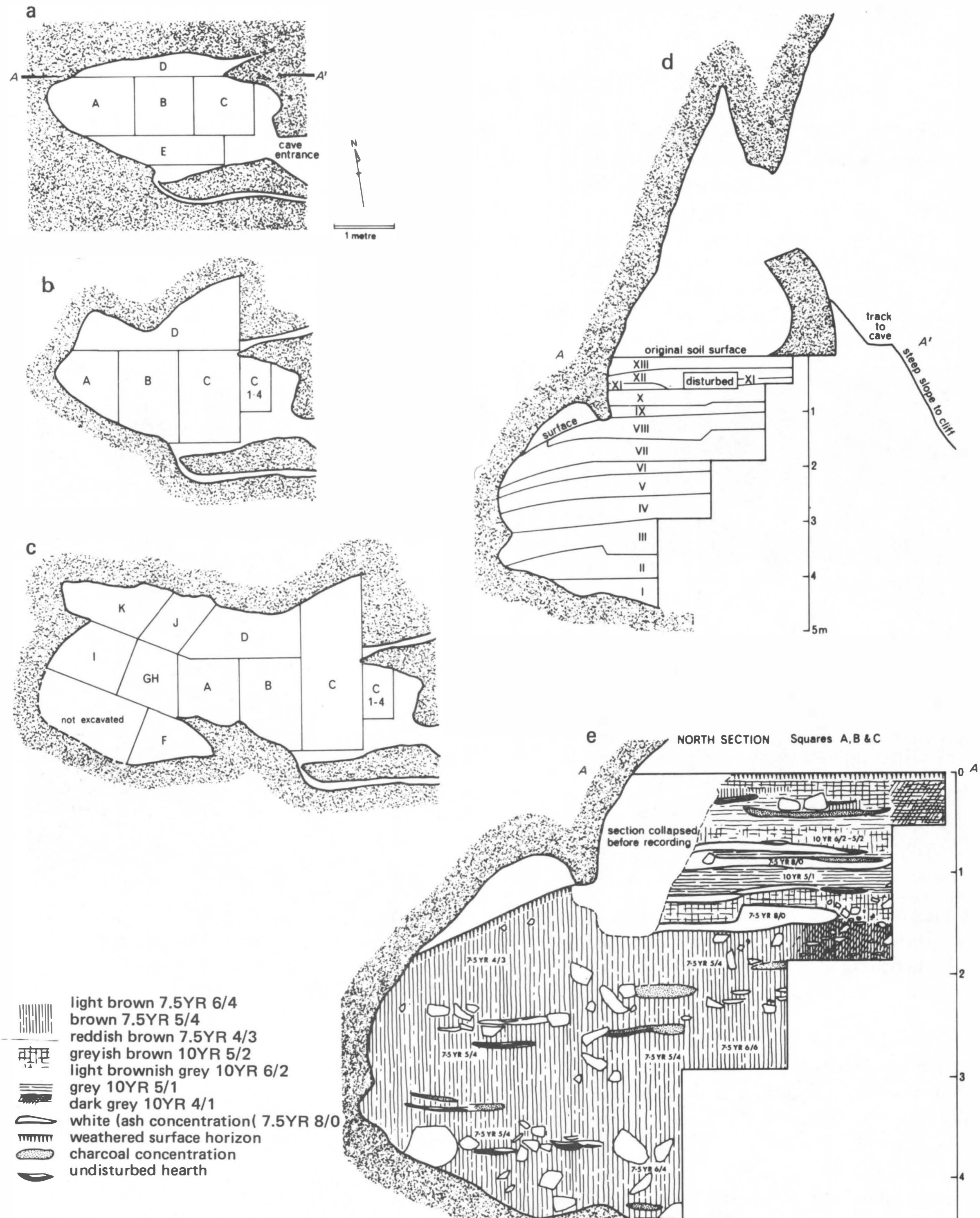


Fig.40 Uai Bobo 2: plans and sections

- a Plan of excavated squares at the surface
- b Plan of excavated squares at 1.7 m below the surface
- c Plan of excavated squares at 4.2 m below the surface and 0.7 m above bedrock
- d Horizons at Section A-A[1]
- e Soil stratification at Section A-A[1]

Plate 41

Baucau 1: coconut shell ladle commonly used for cooking meat, rice, beans and corn mash in pottery vessels. Fragments of such ladles were found in many caves (this one was found on the surface)

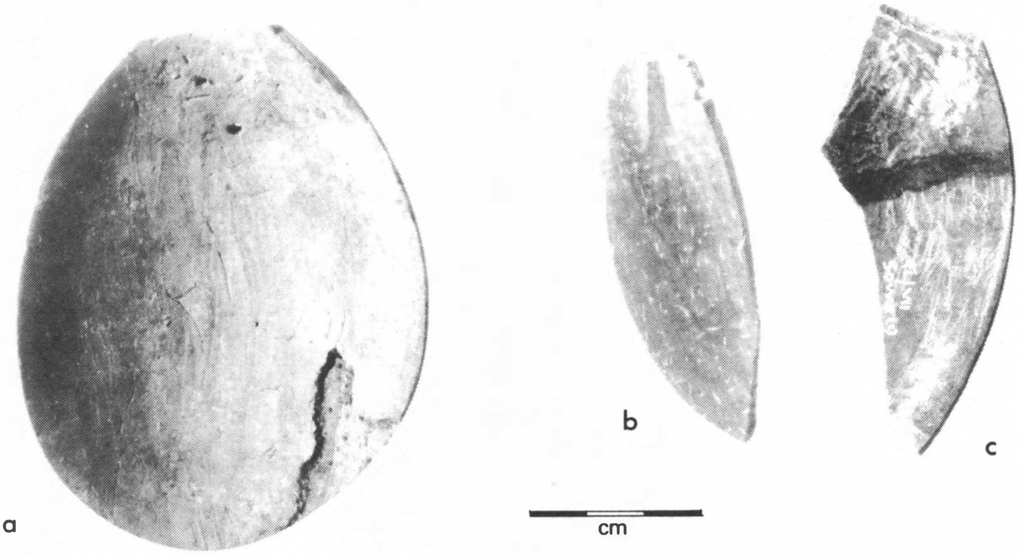
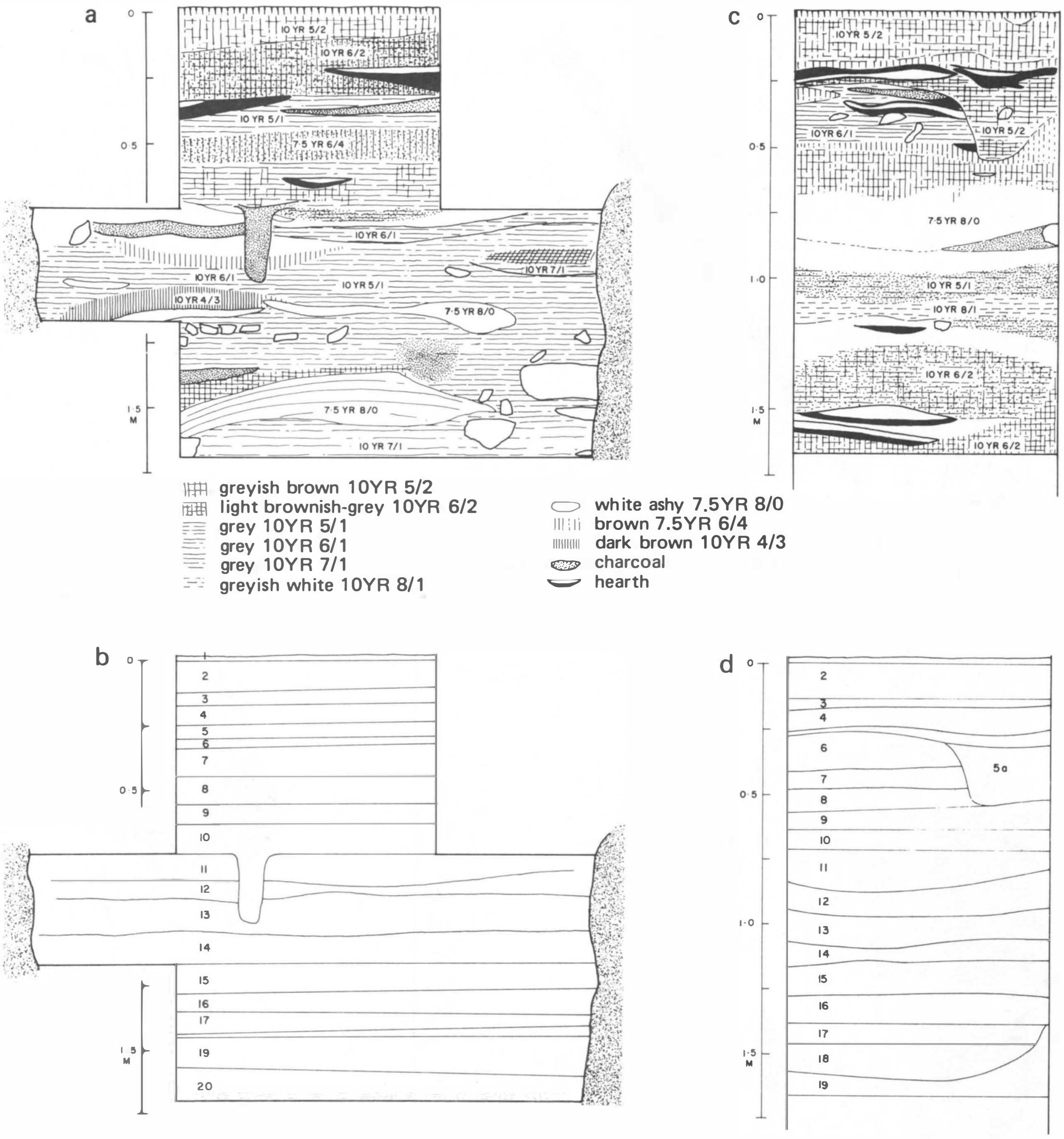


Plate 42 Coconut shell ladles

- a Coconut shell ladle found in the surface dust, Uai Bobo 2, Square D1
- b Broken ladle, Uai Bobo 1, Square SO(1)
- c Broken ladle found embedded in the goat dung layer, Lie Siri, Square SOW5(2)

Because of the difficulty of access to the lower levels at the back of the chamber and the possible danger of undermining the large fallen blocks at the entrance, the trench had to be stepped and bamboo ladders were used (Plate 44a). As can be seen in Figure 40d, the area of excavation moved from the front of the cave at the surface, to the back at the base of the trench. It can be expected, therefore, that some of the differences over time in the material recovered, will be due to the fact that different areas of the cave were excavated.

Plate 43b shows that there was an air space above the sloping surface of the second chamber

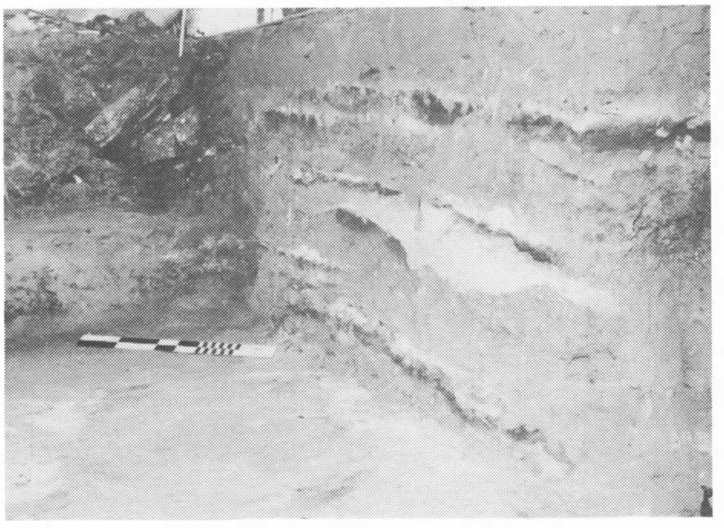


ig.41 Uai Bobo 2: sections

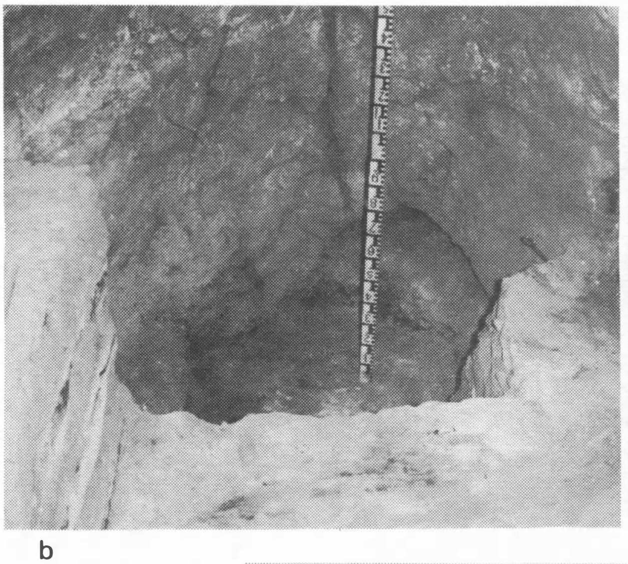
a Soil stratification in the top 1.5 m of the east section of Square B
b Excavated spits of Square B projected onto the above section
c Soil stratification in the top 1.5 m of the east section of Square A
d Excavated spits of Square A projected onto the above section

and this was examined carefully before it was dug in case it should represent an ancient and undisturbed living surface. Unfortunately this was not so, for any such surface which once might have existed had been covered by spill from the front chamber as the earth accumulated there.

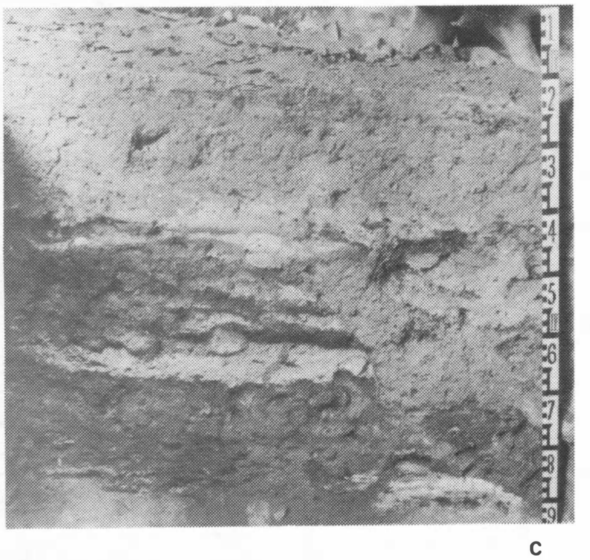
The deposit was similar to that in Uai Bobo 1 both in colour and texture, but rather fewer limestone fragments were encountered in the upper levels. The top 1.7 m consisted of alternate bands of brown and grey-brown earth, and ashy hearths (Fig.41a, c). Because of the drier conditions charcoal was better preserved than in Uai Bobo 1, and good samples were obtained at all levels to near the bottom of the trench. Some hearth lenses were clearly



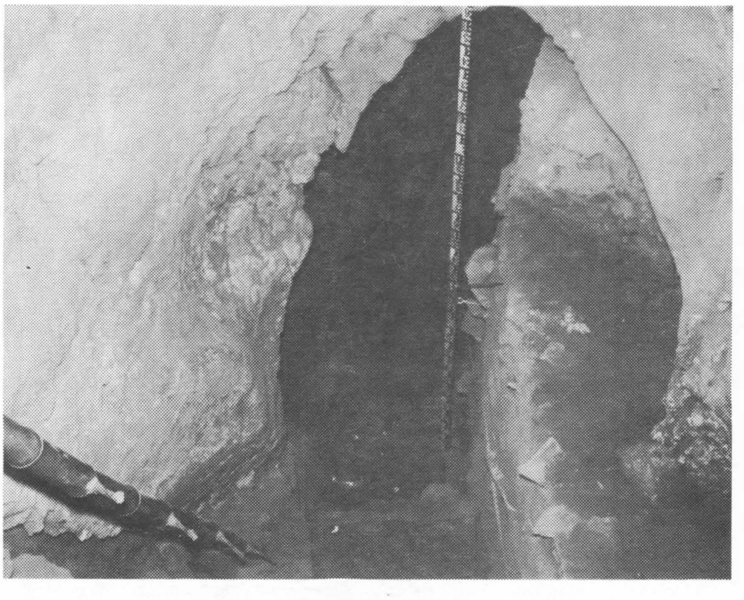
a



b



c



d

Plate 43.

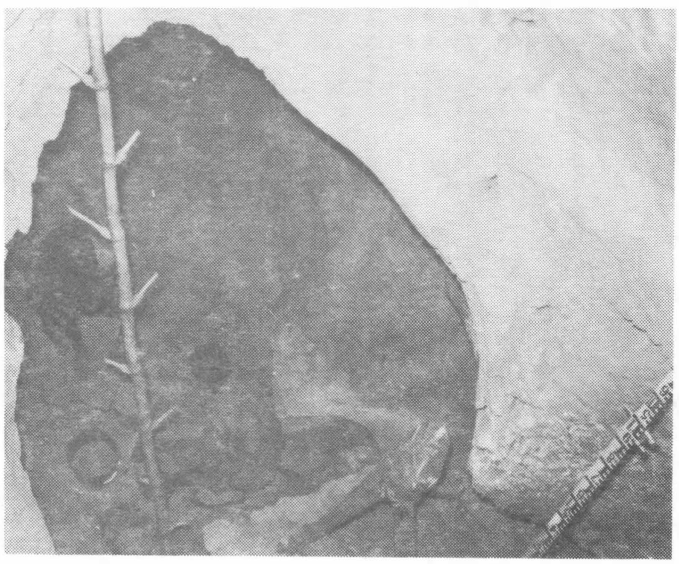
Overleaf

Plate 43a Uai Bobo 2: south section of Squares A-C at base of Horizon X, 90 cm below the surface. Charcoal sample 3760 ± 90 BP (ANU-239), was taken from a hearth 10-15 cm below this floor.

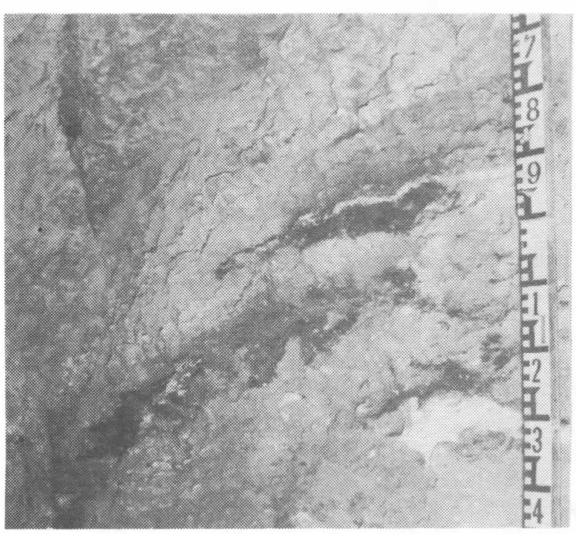
43b Uai Bobo 2: top of rear chamber is visible approximately 1.2 m below the surface in Square A which has been dug to Spit 19 in Horizon VII. Charcoal sample 5520 ± 60 BP (ANU-187), was taken from Square A at this level

43c Uai Bobo 2: test excavation in Square B dug to Spit 10 showing an ancient pit

43d Uai Bobo 2: excavation extended to rear chamber, Squares GH and I. The baulk on the right, comprising Squares D, J and K, was later removed. The bamboo ladder was used for access to the lower levels of the excavation



a



b

c

Plate 44

undisturbed for a thin yellowish-brown oxidised soil layer could be seen underlying the white ash (Plate 44b). But in most cases hearths had been scattered into irregular patches of ash and charcoal. Apart from the pit in Square B already mentioned, a few small holes were found and excavated separately. They never contained more than an occasional flake or sherd, and are probably the remains of small temporary structures such as those found today in caves on the Baucau Plateau.

A rather puzzling feature was found in Horizon IX just below a thick bed of white ash, 1 m below the surface where we uncovered two circles of white ash 8 cm in diameter. One of these was sectioned (Plate 44c) and the ring of white ash surrounding the brown earth could be seen clearly. The most likely explanation seems to be that these were made by large bamboo posts driven through the white ash layer which later filled the impressions in the brown earth below when the posts were removed. No finds were made in the post fills, but six pierced shell discs were found immediately to the southwest of them, three each in Squares B13 and B14.

Below about 1.7 m the deposit changed to a fairly uniform brown earth which continued to base rock, interrupted only by occasional hearth lines or patches of scattered charcoal.

The trench was excavated in 195 units which were combined into 13 horizons for the analysis of the remains as shown in Table 94.

The volume of each unit was calculated and the figures combined to give the horizon volumes set out in Table 95.

RADIOCARBON DATES AND CHRONOLOGY

Four samples were submitted to the ANU Radiocarbon Dating Laboratory:

3740 ± 90 BP	ANU-239	Square A13, Horizon IX
5520 ± 60 BP	ANU-187	Square A19, Horizon VII
7010 ± 125 BP	ANU-328	Square A30, Horizon IV
13,400 ± 520 BP	ANU-238	Squares IK8 and IK9, Horizon I

The first three samples comprised wood charcoal from discrete hearths, but for ANU-238, charcoal taken from two hearths 20-30 cm above the rock floor in Squares IK8 and IK9, was supplemented with bone fragments from the same hearth, and with 12 gm of seed cases found scattered throughout Horizon I. The seed cases will be discussed later.

Figure 48 shows how these radiocarbon dates can be used to estimate the timespan accounted for by each horizon and so provide a chronological framework against which to understand the analysis of artifact and faunal materials. Table 96 provides a brief summary of this for ease of reference.

All the caves in the area are still in occasional use and in Uai Bobo 2 this was shown by the presence of seven pieces of green bottle glass coming from two different bottles, and a single piece of copper wire. Seven of these modern objects were in Horizon XIII and the other one in

Opposite

Plate 44a Uai Bobo 2: excavating Horizon I at base of rear chamber. Sample ANU-238 (13,400 ± 520 BP) was taken from a hearth at this level and from *Celtis* seeds found scattered throughout Horizon I

b Uai Bobo 2: undisturbed hearths in south section of Square IK just above base rock. Charcoal and bone fragments from another hearth at an equivalent level were used for sample ANU-238

c Uai Bobo 2: ash circles in Square B, Spits 12-13, Horizon VIII The irregular edge of deposit beyond the circle was caused by the collapse of a section

Horizon	A	B	C	D	E	F	G	H	I	J	K	GH	GHK	IK
	Square													
XIII	1,2,3	1,2,3	1,2	1,2	1,2,3	-	-	-	-	-	-	-	-	-
XII	4,5 5a,6	(pit)	3	3,4	4,5	-	-	-	-	-	-	-	-	-
XI	7,8	(pit)	4	5,6,6a	6	-	-	-	-	-	-	-	-	-
X	9,10 11	9,10 11	5,6,7	7,8,9	7,8,9	-	-	-	-	-	-	-	-	-
IX	12,13	12,13	8,9,10	10,11	-	-	-	-	-	-	-	-	-	-
VIII	14,15 16,17	14,15	11,12 13	12,13 13b	-	1	1	-	-	1	-	-	-	-
VII	18,19 20,21	16,17 18,19 20,21 22	14,15 16,17 18	14,15 16,17 18	-	2,3 4	2,3 4,5	1,2,3 4,5	1,2,3 4	2,3	-	-	-	-
VI	22,23 24	23,24 25	-	19,20	-	5,6	6,7	6,7	5,6	-	-	-	-	-
V	25,26 27,28	26,27 28,29	-	21,22 23	-	7,8 9	8,9 10	8,9 10	7,8	-	-	-	-	-
IV	29,30 31,32	30,31 32,33	-	-	-	-	11	11	9,10 11	-	1,2	12,13 14	-	-
III	33,34 35,36	-	-	-	-	-	-	-	12,13 14,15	-	-	15,16 17	-	-
II	37,38	-	-	-	-	-	-	-	16,17	-	3,4	18,19	5,6	5,6
I	-	-	-	-	-	-	-	-	-	-	-	-	9	7,8,9

Table 94 Uai Bobo 2: spit correlations

Horizon	m^3
XIII	0.95
XII	0.78
XI	0.54
X	1.34
IX	0.92
VIII	1.62
VII	3.68
VI	1.28
V	2.35
IV	2.23
III	1.53
II	1.69
I	0.53
Total	19.44

Table 95 Uai Bobo 2: horizon volumes

Horizon XII. On the basis of these finds I have assumed in Table 96 and Figure 48 that the top few centimetres represent the last 100-200 years.

In order to construct Table 96 and the graph in Figure 48 the procedures recommended by Polach and Golson (1966:22) have been followed. The dates have been increased by 3% to adjust them to the best half-life of C14 of 5730 ± 30 years, and then rounded to the nearest 100 years. The errors have been increased to a minimum of 200 years for two standard deviations. The converted dates are as follows:

3,900 ± 200 BP	ANU-239
5,700 ± 200 BP	ANU-187
7,200 ± 200 BP	ANU-328
13,800 ± 1000 BP	ANU-238

On Figure 48, the vertical axis represents the depth of the deposit, and the horizontal axis, the time over which the deposit has accumulated. Each dated sample is indicated by a diamond of which the height indicates the depth over which the sample was collected, and the width two standard deviations. Lines projected from the vertical axis show the mean depth of the horizon boundaries. Where these lines intersect linking the four samples, the dating range for the horizon boundaries can be read. As the sample dates are shown at two standard deviations, there is a good probability that the range includes the real date. The mid-point of this range, rounded up to 100 years is taken as a convenient reference date for the horizon boundaries. The dates thus obtained, are given in Table 96. Correlations between the sequences from other sites and that at Uai Bobo 2 are made according to the chronology given by this table.

Horizon	Horizon boundaries, range in years BP Minimum	Maximum	Rounded mid-point in years BP
	modern		
XIII			
	600	900	700
XII			
	1400	1700	1500
XI			
	1900	2200	2000
X			
	3200	3800	3500
IX			
	3800	4300	4000
VIII			
	5000	5200	5100
VII			
	5700	6200	5900
VI			
	5900	6500	6200
V			
	6300	7000	6600
IV			
	7400	8200	7800
III			
	9300	10,600	9900
II			
	10,600	12,200	11,400
I			
	13,800	15,800	14,800

Table 96 Uai Bobo 2: proposed chronology

THE DISTRIBUTION OF FLAKED STONE

As with Uai Bobo 1 the greatest density of flaked stone occurs towards the middle of the site, although at Uai Bobo 2 there is even less at the very top and bottom. Table 97 lists the number of waste flakes, cores and trimming flakes, utilised flakes and implements with secondary working. Table 98 gives the density of waste flakes as the number per m^3. These proportions are shown in Figure 50 where they can be compared with those for the assemblages from the other three excavated sites. In Table 101 a typological breakdown of the worked and utilised stone is given.

Horizon	Waste flakes Nos	%	Cores and trimming flakes Nos	%	Utilised flakes Nos	%	Flakes with gloss Nos	%	Secondary working Nos	%	Total nos
XIII	25	78	1	3	6	19	-	-	-	-	32
XII	8	80	-	-	1	10	-	-	1	10	10
XI	12	85	-	-	2	15	-	-	-	-	14
X	168	85	3	2	14	7	2	1	9	5	196
IX	1058	91	3	-	36	3	27	2	40	4	1164
VIII	1205	89	15	1	61	5	23	2	45	3	1349
VII	2190	90	27	1	79	3	44	2	95	4	2435
VI	324	88	-	-	17	5	9	2	18	5	368
V	273	87	5	2	14	4	3	1	19	6	314
IV	71	90	-	-	2	3	1	1	5	6	79
III	6	86	1	14	-	-	-	-	-	-	7
II	-	-	-	-	-	-	-	-	-	-	-
I	-	-	-	-	1	-	-	-	-	-	1
Total	5340	89	55	1	233	4	109	2	232	4	5969

Table 97 Uai Bobo 2: numbers and percentages of waste and utilised flaked stone

Horizon	Nos	No. per m^3	% per m^3
XIII	25	25	1
XII	8	10	-
XI	12	24	1
X	168	129	4
IX	1058	1176	38
VIII	1205	753	24
VII	2190	592	19
VI	324	249	8
V	273	114	4
IV	71	32	1
III	6	4	-
II	-	-	-
I	-	-	-
Total	5340	-	100

Table 98 Uai Bobo 2: waste flake density

Horizon	Nos	Mean weight (gm)
XIII-XI	45	1.4
X	168	1.9
IX	1058	1.6
VIII	1205	1.9
VII	2190	1.7
VI	324	1.5
V	273	1.2
IV-III	77	1.7
Total nos	5340	-

Table 99 Uai Bobo 2: waste flake mean weights

Horizon	Waste flakes as % of total stone	Worked and utilised stone only: Cores and trimming flakes	Utilised flakes	Flakes with gloss	Secondary working
XIII-XI	80	10	80	-	10
X	86	11	50	7	32
IX	91	3	34	25	38
VIII	89	10	42	16	32
VII	90	11	32	18	39
VI	88	-	39	20	41
V	87	12	34	8	46
IV-I	87	10	30	10	50

Table 100 Uai Bobo 2: percentages of the main categories of flaked stone

Because of the small numbers at the top and bottom of the site, some of the horizons have been grouped (Table 100) to give larger samples for the comparison of the proportions of the main classes of flaked stone at the various levels. The weight of waste flakes was divided by the number in each horizon (Table 99) to see if there was any tendency for the size of waste to change throughout the occupation of the site. As in Uai Bobo 1, no consistent trend was found.

Horizon	Cores	Trimming flakes	Utilised	Gloss	Side scrapers	Thumbnail scrapers	End scrapers	Nosed scrapers
XIII	1	-	6	-	-	-	-	-
XII	-	-	1	-	1	-	-	-
XI	-	-	2	-	-	-	-	-
X	3	-	14	2	4	-	-	-
IX	3	-	36	27	22	-	1	-
VIII	14	1	61	23	21	-	1	-
VII	21	6	79	44	60	1	2	1
VI	-	-	17	9	10	-	-	-
V	5	-	14	3	13	-	-	-
IV	-	-	2	1	3	-	2	-
III	1	-	-	-	-	-	-	-
II	-	-	-	-	-	-	-	-
I	-	-	1	-	-	-	-	-
Total nos	48	7	233	109	134	1	6	1

Horizon	Adzes	Burins	Choppers	Broken edges	Misc. and irregular	Total nos
XIII	-	-	-	-	-	7
XII	-	-	-	-	-	2
XI	-	-	-	-	-	2
X	-	1	-	-	4	28
IX	1	-	1	5	10	106
VIII	-	1	-	7	15	144
VII	-	-	1	8	22	245
VI	-	-	-	4	4	44
V	-	-	1	3	2	41
IV	-	-	-	-	-	8
III	-	-	-	-	-	1
II	-	-	-	-	-	-
I	-	-	-	-	-	1
Total nos	1	2	3	27	57	629

Table 101 Uai Bobo 2: typological breakdown of worked and utilised flaked stone

Analysis of cores

There were no marked differences between the cores from Uai Bobo 1 and Uai Bobo 2 apart from two exceptionally large cores in the latter site, each over 10 cm in diameter, from Horizons IX and VII (Fig.42e). Both of these cores are well outside the normal range of variation and show negative flake scars up to 70 mm long. These are the only cores large enough to have produced the size of flakes used for the common forms of secondarily worked tools. This suggests that most of the larger tools were not made at the caves, but brought in ready made. Flint working on the site seems to have been confined, for the most part, to producing the small flakes used for light cutting and scraping jobs, and to resharpening the larger artifacts.

Forty-four of the 48 cores were multi-platform (Type 1), two were disc cores (Type 2), and two had straight opposed platforms (Type 3). Tables 102 and 103 give the mean sizes and numbers of platforms, and Table 104 the ratio of cores to waste flakes. Some of the horizons have been grouped to provide larger samples.

The two large cores mentioned distort these distributions and partially account for the large standard deviations. The reduction in mean core size is not significant because of the great variability.

Analysis of utilised flakes

The same forms of utilisation were found in Uai Bobo 2 as in Uai Bobo 1, and of the 342 utilised flakes, 109 had traces of edge gloss. Of the 233 without gloss, 151 (65%) were

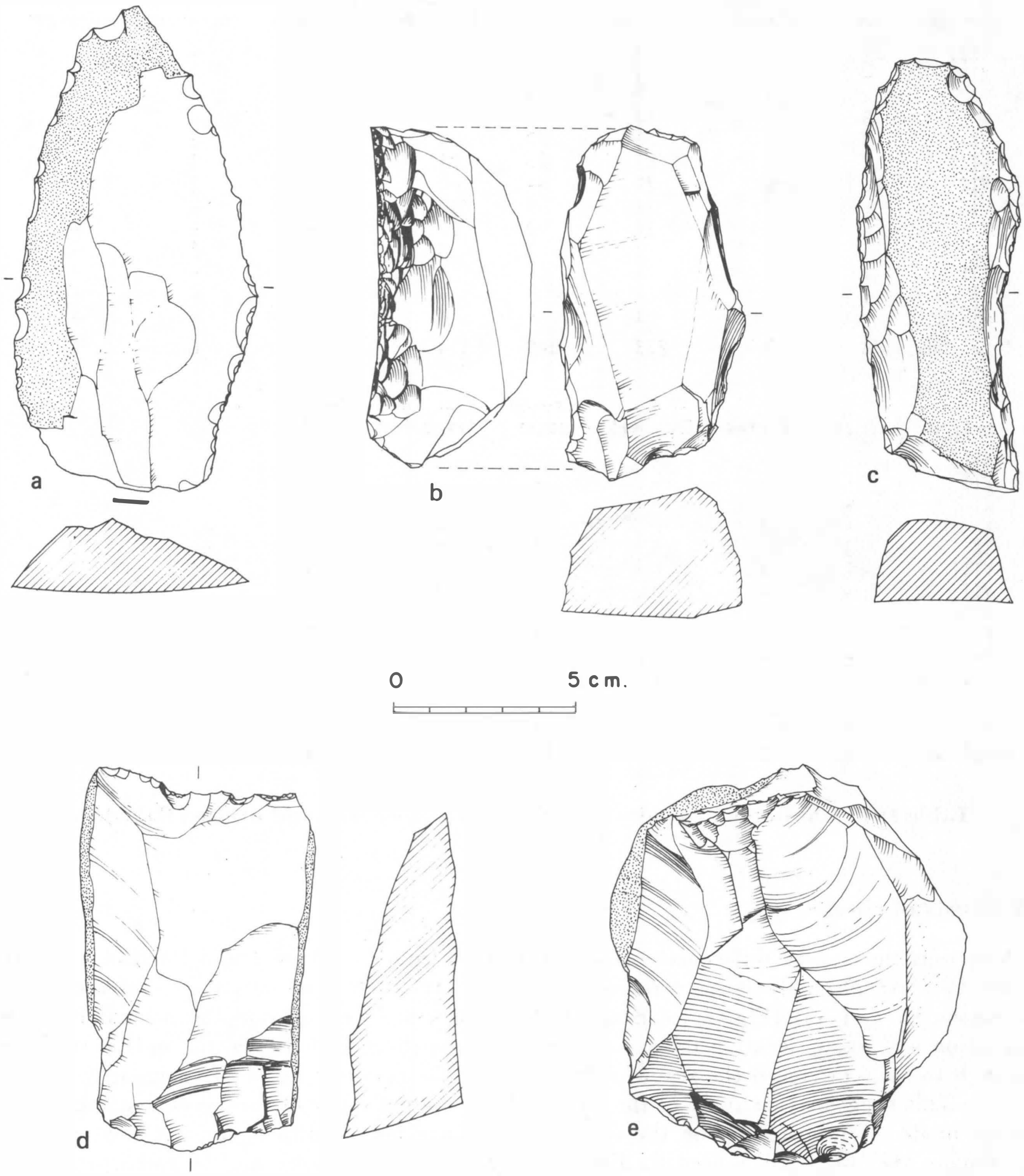


Fig.42 Uai Bobo 2: flaked stone tools

a 126, large pointed flake with battered edges, coarse chert, Square B(12), Horizon IX
b 531, side scraper, two worked edges, Square D(14), Horizon VII
c 229, side scraper, two worked edges, Square A(15), Horizon VIII
d 701, end chopper, or cleaver, Square D(22), Horizon V
e 108, large multi-platform core, collapsed baulk, Horizon IX

Artifacts are shown bulbar face down. The position of the striking platform of a only is shown by a broad line

Horizon	Nos	$\bar{x}$	s
XIII-VIII	19	40.9	15.6
VII-III	27	32.3	21.6
Total nos	46	-	-

Table 102 Uai Bobo 2: diameter of unbroken cores, measurements in mm

No. platforms	No. cores
1	14
2	27
3	5
4	1

Table 103 Uai Bobo 2: number of separate striking platforms per core, for all horizons

Horizon	Ratio
XIII-IX	1:80
VIII	1:86
VII	1:105
VI-I	1:110

Table 104 Uai Bobo 2: ratio of cores to waste flakes

	Length		Breadth		L/B ratio	
Horizon	$\bar{x}$	s	$\bar{x}$	s	>2:1	Nos
XIII-X	39.3	15.6	26.6	9.7	26	12
IX-VIII	36.3	10.2	24.1	8.5	26	69
VII	33.9	11.7	21.7	6.9	26	51
VI-I	35.6	15.8	27.8	8.4	-	19
Total nos	-	-	-	-	-	151

Table 105 Uai Bobo 2: size and proportions of simple utilised flakes, measurements in mm

	Length		Breadth		Length of glossy edge					
Horizon	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	Nos	Gloss on both surfaces	Secondary working	Total
X-IX	44.5	13.1	24.3	14.3	9.5	2.6	21	19	2	29
VIII	39.1	17.8	25.3	9.0	7.5	3.1	19	18	-	23
VII	48.1	11.0	26.8	6.6	9.4	3.9	33	37	5	44
VI-IV	42.4	9.0	21.0	6.2	8.0	3.2	7	6	-	13
Total nos	-	-	-	-	-	-	80	80	7	109

Table 106 Uai Bobo 2: flakes with gloss utilisation, measurements in mm

complete flakes and their measurements are given in Table 105. As in Uai Bobo 1 there is a smaller proportion of blades in the lower levels of the site.

Of the 109 flakes with utilisation gloss, 80 (73%) were complete flakes, and only these were measured (Table 106).

The length and breadth of these flakes neither differs much over time, nor from other utilised flakes, suggesting that there was little difference in the scale of work performed by the two. The small samples and great variability make statistical tests unwarranted. As in Uai Bobo 1, only a small percentage of flakes with gloss also have secondary working. One of these (Fig.43c) is a blade with one thick margin trimmed as if for hafting. Other flakes with glossy utilised edges are illustrated in Figure 43b, d-g.

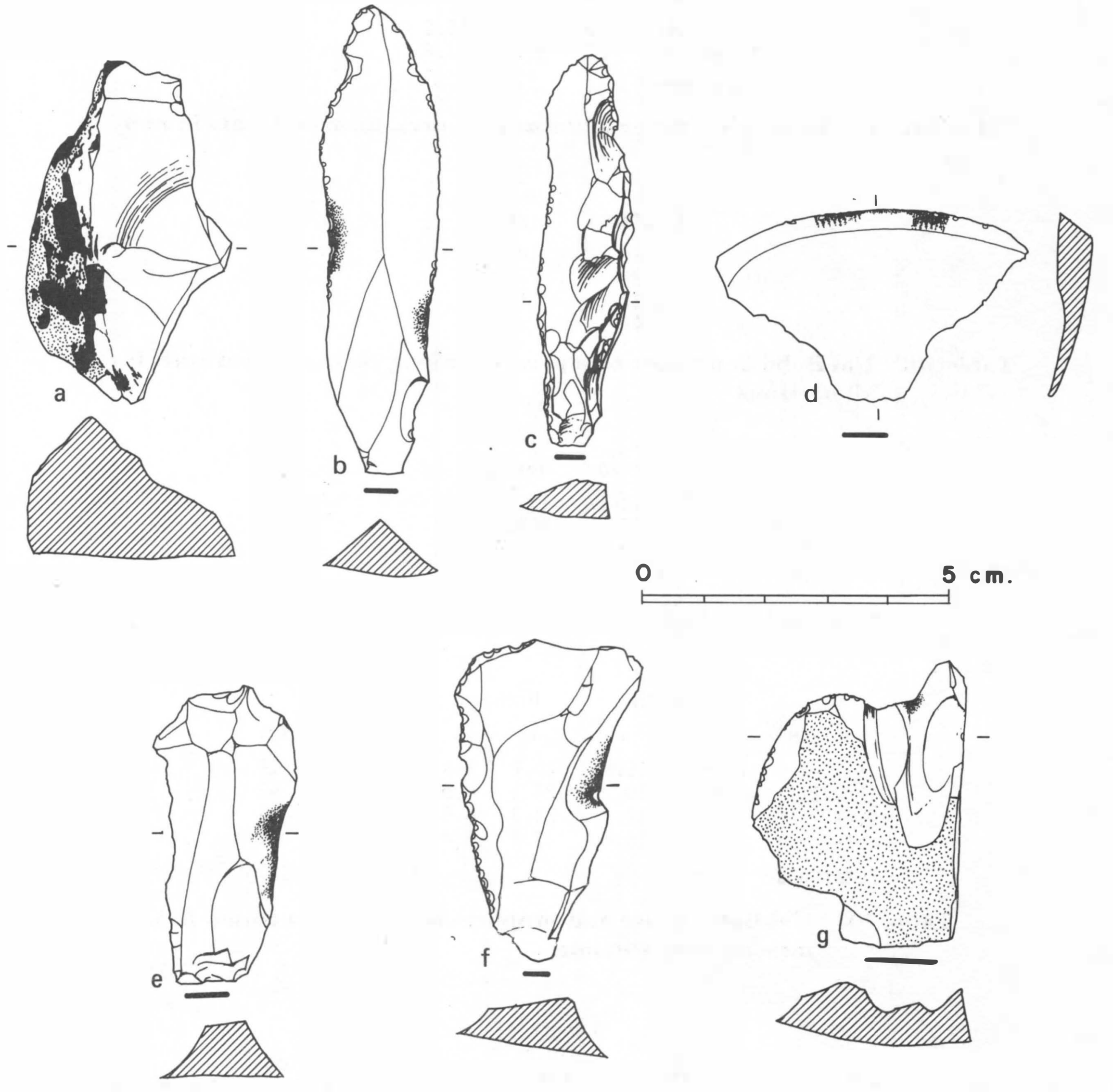


Fig.43 Uai Bobo 2: flaked stone tools

a 645, broken flake with gum adhering to cortex, Square F(6), Horizon V
b 115, blade with silica gloss on both edges, Square A(13), Horizon IX
c 131, utilised blade, right edge thinned and steeply worked, Square D(10), Horizon IX
d 203, flake with silica gloss on distal end, Square A(16), Horizon VIII
e 445, flake with silica gloss on right edge, Square C(15), Horizon VII
f 458, flake with silica gloss on right edge, Square B(19), Horizon VII
g 446, flake with silica gloss in notch on distal end, Square H(2), Horizon VII

All artifacts except d are shown with bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

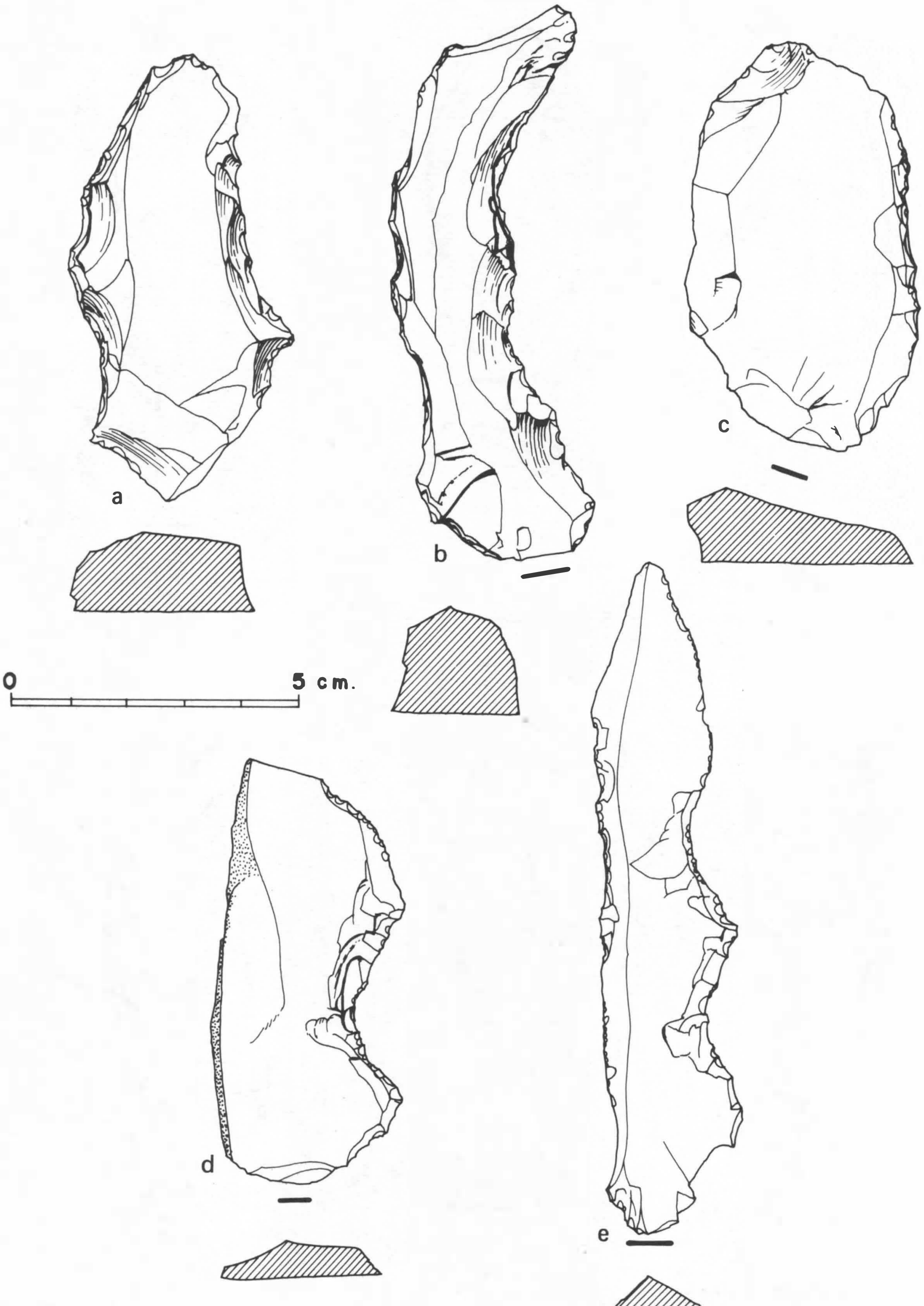


Fig.44 Uai Bobo 2: scrapers

a 141, side scraper, two worked edges. Square C(10), Horizon IX
b 140, side scraper, two worked edges. Square C(10), Horizon IX
c 127, side scraper, one worked edge, Square B(12), Horizon IX
d 561, side scraper, one worked edge, Square H(2), Horizon VII
e 584, blade scraper, three worked edges, Square F(3), Horizon VII

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

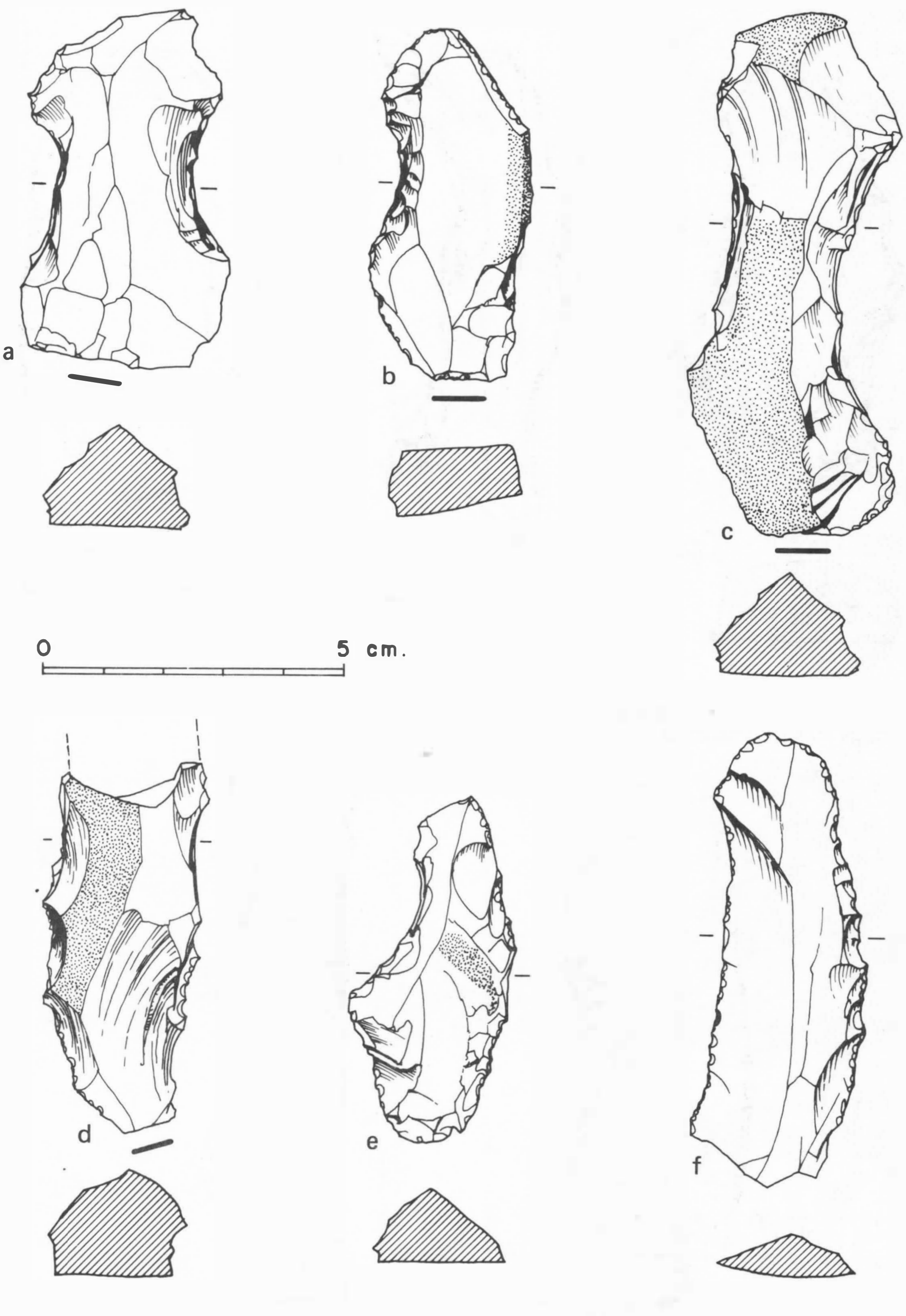


Fig.45 Uai Bobo 2: scrapers

a 533, side scraper, two worked edges, Square D(14), Horizon VII
b 552, side scraper, two worked edges, Square B(21), Horizon VII
c 537, side scraper, two worked edges, Square H(2), Horizon VII
d 727, broken scraper, two worked edges, Square F(9), Horizon V
e 732, side scraper, two worked edges, Square D(22), Horizon V
f 756, side scraper, one worked edge, one utilised, Square B(33), Horizon IV

Artifacts are shown bulbar face down. The position of the striking platform on complete flakes is shown by a broad line

Analysis of side scrapers

The same range of side scrapers was found in Uai Bobo 1; their distribution throughout the site is given in Table 101 and many are illustrated in Figures 42, 45 and 46. Some of these tools merit comment:

Figure 42b is a large, carefully made, steep-edge scraper which, aesthetically, is one of the most attractive stone tools from the excavations.

Figure 44b is a long curved scraper 'slug' showing extensive use and resharpening; edges are steep and step-flaked.

Figure 44e is a long blade with two carefully worked notches, and one straight edge on the opposite margin.

Figure 45c has two concave edges, both steep and overhanging the base.

Figure 45e is a small tool with one steep notched edge, and one straight.

For the analysis of attributes the 13 horizons have again been grouped as shown in Table 107 to yield assemblages large enough for comparison between levels and between sites. In the following tables these are compared one against each other in terms of the various continuous attributes described in Chapter IV.

Assemblage	Horizon	Nos	% of secondarily worked artifacts
1	XII-IX	27	54
2	VIII	21	47
3	VII	60	63
4	VI-IV	25	62
Total nos	-	133	-

Table 107 Uai Bobo 2: side scrapers grouped for attribute analysis

Although the stone tools in the Uai Bobo sites were not so badly broken as those in the caves at the coast, there were many on which only some attributes could be recorded; usually angle and height of the working edges. In the following tables, therefore, the sample size used for each attribute is noted alongside the mean and standard deviation. Tables 108 and 109 list the values for the continuous attributes relating to either the complete artifact, or the principal working edge. Second or third edges were too few to make the values numerically meaningful. Table 110 gives the results of tests for the significance of differences between the mean values of the continuous attributes. Values for *t* are given for the greatest difference between any two assemblages for each attribute, not for all combinations of assemblages. Where the greatest difference is not significant at the levels of probability specified, other mean differences are also not significant. The distribution of the values for weight was too skewed, and $\frac{T}{\text{length}}$ ratios too variable to make significance tests warranted. Log weights were recorded but there was difficulty in handling these on the same computer program as other attributes because of the differences in the size of the numbers.

As in Uai Bobo 1, side scrapers, which are the dominant stone tool type, show no systematic changes over time in size, proportions and edge characteristics.

	Length			Breadth			Thickness			Weight		
Assemblage	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos	$\bar{x}$	s	Nos
1	62.7	16.6	18	31.0	8.0	19	14.6	5.6	20	30.7	23.6	19
2	69.1	25.1	11	40.8	13.2	11	17.5	5.0	14	51.7	51.4	10
3	60.1	15.7	42	32.7	6.3	48	13.7	5.3	53	27.1	31.6	42
4	57.3	12.4	15	35.6	12.3	17	15.7	5.3	22	30.9	28.3	15

Table 108 Uai Bobo 2: side scraper dimensions: linear measurements (mm), weight (gm)

Assemblage	$\frac{B}{L}$ ratio* $\bar{x}$	s	Nos	$\frac{T}{B}$ ratio $\bar{x}$	s	Nos	Edge-height $\bar{x}$	s	Nos	Edge-angle $\bar{x}$	s	Nos
1	5.2	1.5	18	0.4	0.5	19	8.0	5.7	27	80°	13	27
2	6.6	3.6	11	0.4	0.5	10	8.6	4.9	19	81°	17	20
3	5.7	1.5	42	0.3	0.5	48	7.0	3.3	56	77°	16	58
4	6.5	2.4	15	0.5	0.5	17	8.0	2.9	20	83°	12	25

*$\frac{B}{L}$ ratio has been multiplied by 10 for computing purposes

Table 109 Uai Bobo 2: side scraper proportions and edge attributes (continuous)

Attribute	Greatest difference is between assemblages	Value for student's *t*	Degree of freedom	Differences significant at probability levels of 5%, 1% and 0.1%
Length	2:4	1.584	24	not significant
Breadth	1:2	2.554	28	significant at 5%
Thickness	2:3	2.413	64	significant at 5%
$\frac{B}{L}$ ratio	1:2	1.467	27	not significant
Edge-height	2:3	1.603	73	not significant
Edge-angle	3:4	1.680	81	not significant

Table 110 Uai Bobo 2: significance of side scraper attribute mean differences

Other retouched flaked stone tools (Figs 42, 46)

As in Uai Bobo 1 there is a small number of carefully worked tools which do not fit into any of the categories already mentioned.

Figure 42a is a large leaf shaped flake (132 x 62 x 23 mm), with bifacial battering around most of the perimeter. It is made of a much coarser chert than most of the tools in the Uai Bobo sites, and looks quite out of place in the industry. There is no doubt that it is a deliberately struck flake and I have a feeling, which is impossible to substantiate, that it may belong to another and possibly older industrial tradition in Timor and has been brought into the cave as a chance find in the past. A similar large flake was found in Bui Ceri Uato, Horizon VI.

Figure 42d is a chopper or cleaver, with bifacial working on the narrow end. This is a pseudo-flake without a proper platform and bulb, but the chopping edge has been prepared by the removal of a 'tranchet' flake.

Figure 46a is a broken flake converted into a burin by two parallel vertical blows; the beak has some fine utilisation scars.

Figure 46b is a broken side scraper converted into a burin by a single vertical blow, with utilisation on the beak. As with the burins from Uai Bobo 1 there must be some doubt about the function of these tools, even if they are deliberately made, until larger numbers and more certain examples are found.

Figure 46d is a trapezoidal shaped flake with bifacial flaking on both margins. The shape is not accidental and resembles that of the flaked adzes in Nikiniki 1 (Glover 1972c) and Artifact 1341 from Uai Bobo 1 (Fig.34e) which rather hesitantly, is also called an adze. On the other hand, the bifacial flaking is similar to that on the scalar cores of Australia, New Guinea and elsewhere.

Figure 46h is a small, finely worked scraper, like the thumbnail scrapers of Uai Bobo 1 (Fig.35k-m); its dimensions are 19 x 17 x 5 mm.

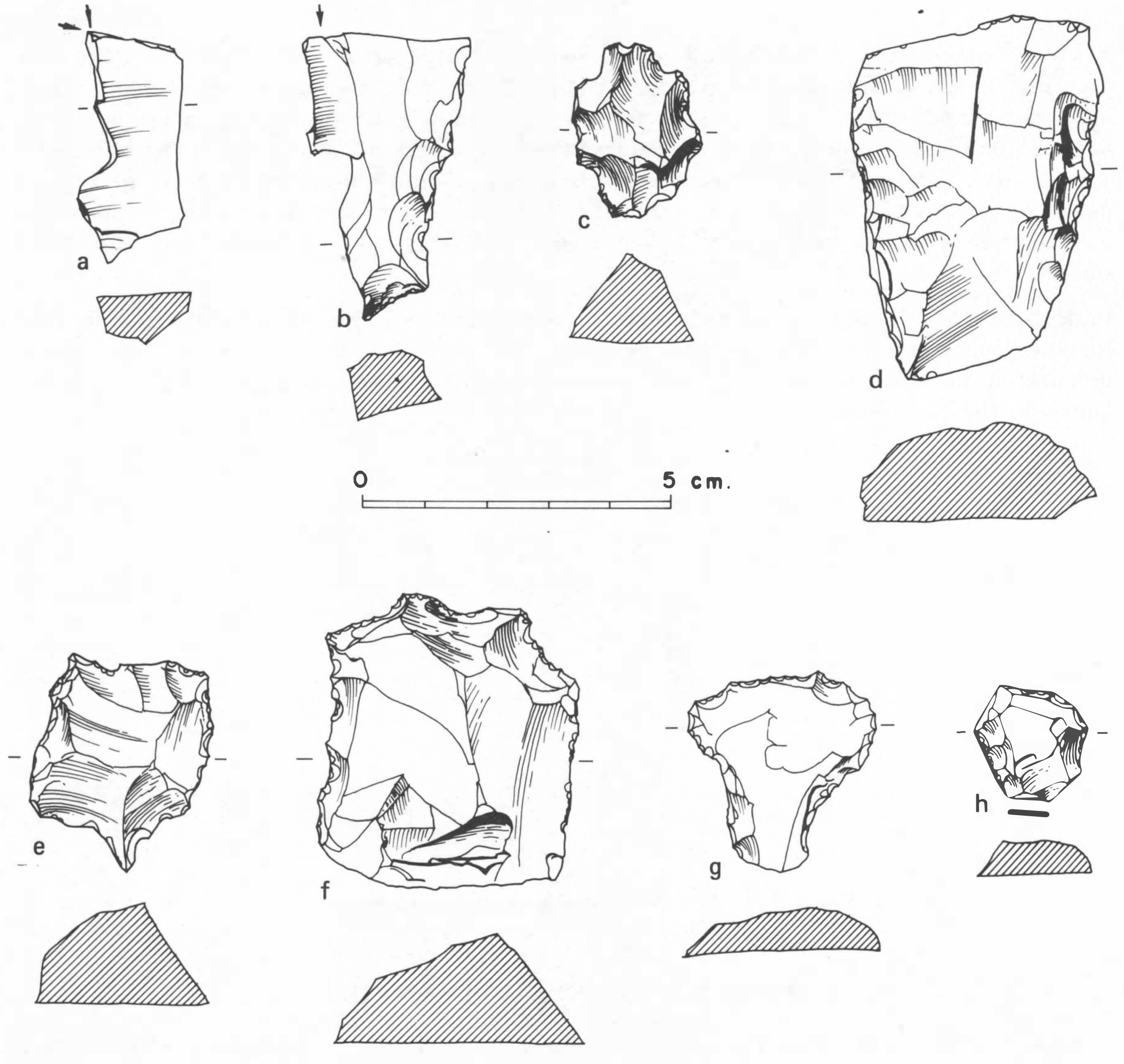


Fig.46 **Uai Bobo 2: flaked stone tools**

- a 57, burin, Square C(6), Horizon X
- b 260, burin, two spalls removed from left margin. Made on broken scraper, Square G(1), Horizon VIII
- c 166, pyramidal core, single platform, Square B(12), Horizon IX
- d 165, flaked adze, bifacially worked on two margins, Square B(12), Horizon IX
- e 742, pyramidal core, single platform, Square B(26), Horizon V
- f 754, end and side scraper, Square A(31), Horizon IV
- g 755, broken end and side scraper, Square A(29), Horizon IV
- h 583, thumbnail scraper, Square B(20), Horizon VII

Artifacts are shown bulbar face down. The position of the striking platform of h only is indicated by a broad line

OCHRES

A small stone dish or palette was found in Square A(14), Horizon VII (Plate 46h), the only such find in any of the caves excavated. It is nearly circular, two diameters at right angles measure 86 and 81 mm, and it varies from 4-7 mm in thickness. The curvature is largely natural, for the dish appears to be a product of exfoliation from a shaley nodule with limonite segregations. Part of the interior surface is preserved and shows an irregular pattern of parallel grooves which suggests that either the dish itself was ground to obtain ochre, or ochre from elsewhere was ground in it. The outer edge is roughly cut and bevelled from the lower surface.

In Horizons V, VI and VII a few pieces of ochre showing signs of grinding (Table 111) together with the probable palette, suggest that activities at the site included paint preparation for body decoration, or for some portable objects, certainly no rock paintings are known in the immediate area.

Horizon	Weight of ochre (gm)	No. of pieces with ground faces	Ochre 'palette'
XIII	-	-	-
XII	-	-	-
XI	-	-	-
X	-	-	-
IX	251	-	-
VIII	19	-	-
VII	291	1	1
VI	31	2	-
V	17	2	-
IV	1	-	-
III	-	-	-
II	-	-	-
I	-	-	-
Total	610	5	1

Table 111 Uai Bobo 2: distribution of ochre

HAMMER STONES AND ANVILS

Compared with the Bui Ceri Uato site there was little evidence in Uai Bobo 1 or Uai Bobo 2 for regular stone flaking. The lower ratio of cores to worked tools (Fig.50) is matched by the small number of identifiable hammer stones. None was found in Uai Bobo 1, and only three in Uai Bobo 2; two in Horizon VII, and one in Horizon VIII, weighing 395, 380 and 500 gm respectively. Horizon VII also contained a pebble anvil with a small, irregular, pitted depression in one of the flat, broad surfaces, and there was a pebble grinding stone in Horizon VIII with one surface ground flat and slightly polished. Given the relationship between the proportion of cores and the large number of utilised pebbles at Bui Ceri Uato, it seems reasonable to interpret these stones in Uai Bobo 2 also as hammers and anvils for stone flaking, rather than tools for food preparation. In many cases, however, such pebbles probably had multiple functions even if they were brought onto the site primarily for stone working.

ANALYSIS OF POTTERY

In Chapter IV I outlined various approaches to the measurement of pottery frequency and mentioned the experiment made with the pottery from Uai Bobo 2. Four measures of pottery frequency were compared, by sherd count, weight, surface area and count of vessel rim sherds, and the various figures are given in Tables 112 and 113.

From these figures, percentage distributions and a rank order table of pottery frequency were

Horizon	Count	Weight (gm)	Area	Rims
XIII	837	2160	3012	20
XII	387	1436	2033	13
XI	299	1309	1553	18
X	947	4919	6037	28
IX	165	1259	1370	8
VIII	76	306	425	2
Total	2711	11,389	14,430	89

Table 112 Uai Bobo 2: pottery frequency

Horizon	Count	Weight	Area	Rims
XIII	880	2271	3167	21
XII	490	1818	2573	17
XI	559	2447	2865	34
X	709	3682	4519	31
IX	180	1371	1492	9
VIII	47	189	263	1
Total	2865	11,778	14,879	113

Table 113 Uai Bobo 2: pottery frequency per m^3

calculated where it was shown that weight sherd count, surface area and a count of rims alone were mutually consistent measures of the relative proportions of pottery in the various levels of the site. Points to note about the distribution are that a small amount of pottery first appears in Horizon VIII, between the dated charcoal samples 5520 ± 60 BP (ANU-187) and 3760 ± 90 BP (ANU-239), which come, respectively, from Square A19, Horizon VII, at 1.6 m below the surface, and from Square A13, Horizon IX at 1.0 m below the surface. Within that square, the lowest pottery was found in Square A15 at 1.3 m and in other squares only a little deeper (in Squares D13, F1, G1 and J1). Given the absence of sealed floor levels, and the erratic redistribution of objects that must have taken place as the deposit accumulated, it seems best to date the introduction of pottery by taking the mid-point of Horizon VIII, that is to say about 4500 ± 200 years ago.

This is about 1000 years later than the date given for the first appearance of a domesticated animal in the site, but I am not prepared to distinguish between these events on the present evidence, since the numbers of bones and sherds in these levels are very small and a minor, unrecognised disturbance could significantly affect the associations between them.

To examine the effect of 'scuffage and treadage' on the distribution of material in the site, the locations of all sherds which could be joined together have been noted, and their relative positions analysed to determine the likelihood that the associations of material, as excavated, provides a true indication of their original association.

Pottery is particularly susceptible to this sort of investigation since scattered sherds can be fitted together and one can be reasonably sure that the vessels were whole when brought onto the site. Timorese cave pottery is rather less useful, however, than many wares because the simple forms, lack of decoration and thin body walls, make it difficult to join any but rim sherds. For these reasons only 167, or 6% of all sherds could be joined into 44 separate vessel parts. Of these, 57% came from the same spit and same square, 23% came from the same square but not the same spit, and 20% came from adjacent squares.

With nearly half the joining sherds coming from different excavation units there clearly has been some scattering of the surface materials. But looking at it another way, we can see that there is a good probability that joining sherds come from at least the same horizon for; 79% came from the same horizon, 18% came from adjacent horizons, and 3% came from non-adjacent horizons.

The 3% or five sherds, which came from non-adjacent horizons serve warning that there has been a vertical displacement of objects by disturbances which were not recognised during excavation. The maximum vertical distance separating any two sherds which could be joined together was 70 cm. For this reason, therefore, interpretations which depend on the position or associations of one or two objects only, must be tentative. However, those based on larger numbers can be relied on, a point to be remembered in the discussion of the faunal remains.

Rim sherds

The number of rim sherds in each horizon has already been given in Table 112. Many of these rims can be joined together and some rims which cannot be joined are clearly from the same vessel. Thus, the 89 rims can be grouped into 38 recognisable vessels. This is a small number when it is remembered that pottery has been used at the site for about 4500 ± 200 years. That is an average of one vessel every 120 years; a point to note also, when the use of the sites is discussed in Chapter IX. Making adjustments for a few vessels of which sherds are found in more than one horizon, the distribution of the 38 is given in Table 114. These recognised vessels depend on rims only and there may be quite a number of vessels in the deposit for which no rim sherds were recovered. An idea of this incomplete recovery can be gauged when one measures the percentage of the original rim circumference represented by each vessel. It ranges from 5%, a single sherd 2.5 cm long, to 73% on one vessel for which seven rim sherds could be joined together. The average for the entire site is only 24%. This I consider to be surprisingly low, when it is remembered that almost the entire deposit was excavated to below the pottery bearing level, except for just inside the entrance.

Horizon	Direct	Everted A	Everted B	Indeter-minate	Total
XIII	1	1	5	-	7
XII	-	3	-	1	4
XI	1	6	1	-	8
X	-	5	1	2	8
IX	2	5	2	1	10
VIII	-	-	1	-	1
Total	4	20	10	4	38

Table 114 Uai Bobo 2: distribution of rim forms by vessels

Three rim forms were found; (a) direct rims, (b) everted rims A (with marked thickening at neck); and (c) everted rims B (with no marked thickening at neck). The distribution of these three forms is given in Table 114, and they are illustrated in Figure 47. The difference between the two everted rim types was not very great and it is probable that, given a larger sample, a continuum would be found from Form A-B. Thus, although five out of the 10 everted B rims were found in the top horizon, I am not prepared to argue that there was a change in the preference for these in later times. It is a possibility, but no more.

Beyond this, it is not possible to recognise any change in rim characteristics over the 4500 years or so that pottery has been in use at the site. The changes are very small and can only be the result of a continuous and slowly developing tradition, with no abrupt breaks or the introduction of new styles or vessels forms.

Three decorated rims were found (Plate 45i, l), and part of one pot could be built up so that the relationship of the rim to decoration on the body wall could be seen. As on most other vessels where the position of decoration could be determined, it formed a horizontal band below the neck.

Recently, I have been able to make some qualitative, and admittedly subjective, comparisons between the excavated pottery from Timor and both modern and prehistoric wares from Java, Sulawesi and other parts of the Indonesian region. There is a lot in common throughout the whole area in the utilitarian forms; simple restricted shapes with round bases are almost universal for cooking, and the scarcity of other types in the excavated deposits in Timor confirm the impression that almost all of them were cooking pots. There is a greater range of

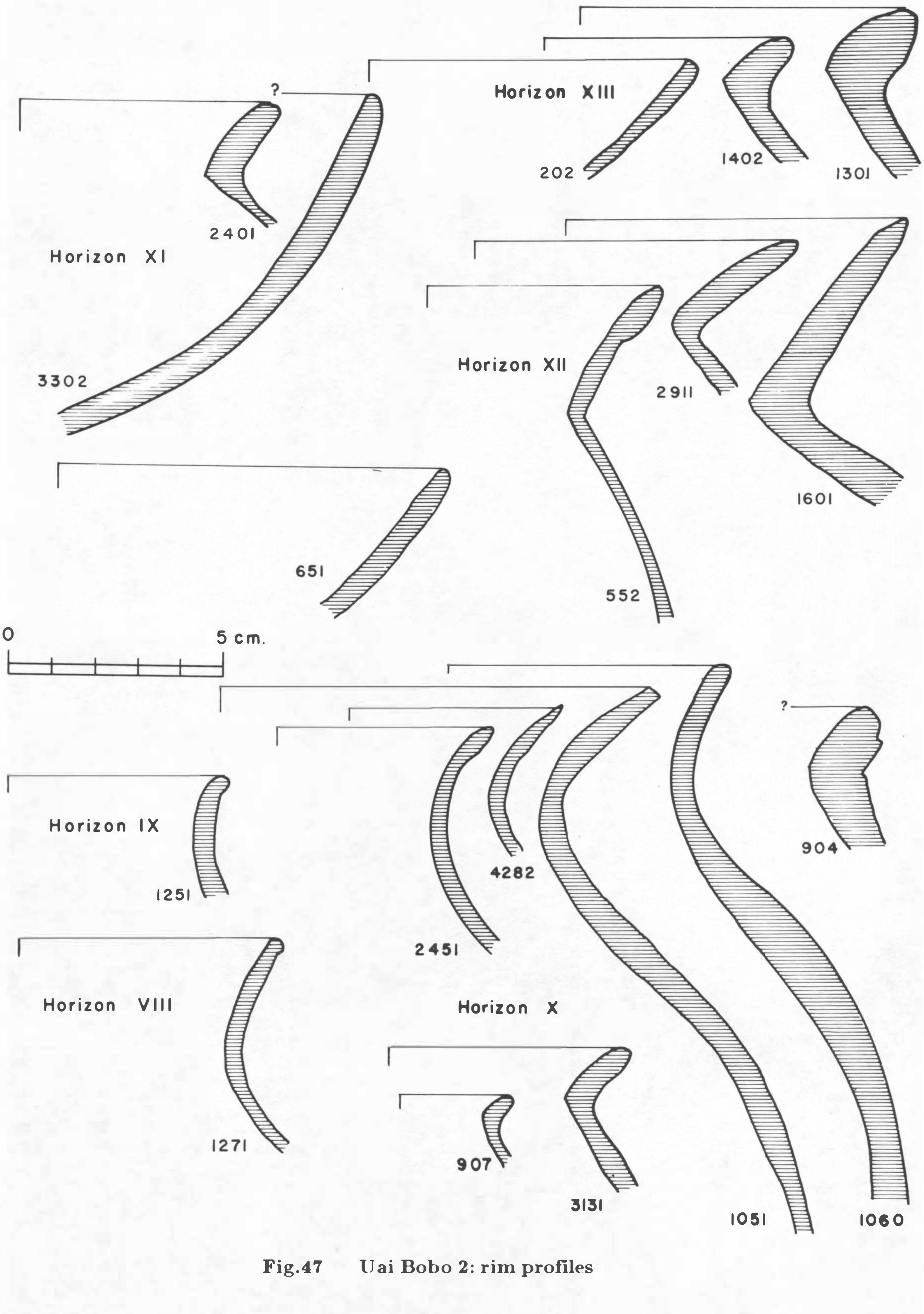


Fig.47 Uai Bobo 2: rim profiles

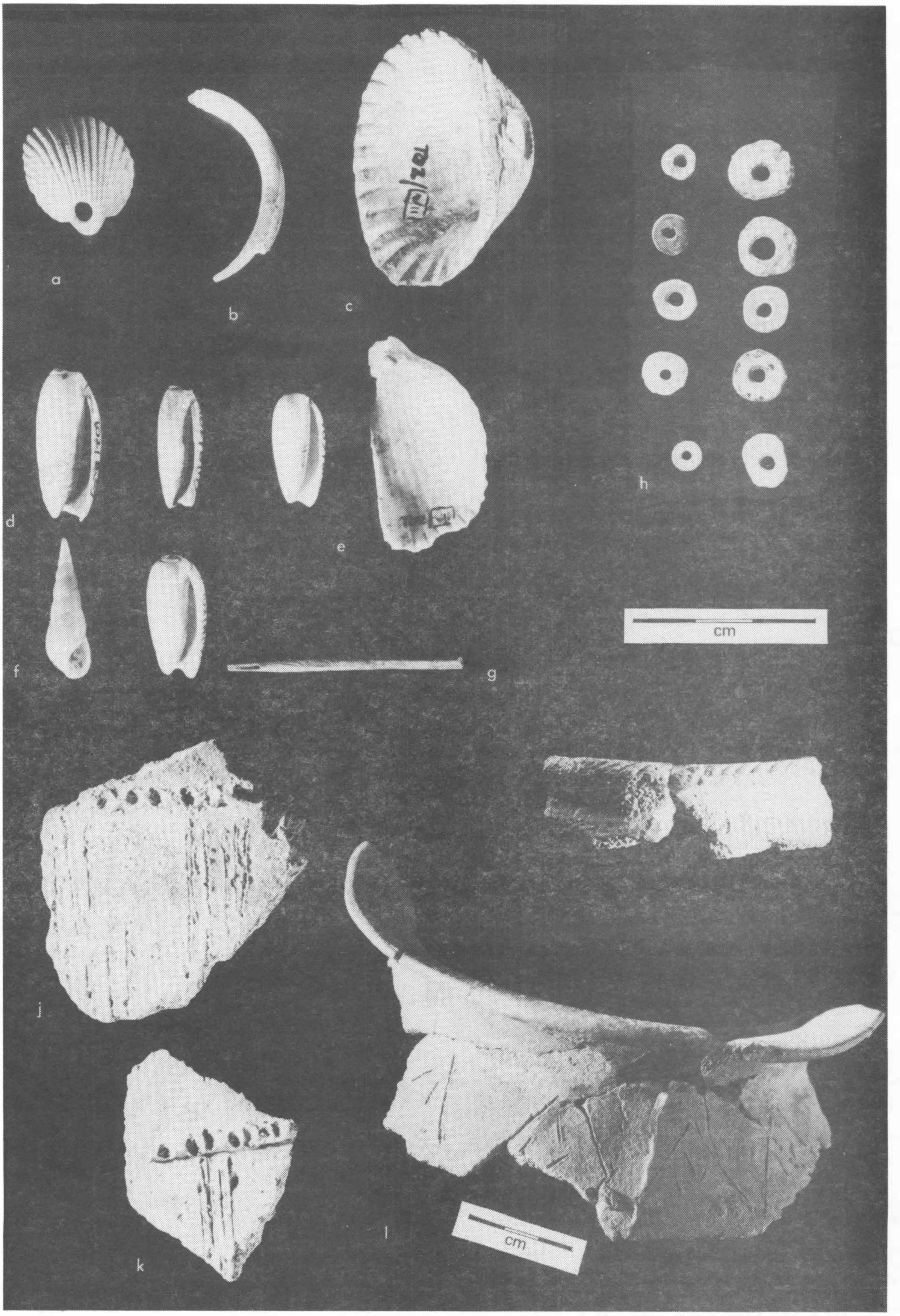


Plate 45

ring bases, footed bowls, stands and so on in pottery from Malaya (Sieveking 1956:Figs 8-23), Java and Sulawesi than so far known in Timor, but again, many of these are from villages, or from caves associated with burials and they may also be found in Timor in such sites. They are not entirely unknown, for one narrow-necked flask and two vessels with complex, but not reconstructable shapes, were found at Lie Siri (Plate 20). Rim forms on cooking and water pots from other parts of Southeast Asia are not easily distinguishable from those in Timor, but appear to be more varied. Recent pottery in many parts of Indonesia is either thrown or finished on a wheel; consequently shapes are more regular and rims in particular show characteristic parallel striations which are practically never found on Timorese pottery. The date for the introduction of wheel thrown or wheel finished pottery in Indonesia is not known for certain, but Heekeren (1958:82) says that some of the pottery in the urnfield at Anjar, Java was made on a wheel. The use of the potter's wheel is unknown in Timor even today, as far as I know. In an earlier paper I described the technique of pottery manufacture in Oralan Village, Vemasse, on the north coast, west of Baucau, one of the closest pottery making villages to the excavated sites (Glover 1969). There are, of course, stylistic differences between manufacturing areas, but the process of hand modelling followed by shaping and finishing with paddle and anvil seems to be universal. I never saw or heard of coil-built pottery in Timor, although Vroklage (1953(I):193-95) described a technique in which additional slabs of clay are added as the body is built up. The process seen by Jardim (1903) at Buruma, near Baucau, is identical to the way pottery is made in the *suco* today, and most of the vessel forms are the same as far as one can tell from this description, although some types, clay drums and square boxes, do seem to have been abandoned.

The body walls of most excavated sherds are noticeably thinner than is common in western Indonesia and Melanesia, but comparable data is difficult to find. At some Timorese sites there is a slight trend towards thinner pottery in more recent times, but the earliest wares are still remarkably thin. The pottery from the early metal age site at Gilimanuk in western Bali (Soejono 1962) appears to share more common features with Timorese pottery than most, although it exhibits a far greater range, and proportion of decorated pottery, than the Timorese sites. This, of course, may reflect the functional difference of the sites for Gilimanuk was a burial ground.

Plate 45 Uai Bobo 2: shell, bone and decorated pottery

Shell, bone tools and ornaments

- a ***Anadara pilula*** **with hole drilled at hinge, Horizon VII**
- b **Broken *Trochus niloticus* shell armlet, Horizon VIII**
- c ***Anadara granosa*, hole chipped at hinge, Horizon VII**
- d **Four olive shells (*Oliva ? brettinghami*), all pierced for threading, Horizons VI and VII**
- e **Broken *Cardium* sp. with hole at hinge and red ochre inside, Horizon VII**
- f ***Melania* sp., a freshwater gastropod, Horizon VIII**
- g **Polished bird bone ? needle, Horizon X**
- h **Ten pierced *Nautilus* (probably *N. pompillius*) shell discs. Horizon IX**

Decorated pottery

- i **907 and 2507, rim with incised decoration on lip. Vessel diameter 6 cm, Horizon X**
- j **660, 1803, body sherds with incised and applied decoration, Horizon XI**
- k **660, 1803, body sherds with incised and applied decoration, Horizon XI**
- l **906, 908, 909, 950, 951, 1052-59, 4281, rim and neck of vessel with incised and applied decoration, Horizon X. Fourteen sherds of this vessel were found but not all are illustrated**

Body sherds

Mention has been made of changes in body wall thickness over time. Table 115 shows that there is a small reduction in mean sherd thickness from the earliest pottery in Horizons VIII and IX, to Horizon XIII, although the trend is not always consistent, and a *t* test showed that it was not significant (Glover 1972a:302-3).

Horizon	$\bar{x}$	s	Nos
XIII	3.59	1.03	623
XII	4.54	1.17	387
XI	4.63	1.18	375
X	4.52	1.34	484
IX, VIII	4.87	1.55	256

Table 115 Uai Bobo 2: body wall thickness

Decoration

A small number of sherds with simple incised decoration occurred only in the middle of the pottery bearing levels (Table 116).

The two sherds in Horizon XI come from the same vessel and those in Horizon X from at least two others. Horizons X and XI are dated on Table 96 to between 3500 and 1500 BP and it is not possible to date the decorated pottery more precisely than this.

The only other form of decoration found on the pottery was surface burnishing. This almost always comprised polishing the entire sherd surface, and in the lower levels, at least, there were some very thin and highly burnished sherds which showed a considerable expertise in pottery techniques. None of the vessels nearer the surface were so well finished. The incidence of burnishing is given in Table 117.

Although surface burnishing of pottery is common in many parts of Timor today, it is not, as far as I could discover, practised in the Venilale and Ossu area. The absence of burnished ware in the upper levels, and its small but persistent occurrence in the coastal sites of Lie Siri and Bui Ceri Uato suggests that the pottery in the cave is of predominantly local origin and is not imported from other districts. In the Tetum speaking Viqueque region, to the south, red-slipped and burnished pottery is also made today.

Horizon	Nos
XIII	-
XII	-
XI	2
X	13
IX	-
VIII	-
Total	15

Table 116 Uai Bobo 2: distribution of incised sherds

Horizon	Nos	% of all sherds in each horizon
XIII	-	-
XII	-	-
XI	26	9
X	237	25
IX-VIII	56	23
Total nos	319	-

Table 117 Uai Bobo 2: distribution of burnished pottery

Paste

Three sherds from Uai Bobo 2 (Horizons VIII, IX and XIII), one sherd from Uai Bobo 1 (Horizon VII) and some modern pottery from *suco* Builale, *posto* Osso, and from *suco* Uato Haco, *posto* Venilale, were sectioned by Mr Key for mineralogical examination. He reported that the clay from all these sherds shared common features, especially in the presence of angular limestone fragments, which distinguished it from the clay in any of the sherds examined from the excavated sites or pottery making centres of the north coast. Although Key could not say that the same clay sources were used for the prehistoric and modern pottery it was probable that all the excavated sherds examined, which included one from the earliest and best dated occurrence of pottery in Timor, were made within the Venilale region. This is important because it shows that the first pottery in the site was not imported from the coast, nor from another island. As the vessel forms and surface finish show, pottery appeared as a well developed, even sophisticated craft, for which local resources were immediately used.

MISCELLANEOUS MODERN OBJECTS

The presence of even a small number of indubitably modern artifacts in a deposit is of help in evaluating the degree of recent disturbance on an archaeological site. In Uai Bobo 2 eight such objects were found; seven pieces of broken glass and one short length of flat copper wire. Six of the glass flakes come from what is certainly a very recent green wine bottle made in a two-piece mould, and probably Portuguese. They were all found in Squares D(1-3) and E(1), Horizon XIII. Another piece of broken glass was found in Square C(3), Horizon XII. This is from a different bottle, of thick dark green glass, with flat sides. It is most probably from a Dutch gin bottle, hand-blown into a wooden mould and may date from the 18th to mid-19th century. No sherds of glazed Chinese ceramics were found in the deposit, although one was found on the steep slope about 10 m below the cave.

ARTIFACTS OF WOOD, SHELL AND BONE

Wood

Conditions in the caves did not favour the preservation of non-carbonised organic materials other than bone, and some hard nut shell such as *Aleurites moluccana*. In the loose surface dust, however, of Squares D(2) and C(1) two wooden objects were found. The first is the spoon section of a coconut shell ladle of a sort in common use in Timor today, and no doubt for many thousands of years in the past. It has two irregularly placed perforations for lashing the handle. It is illustrated in Plate 42 alongside a complete ladle (Plate 41), found in a cave on the Baucau Plateau.

The second object is a broken disc of hardwood, 32 mm thick by about 92 mm in diameter, neatly trimmed around the edge, but not lathe turned. It is smooth and slightly polished by long handling and one surface bears the edge of a carved design (Plate 46). The deep V-shaped profile of the carving indicates that it was done with a sharp, metal tool. My workmen were unable to supply suggestions as to the function of the disc, although it is probable that it is of fairly recent manufacture.

Shell (Plate 45)

A number of shell ornaments (Table 118), broken shell fragments and a few food shells were found.

All shells except for one *Melania* sp. and one *Terebralia palustris* are marine shells which must have been brought directly from the coast or obtained by trade. *Terebralia* is a mangrove shell commonly used for food in Melanesia today, and must also have come from

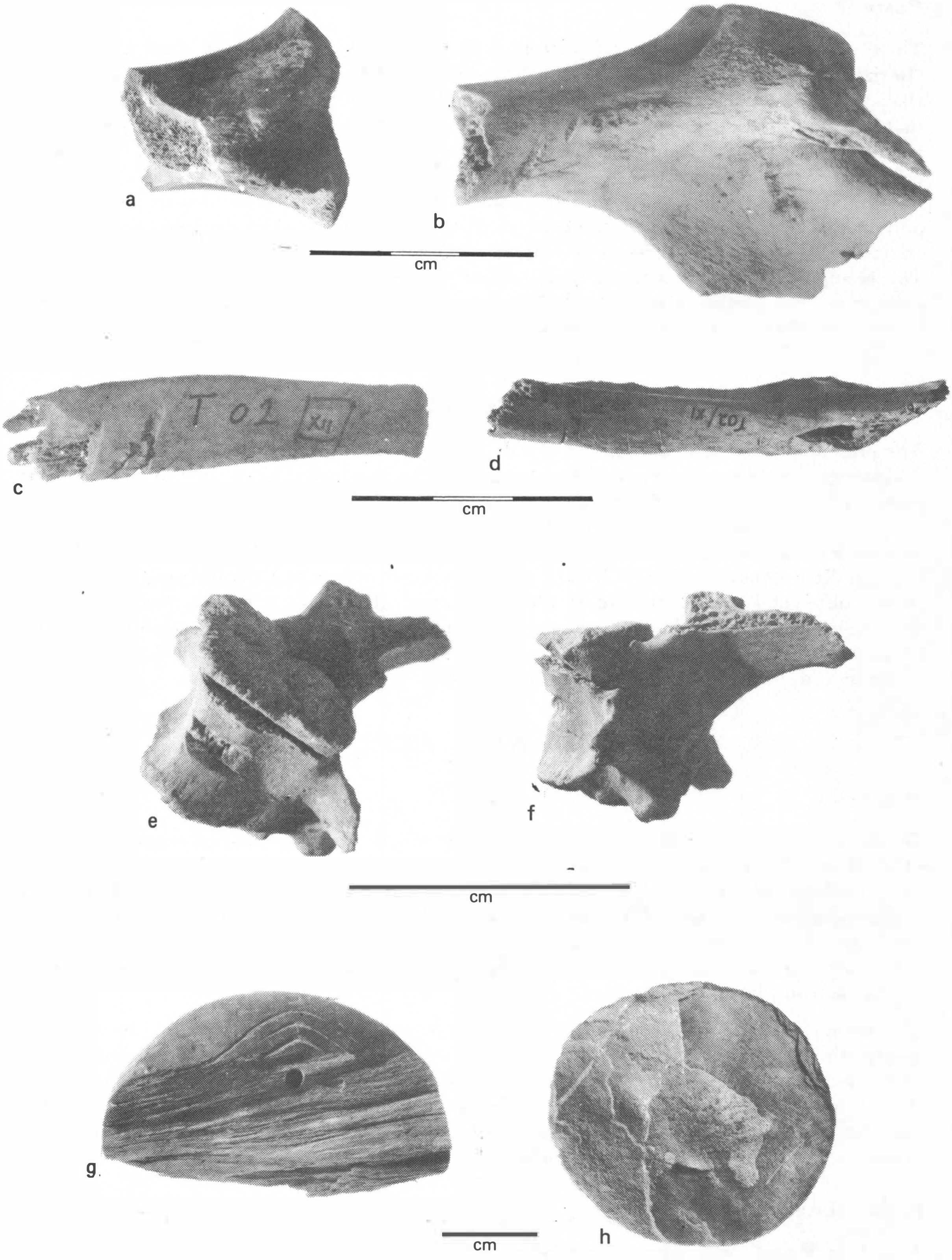


Plate 46

Plate 46 Uai Bobo 2: finds

- a Tibia of an immature pig which has been cut through by a metal tool, below the epiphysis (Appendix 2), Horizon XIII
- b Pelvic fragment of pig with butchering marks, Horizon XIII
- c Unidentified rib with butchering marks, Horizon XII
- d Unidentified bone with butchering marks, Horizon XI
- e Vertebra of pig showing three parallel butchering marks, Horizon XI. It seems almost certain that a metal tool was used to inflict these cuts. The bone is dated to between 1500-2000 BP
- f Vertebra of pig showing three parallel butchering marks, Horizon XI. It seems almost certain that a metal tool was used to inflict these cuts. The bone is dated to between 1500-2000 BP
- g Carved and broken wooden disc found on the surface in Square C
- h Ochre palette from Square A(14), Horizon VII

Horizon	Pierced discs	Olive shells	Cockles	*Trochus*	Other
XIII	-	-	-	-	-
XII	-	-	-	-	-
XI	-	-	-	-	-
X	1	-	-	-	-
IX	11	-	-	-	-
VIII	21	2	-	1	-
VII	4	3	3	-	1 Cowrie
VI	1	3	-	-	1 Helmet shell
V	-	-	1	-	-
IV	-	-	-	-	-
III	-	-	-	-	-
II	-	-	-	-	-
I	-	-	-	-	-
Total	38	8	4	1	2

Table 118 Uai Bobo 2: distribution of shell ornaments

close to the coast. *Melania* sp. is found in fresh and brackish water and may be found in the Seiçal River a few kilometres east of the cave. Only the *Melania*, *Terebralia* and one *Haliotis asinina* are likely to have been food shells, and this must reflect the distance of the cave from easily exploited marine or freshwater food sources.

The presence of several *Nautilus* fragments, one of which appears to have been cut together with the pierced discs, suggests that manufacture took place in the cave. Whether the discs were intended to be sewn on for decoration, or to be strung on ropes for either ornaments or money, cannot be determined for certain. However, Dr A. Chowning, Department of Anthropology, University of Papua New Guinea, has suggested that the principal characteristics of shell money ropes are that they should be common species, for large numbers are usually required, that they all be the same species, and of uniform size. In the case of these discs, the first two requirements are more or less met; *Nautilus pompilius* is relatively common on the coasts of Timor where it is prized as an ornament to hang from house eaves today, and 36 out of the 38 discs are made from *Nautilus*. But the size is rather too variable, I think, for these discs to have been strung on one or two ropes as money, and it seems more likely that they were ornaments to be sewn separately on to clothing or some other object. The surface of many of the discs had flaked off, but on those which are intact, there is a distinct conical or biconical profile to the hole section. The internal and external diameters of these shells were measured to 0.1 mm and the range, mean and standard deviations are given in Table 119 for all the *Nautilus* discs combined.

Diameter	Range (mm)	$\bar{x}$	s	Nos
External	0.46-1.02	0.68	0.16	36
Internal	0.11-0.32	0.21	0.05	36

Table 119 Uai Bobo 2: dimensions of pierced shell discs

Bone

Compared with archaeological sites in parts of Indonesia and Australia, the Timorese sites were conspiciously lacking in bone tools. Sarasin (1936:27) comments on the absence of them at Nikiniki 1, and at Uai Bobo 2 only two possible bone artifacts were found, a bird bone needle or awl from Horizon VIII, and a cut and polished bird leg bone. The needle is probably broken, but in its present state is 37 mm long by about 2 mm in diameter, tapering to 1 mm at one end where a bevelled surface has been ground. One other worked bone was found in Bui Ceri Uato.

ANALYSIS OF FAUNAL REMAINS

Uai Bobo 2 produced what was, in many ways, the best faunal sequence of all the caves excavated, and the greater depth of deposit enabled a more certain dating of the main changes. The sorting procedure has been outlined in Chapter IV and Appendices 1-3 contain detailed indentification and description of the bones. The basic data tables only are presented in the following sections with some comments. The principal interpretations, which depend on intersite comparisons, are made in Chapter IX.

Murids (Appendix 2)

Very good collections of murids were made in Uai Bobo 2 especially from the lower levels, and these will permit Mr J. Mahoney to make detailed taxonomic descriptions of at least three new genera of large murids and possibly two or three new species of smaller murids, including *Melomys* and *Rattus*. Table 120 lists the minimum number of individuals in each horizon of the various genera and species. As with the other sites, large and small murids are totalled separately. Since the horizon volumes are not equal, the proportional frequency distributions of the small murids are shown in Figure 49 together with incidence of human occupation as shown by stone tool and pottery densities.

Tentative identifications for *Coryphomys* and Murid C are shown by the question marks. The loose deposit at Uai Bobo 2 meant that few small murids were so broken as to be unrecognisable. Among the *Rattus* sp. Mr Mahoney noted that there is only one species from Horizons XIII-XII, and two from Horizons XI-I, of which one is probably *Rattus rattus*.

As in Uai Bobo 1, the large murids and *Melomys* finish well before the top of the deposit. The change occurs from Horizons IX-XI and can be dated to between 4000 and 1500 BP (Table 96). In Uai Bobo 1 the large murids and *Melomys*, with a single exception, finish in Horizon V, which I have dated to 1400-1800 BP. In Lie Siri (Table 28) the large murids and *Melomys* continue to the top of the cave deposit proper which is there dated to 2000-3000 BP.

Compared with Uai Bobo 1, a higher proportion of the large murids are found in Horizon I where there are few, though certain, traces of human occupation. Nevertheless, 35% of the large murids are found between Horizons V-X where human occupational remains are relatively abundant, compared with only 7% of the small murids.

It would be possible to argue that *Rattus exulans* was introduced into Timor, perhaps through the agency of man, some 4000-5000 years ago, but for the presence of one mandible in Horizon III which Mahoney has positively identified as *Rattus exulans*. Apart from this single instance, *Rattus exulans* is found in all sites only at the top of the deposits. The single mandible could possibly have been misplaced during excavation, or even during the cleaning,

Horizon	LARGE MURIDS *Coryphomys*	A	B	C	Not identifiable	Nos	SMALL MURIDS *Melomys* sp. incl. *Pogonomelomys* Small	Large	*Rattus exulans*	Other *Rattus* sp.	Not identifiable	Nos
XIII	-	-	-	-	-	-	-	-	2	4	-	6
XII	-	-	-	-	-	-	-	-	7	12	-	19
XI	-	-	-	-	-	-	-	1	1	13	-	15
X	-	-	-	1	-	1	2	2	25	122	-	151
IX	1?	1?	2	-	1	5	-	2	2	15	-	19
VIII	1	-	2	3	2	8	-	2	-	10	-	12
VII	2	4	4	2	4	16	1	18	1	70	2	92
VI	1	1	2	1	1	6	2	9	-	20	2	33
V	-	1	4	2	4	11	1	18	-	38	5	62
IV	-	-	1	-	2	3	3	87	-	208	20	318
III	-	1	2	-	2	5	10	110	1	421	3	545
II	-	5	10	1	2	18	71	93	-	528	9	701
I	1?	2	14	1?	-	18	63	65	-	209	-	337
Total	6	15	41	11	18	91	153	407	39	1670	41	2310

Table 120 Uai Bobo 2: minimum numbers of murids

Horizon	Not cave dwellers *Pteropus* sp.	*Pteropus? griseus*	*Acerodon* sp.	*Nyctimene cephalotes*	Possibly cave dwellers *Hipposideros diadema*	Cave dwellers *Dobsonia peroni*	*Rousettus amplexicaudatus*	*Rhinolophus* sp.	*Taphozous* sp.	Nos
XIII	-	-	-	-	-	-	-	-	-	0
XII	-	-	-	-	-	-	-	-	-	0
XI	-	-	-	-	-	-	-	-	-	0
X	-	-	-	-	-	-	1	-	1	2
IX	3	-	-	-	-	3	2	-	-	8
VIII	4	-	-	-	-	1	-	-	-	5
VII	4	-	-	-	-	1	-	-	-	5
VI	-	-	1?	-	-	1?	-	1	1	4
V	1	-	-	-	-	2	-	-	1	4
IV	1?	-	-	-	-	1	-	-	1	3
III	-	-	-	-	-	-	-	-	1	1
II	4	-	-	4	-	1	-	2	1	12
I	8	3	2?	2	1	-	-	1	-	17
Total	25	3	3	6	1	10	3	4	6	61

Table 121 Uai Bobo 2: minimum numbers of chiroptera

sorting and labelling of the 4500 or so murid mandibles recovered from Uai Bobo 2. On the other hand, *Rattus exulans* is the smallest of all the murids found, and other broken pieces of the fragile mandibles may have been overlooked in the sieves. It is best, I think, to regard the case as non-proven for the time being.

Chiroptera (Appendix 3)

Table 121 lists the minimum number of individual bats identified by Mr J.L. McKean. Tentative identifications, or numbers, are indicated by question marks. In Uai Bobo 2, over half the bats are species of *Pteropus* and *Nyctimene* which must have been brought into the cave by man. As in Uai Bobo 1, no bats at all were found in the top three horizons.

Domesticated and other larger land mammals

Table 122 lists the minimum numbers of individual mammals recognised from the bones described in Appendix 1.

Horizon	*Canis*	*Sus*	*Capra/Ovis*	*Phalanger*	*Paradoxurus*	*Macaca*	*Cervus*
XIII	-	2	-	-	-	-	1?
XII	-	1	1	-	-	1	-
XI	-	2	-	1	1	1	-
X	1?	1	1	1	1	1	-
IX	-	2	1?	1	1?	-	-
VIII	-	2	-	-	1	1	-
VII	-	1?	1?	1	1	-	-
VI	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-
IV	-	-	-	-	-	-	-
III	-	-	-	-	-	-	-
II	-	-	-	-	-	-	-
I	-	-	-	-	-	-	-
Total	1?	11	4	4	5	4	1?

Table 122 Uai Bobo 2: minimum numbers of large land mammals

None of these mammmals are found below Horizon VII, which is dated to 5100-5900 BP, and there are no certain identifications of *Capra/Ovis* below Horizon X; that is before about 3500 BP. In Horizon VII, the tentative identification of *Sus* depends on one upper molar, and for *Capra/Ovis*, on a deciduous upper premolar. In Horizon IX, the possible *Capra/Ovis* depends on an immature ulna and calcaneum; Professor Higham says only that 'they may be *Capra/Ovis*', but are too young for him to be certain. From Horizons VIII-XIII pig bones are found in reasonable numbers in each horizon (Appendix 1) and there can be no doubt about the presence of pig after about 4000-5000 BP.

The civet cat in Horizon VII depends on a single, but well preserved right mandibular ramus and cuscus at the same level and has been identified by Mr J. Calaby. Macaque is identified on three bones in Horizon VII and 10 in Horizon X, and one each in Horizons XI and XII. These three mammals appear in both Uai Bobo 1 and Uai Bobo 2 at about the same time as pigs and pottery and one can only conclude that man was responsible for their introduction to the island.

Only one possible dog bone was found in Horizon X. A fibula with cut marks on one side was tentatively identified in Canberra and sent to Higham separately from the remaining bones, but it appears to have been lost *en route*. The possible presence of *Cervus* in Horizon XIII has already been discussed.

A number of bones with recognisable cut marks were found, presumably made when the carcasses were butchered. In Horizon XIII, there was a pelvic fragment and the proximal end of a tibia, both of pig. The latter has been severed diagonally when the bone was still green (Plate 46a). In Horizon XII, there was an unidentified rib with three almost parallel cuts

(Plate 46c) and in Horizon XI, a humerus and two fragments of vertebra, all of pig, with clearly recognisable cut marks. One of the vertebrae (Plate 46e) is of particular interest, because I believe that the cuts could only have been made with a metal tool. Three parallel blows have evidently failed to find the space between the vertebrae; two have cut a notch in the centrum, and the third blow has cut deeply into the bone, but without splitting it. Presumably the fourth blow severed the vertebral column.

Human bones

Dr A.G. Thorne has identified the following fragmentary human bones which were scattered in the middle levels of the site.

Horizon IX	M^3, left, permanent
Horizon VIII	three very thin cranial vault fragments one cervical vertebra one proximal femur fragment one maxillary permanent molar fragment
Horizon VII	one maxillary permanent right canine one maxillary permanent left third molar (unerupted) one tarsal proximal phalange (digit 1) one cranial vault fragment, heavily calcined
Horizon V	one distal tarsal phalange

It is not clear from Thorne's report whether the three 'very thin cranial vault fragments' from Horizon VIII and the heavily calcined fragment from Horizon VII, could be from the same individual. If they are incompatible, as seems to be the case, then at least two individuals are represented. It is possible that most of the bones in Horizons VII and VIII are from shallow burials, such as those in the Osso Ua burial cave.

PLANT REMAINS

Owing to a misunderstanding with the workmen, *kami* nut shells (*Aleurites moluccana*) were not systematically collected from Uai Bobo 2.

A number of small seed cases were found, mainly in the lower levels of the site, of which 11.3 gm (approximately 20) were used as part of the sample from Horizon I submitted to the ANU Radiocarbon Dating Laboratory as ANU-238, and which yielded a date of 13,400 ± 520 BP. The rest were sent to Dr D. Yen for identification, together with other plant remains. The identifications are listed in Appendix 4. The small seed cases already mentioned were identified by Dr H. St John as *Celtis* sp., family Ulmaceae. Although most common in Horizon I, these small hard, seed cases were found in most levels up to Horizon X. At Uai Bobo 1 also, they were not present in the upper horizons, although plant remains were generally better preserved nearer to the surface. In Lie Siri *Celtis* seed cases were found in many parts of the trench and in most horizons up to VIb, which have been dated to approximately 2000-3500 BP. The absence of *Celtis* in later deposits raises a problem which cannot be satisfactorily answered at present. Dr St John, and Burkill (1935:506-7), both describe *Celtis* as a 'useful' shrub or tree of which a number of species are found naturally distributed from India to Southeast Asia. The fibrous bark of some species was used for the manufacture of bark-cloth in Sulawesi (Burkill 1935:506) and the wood has a variety of magical and medicinal uses. The seeds also appear to be edible although there is not much evidence to show that they were anywhere an important food. Considering that the largest number of the seeds occur in those levels with most rat bones, and with fewest traces of human occupation it is quite possible that the seeds are the remains of rat food stores, not of human ones.

Celtis and many of the rat species, disappear from the deposit at about the same time. Whether these facts are directly linked, or whether *Celtis* and the rats were similarly affected by ecological changes resulting from human interference in the environment is, at present, impossible to tell. It is necessarily speculative since I do not know if *Celtis* still occurs in this part of Timor, and if it does, what uses are made of it.

Other useful plants, which were later cultivated in Southeast Asia, occur irregularly throughout the deposit. In Horizon I (Square IK8) there was one seed of *Coix* sp. which had been pierced longitudinally. This is most probably the Job's tear which has been commonly used both for consumption and ornament in many places between Africa and Melanesia (Massal and Barrau 1956:43; Burkill 1935:629-31). Horizon II produced one possible *Piper* sp. seed. Horizon V, two broken and carbonised *Inocarpus* seeds (Polynesian chestnut), and half a seed case of a Cucurbitaceae which Yen thinks is either pumpkin or *Mormordica*. The latter according to Burkill (1935:1485) is a native of the Old World tropics and its bitter fruits, as well as the leaves and roots, have a variety of medicinal and culinary uses.

One probable *Setaria* seed (millet) was found in Horizon X, and *Inocarpus* and possible *Prunus* seeds in Horizon XII, together with three fragments of *Bambusa*. The implications of these finds are discussed in Chapter IX, and in an earlier paper (Glover 1979) in which I compared the plant remains from prehistoric sites in south and Southeast Asia.

A soil sample from Horizon XII was examined for pollen but only fungal spores and a few poorly preserved Pteridae and Poaceae grains were found.

SOIL SAMPLES

In Chapter IV I have discussed the information required from the analysis of soil samples, and the difficulty in obtaining useful results. Most valuable were the measurements of pH, and the percentage by weight of organic matter in the deposit (Table 123). The determinations were made by Mr K. Fitchett.

The most notable feature is the pronounced increase in the organic content at the top of the deposit. This supports the argument, based on the frequency of pottery, that, despite the scarcity of stone tools in the upper horizons, the cave was still in common use. It is not possible, however, to say that the frequency of use had increased in recent times since the lower horizons may at one time have contained more organic material than at present. In the calculation of artifact densities, allowance should perhaps be made for this, but it is difficult to see how this could be done given the various unknown factors. For the rate of decomposition of organic matter over time, the method of its removal and the ratio of carbonised to non-carbonised organic matter in the different levels would all have to be taken into account. The variation of organic content within a single horizon, 0.82-2.35% in Horizon VII, should be noted together with the increase to 5.46% in Horizon IX which coincides with the change in colour of the deposit from a relatively uniform reddish-brown to a grey, charcoal-rich earth which contains the stratified ash lenses shown in Plate 43a. Horizon IX also contains the greatest density of stone tools.

Horizon	pH	Organic content % by weight
XII	8.18	30.74
IX	8.17	5.46
VII rear of cave	8.11	2.35
VII mid cave	8.25	0.82
V	8.18	1.97
III	8.12	2.29
I	8.23	1.12

Table 123 Uai Bobo 2: soil analysis

IX A PREHISTORY FOR TIMOR

THE RELEVANCE OF THE EXCAVATIONS TO THE RESEARCH AIMS OUTLINED IN CHAPTER I

The five research aims discussed in Chapter I are summarised here for convenience:

1. To investigate the role of Timor in the Pleistocene settlement of Australia.
2. To discover whether Timor was involved in the spread in Australia of the stone tool traditions, characterised by small backed blades and unifacial and bifacial points.
3. To obtain dates for the introduction of pottery, domesticated animals and horticulture.
4. To suggest dates, based on correlations with sequences in eastern Timor, for the prehistoric material already known in western Timor from the work of Bühler, Willems and Verhoeven.
5. To investigate the composition of the native land fauna of Timor and to get dates for the introduction of the various species of larger mammals thought to have been brought in by man.

In order to fulfil these broad aims, fieldwork was directed towards obtaining dated assemblages of stone and pottery artifacts and bone food remains. I have stressed the importance of obtaining a basic historical framework through the recognition of archaeological cultures defining their limits in space and time. In Southeast Asia this is still pioneering work and appropriate methods have to be used. The conditions of research in Timor were such that results had to be obtained during limited field seasons and with no trained or even completely literate assistants. Many refinements of technique for excavation, recording and for the recovery of organic materials could not be employed. Basic data on Timor in geology, ethnology and biology is inadequate and results from the excavations have been related to knowledge in these disciplines at a very general level only.

Relevance of the work to the five initial aims can be summarised briefly:

1. No deposits excavated were older than the very end of the Pleistocene period, and consequently nothing can be said about the role of Timor in the primary settlement of Australia. Elsewhere (Glover 1973b), I have summarised the evidence from West Timor which indicates that extinct forms of elephant, and possibly man, were present in Timor at a much earlier period, perhaps by the middle Pleistocene, and it is still possible that the first Australians came to the continent via Timor.

2. The stone industry from the caves in Timor is distinctive and possess a few, but easily recognisable, artifact types; tanged points, bifacial flaked adzes and side scrapers with steep, concave working edges often on both margins of larger blades. No similar forms are regularly found in Australian stone assemblages. In addition, none of the suite of small backed blades or bifacial and unifacial points of the Australian small tool tradition were found in Timor. Enough excavations have been made in a number of localities for me to be satisfied that these forms will not be found in Timor. If they were introduced into Australia, then it was by a route which avoided Timor - perhaps directly to northwest Australia from either Java or Sulawesi, or both. The implications of this are interesting but will not be discussed here.

3. In all the excavated sites the lowest levels contained only stone tools and the bones of native rodents, bats, fish, birds and reptiles. In the middle levels these were gradually replaced by an introduced fauna accompanied by pottery. Although direct evidence for plant cultivation is not certainly present until much more recent times, I believe that a *prima facie* case can be argued that this change in the sequence of food remains and artifacts was the

result of the arrival or development of a way of life dependent on plant cultivation and animal husbandry. The evidence for this, and its implications for the culture history of the region is discussed below.

4. Many points of similarity were found between the material from the Uai Bobo sites and that recovered from Nikiniki 1, Ulnam, and Liang Leluat II, by Bühler, Willems and Verhoeven. Inadequate reporting of the latter two sites prevents more than general comparisons. In particular, the apparent lack of any pottery in Liang Leluat II at the level containing the tanged points (Verhoeven 1959) makes it difficult to correlate this material with the Uai Bobo sequence, where no tanged points pre-date the appearance of pottery and exotic fauna.

With Nikiniki 1, more detailed and reliable comparisons can be made (Glover 1972c). The scarcity of flaked stone in the top 70 cm there parallels the situation at Bui Ceri Uato, Uai Bobo 1 and at Uai Bobo 2. Stone tools are rare at Bui Ceri Uato above Horizon VIII, Uai Bobo 1 in Horizon V and Uai Bobo 2 in Horizon X, all of which I believe can be dated to not later than 2000-1500 years ago. At Lie Siri stone tools were found closer to the surface, but dates older than 2000 BP were obtained from this level. It is not clear from the Nikiniki 1 report whether pottery and the introduced, perhaps domesticated, animals were found at the very base of the trench. Bühler only says (Sarasin 1936:9) that below 1.20 m finds were very scarce and that digging stopped at 1.35 m. If pottery continued to the base, then all of the lowest horizon (75-135 cm) must be dated to between about 4500-1500 BP. The presence of pig, bovid, *Capra/Ovis* and the extinct giant rat, *Coryphomys bühlerei* within this horizon (Sarasin 1936:31-32) is in agreement with the evidence from eastern Timor. Only the horse bones mentioned by Sarasin are difficult to accept at this date. Horse was found only at one of the sites in the east, at Uai Bobo 1, Horizon VII, which cannot be older than 800-900 years.

The small quantities of decorated pottery at Nikiniki 1 (Glover 1972c) come in the appropriate place in the sequence and probably date to between 3000-1500 BP. Fewer side scrapers were found in Nikiniki 1 than in the east, but they are very similar in shape, proportions and edge characteristics. Tanged points are not common in any site but are remarkably alike in East and West Timor. Apart from the possible exception of Liang Leluat II such artifacts do not pre-date the appearance of pottery and introduced animals. Thus, although tanged points are the tool type most specifically designed for hunting, they appear to have been made only within the context of what I postulate to be a culture at least partially dependent on food production. They may have been developed for hunting the larger introduced animals such as pig and monkey.

It is difficult to compare in detail the pottery from East and West Timor because of the small sample and selective collection from Nikiniki 1. There are no immediately apparent gross differences between the two areas. The same two forms were found, round-based cooking pots with short, everted rims, and bowls, some with low ring bases and direct, almost vertical rims. A small proportion of pottery in both areas is burnished and a few vessels are definitely slipped. The two incised and impressed vessels from Nikiniki 1 do not share any motifs with the pottery in the east but the technique, positioning and 'feel' of the designs are not so different. The only painted pottery in Nikiniki 1 was found on the surface and this agrees with the evidence from the east. Painted decoration in Timor is certainly a recent introduction and I am inclined to believe that it came with the colonial period.

5. The present mammalian land fauna of Timor includes the rusa deer, a civet cat, macaque and cuscus, as well as domesticated goats, sheep, pigs, bovids and dog. Doubt has often been expressed (e.g. Laurie and Hill 1954:86; Darlington 1957:322-24) as to how many of these breached the Wallace Line independently of man. The excavations have shown that with the exception of the Pleistocene *Stegodon*, the truly native mammals comprised only murid rodents and bats. None of the larger Asian species mentioned above, were found before the appearance of pottery and there is strong presumptive evidence that they were brought either directly or inadvertently by man in his improved sea-craft, within the last 5000 years. Cuscus

also enters the sequence at this time and Timor cannot be seen as an outpost of Australian fauna in the same way as is Sulawesi where there are two indigenous phalanger species. The native murids show a progressive depletion in variety after the introduction of other faunal species; all four genera of large rats, possibly two *Melomys* spp. and one *Rattus* sp. appear to have become extinct. There is also some evidence to suggest that *Rattus exulans*, one of the few *Rattus* species recorded in Timor, is a comparatively recent introduction also. These faunal changes must have accompanied extensive ecological changes in Timor, although the dimensions and nature of these can only be guessed at with the evidence so far available. Although Timor lies within the tropics, rainfall is strongly seasonal and much of the island is semi-arid. The introduction at some time in the past of bush fallow agriculture, which is so widely practised there today (Metzner 1977:116-77), together with browsing and grazing animals must have had a drastic effect on the island's vegetation. The repeated burning of steep slopes followed by monsoon rains would have contributed towards soil erosion leading to the barren landscapes typical of so much of Timor today (Ormeling 1956:54-65; Metzner 1977:249-55, Pl.45-46).

SITE CORRELATION AND THE INTERPRETATION OF ECONOMIC CHANGE

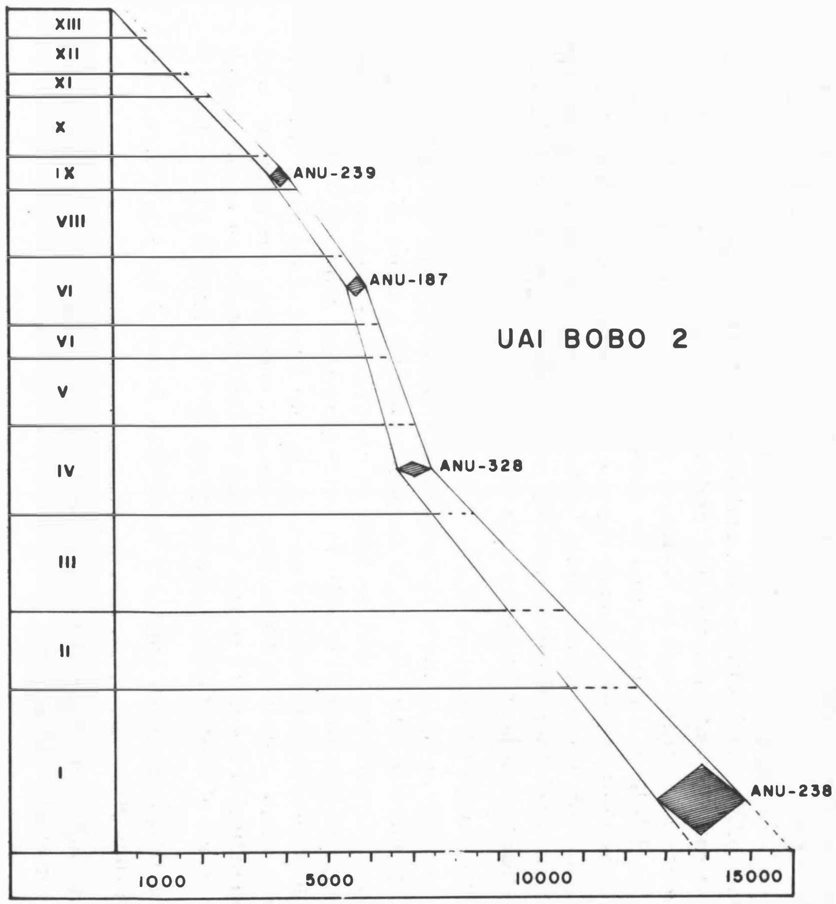
In each of the four site reports I have put forward a chronological scheme against which the changes in artifact and faunal remains can be evaluated, and I have discussed the main similarities and differences between the sites. Figure 48 shows how the site chronologies were derived from the C14 dates. The manner in which this was done is described in Chapter IV and in the respective sections in the site reports. In Table 124 the correlations are summarised, and the appearance of important cultural and economic traits indicated.

Three out of four of the site chronologies depend on radiocarbon dates; the one for Bui Ceri Uato is based on a comparison of key points of the sequence with the other sites, principally with Lie Siri. As I have said earlier, not all samples submitted for dating gave satisfactory results. Even discounting these, the basic changes cannot be shown to be exactly contemporary at all the sites. Thus pottery first appears in Horizon VIII at Uai Bobo 2, Horizon IIIa at Uai Bobo 1, Horizon Vc at Lie Siri and Horizon V at Bui Ceri Uato, which I have dated to 4500 ± 450, 3200 ± 600, 4100 ± 400, and 4000 ± 500 BP respectively. But all of these dates overlap to some extent, and the first and last two agree quite well. At Uai Bobo 1 the whole sequence has turned out to be rather younger than I expected, and one sample from Horizon V is, I believe, contaminated by modern charcoal. Uai Bobo 2, which gives the oldest dates, is the most reliable sequence because the greater depth of deposit there allowed a finer separation of the material from different ages, the better preserved stratigraphy meant that pits and other disturbances were more easily recognised, and charcoal could be collected from undisturbed hearths rather than from scattered ones.

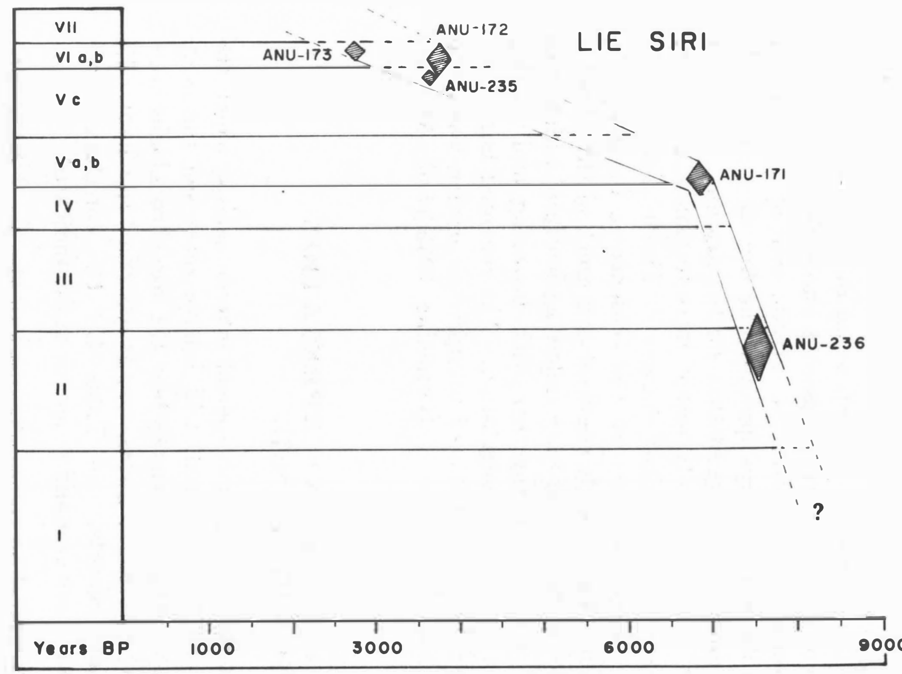
Between approximately 5000-4000 BP, pottery and introduced animals appear in the sequence at all sites. No changes are seen at this time in the stone tool types except for the addition, at Uai Bobo 1, of a small number of carefully made tanged points to a series of assemblages dominated by side scrapers. Other forms, and the basic composition of the stone assemblages, however, show little change at this time (Fig.50). In levels later than 2000 BP, flaked stone decreases in quantity and retouched artifacts are rare in the top levels of all sites. Pottery, which first appears in very small quantities 4000-5000 years ago, becomes more common, with the maximum density occurring in the most recent horizons on the coast, rather earlier inland. The proportional distributions of waste flakes and pottery per m^3 are shown in Figure 49.

Pig is consistently the earliest introduced animal in most sites, followed by dog, *Capra/Ovis* and a bovid, probably in that order.

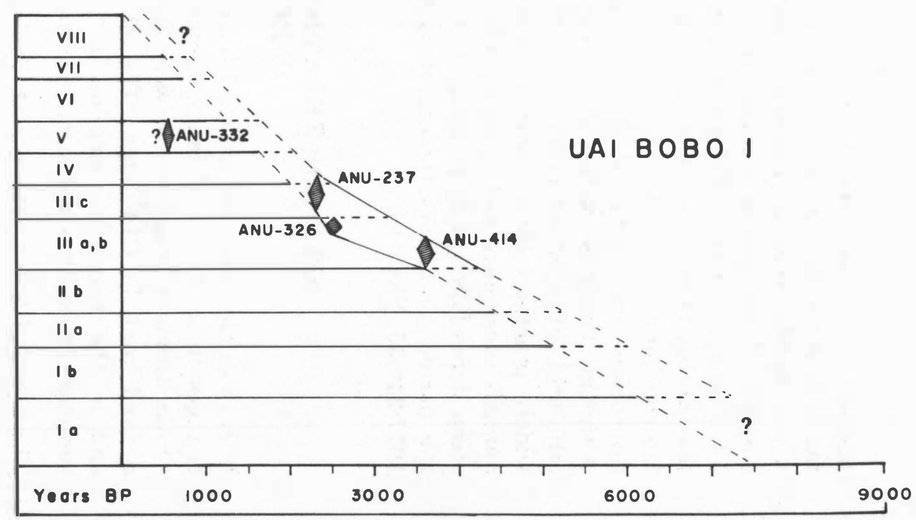
The shell ornaments and tools found in all sites span this basic economic and cultural change, although most occur in the levels with pottery.



UAI BOBO 2
XIII
XII
XI
X
IX
VIII
VI
VI
V
IV
III
II
I
ANU-239
ANU-187
ANU-328
ANU-238
1000
5000
10000
15000



LIE SIRI
VII
VI a,b
V c
V a,b
IV
III
II
I
ANU-172
ANU-173
ANU-235
ANU-171
ANU-236
?
Years BP
1000
3000
6000
9000



UAI BOBO I
VIII
VII
VI
V
IV
III c
III a,b
II b
II a
I b
I a
?
? ANU-332
ANU-237
ANU-326
ANU-414
?
Years BP
1000
3000
6000
9000

Fig.48 **The use of C14 samples for dating the deposits**

On the graphs the vertical scale represents the proportional thickness of the horizons and the horizontal scale the period over which the deposits have accumulated. The dated samples are shown by diamond figures of which the height indicates the depth of deposit from which the sample was collected, and the width two standard deviations. Ages have been corrected to a half-life of 5730 ± 40 years and rounded off as set out in Chapter IV.

The position of the horizon boundaries are shown by lines projected from the vertical axes. Where these intersect the lines linking the C14 samples probable maximum and minimum dates for those points can be read on the horizontal scales.

The chronologies for the different sites which are given in Tables 5, 39, 65, 96, and 124, are based on these graphs.

Uai Bobo 2 is shown at half the scale of the other sites because of the greater depth and age of the deposit.

The laboratory dates and code numbers which should be used if reference is made to these samples are listed in Table 1.

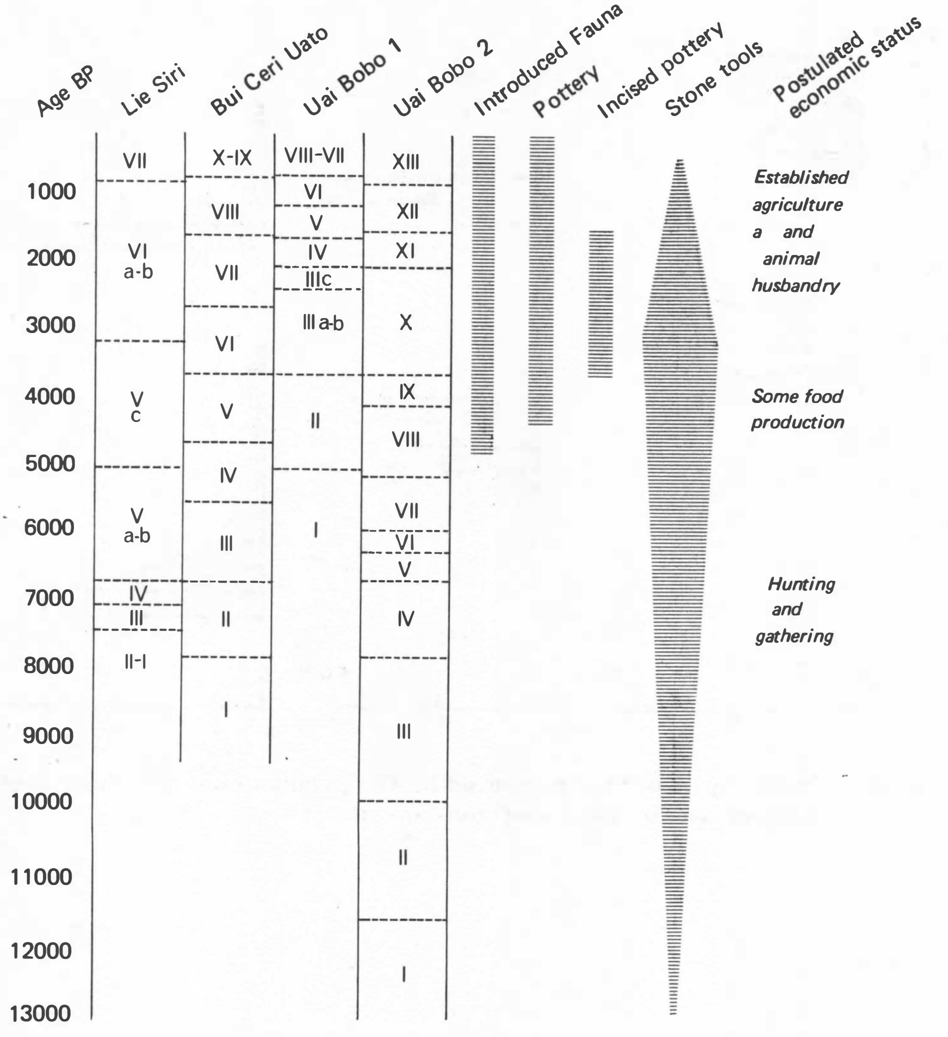


Table 124 **Site correlations against a time scale based on the C14 dates listed in Table 1 and Figure 48**

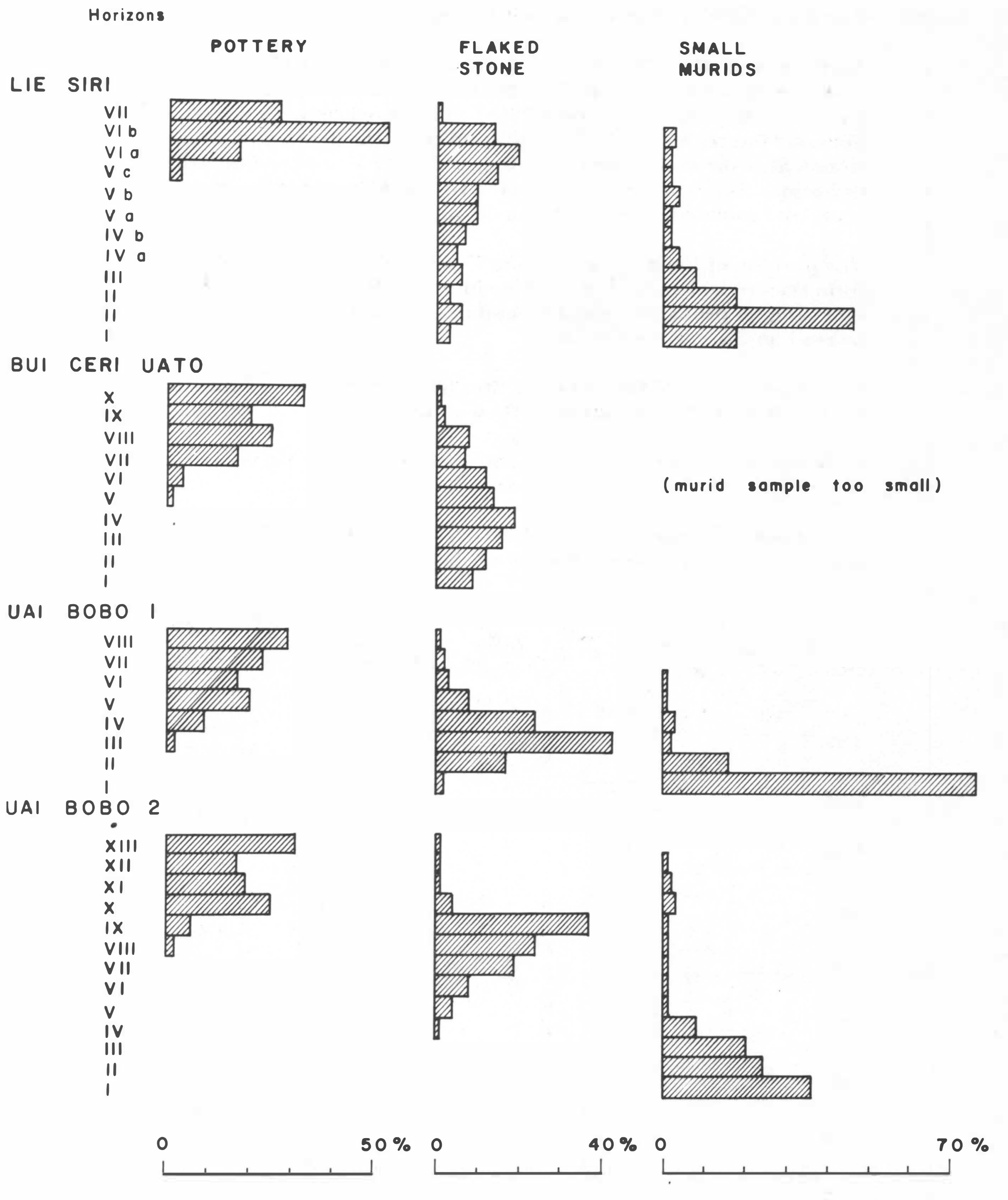


Fig.49 Intensity of site use measured by the proportional distribution of pottery, waste flakes and small murids

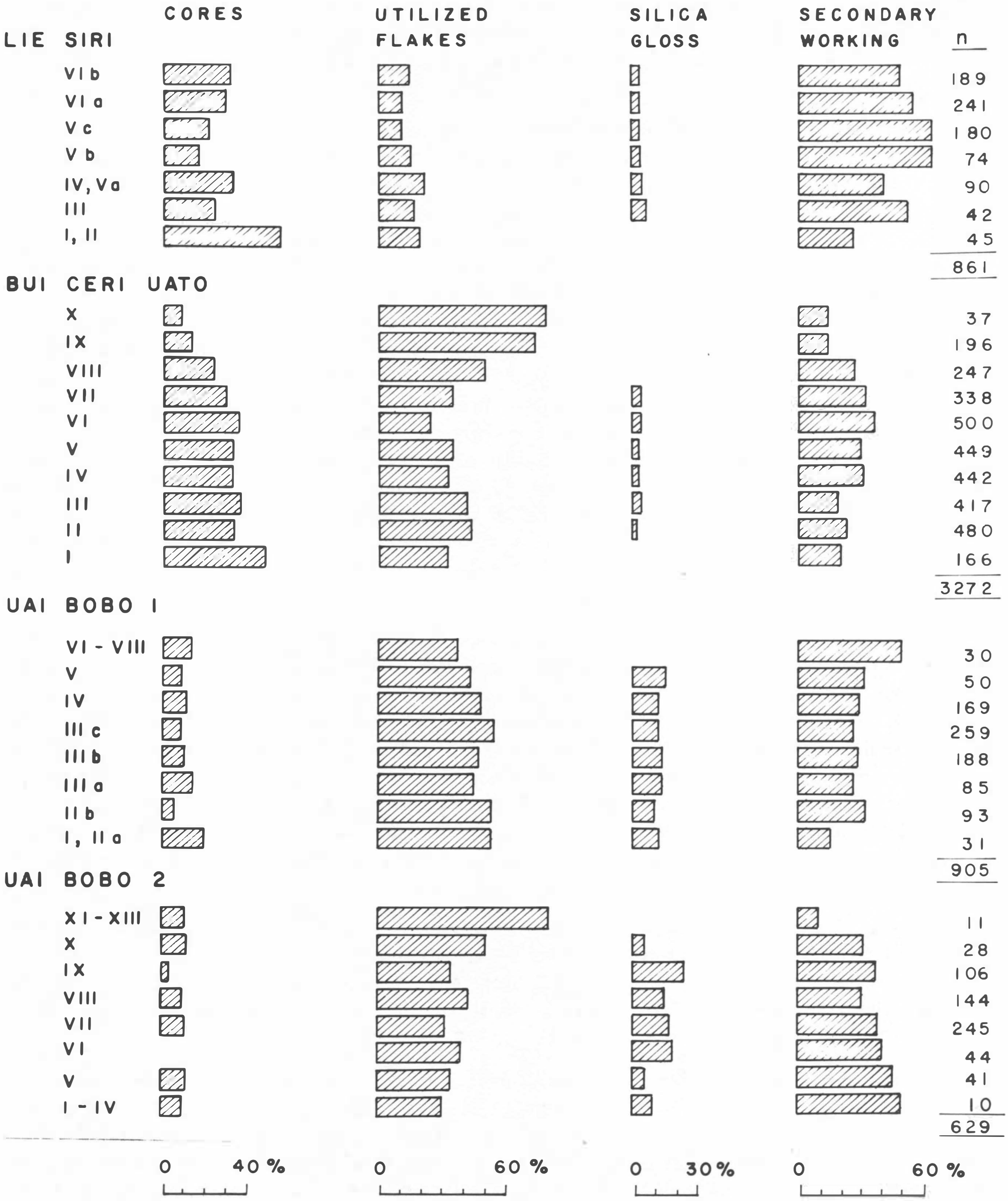


Fig.50 Proportions of the main classes of flaked stone

In the middle of the pottery sequence, and more or less contemporary with the decline in flaked stone tools, a small quantity of incised and impressed sherds occur. At this time also, bones of large murids and bats which comprised the main mammal food remains in the lowest horizons, disappear, leaving only the introduced mammals.

As I have already suggested earlier, and in the various site reports, I believe that the introduction of pottery and exotic animals reflects the arrival in Timor of an immigrant people practising some form of agriculture and animal husbandry. Direct and certain evidence for both plant cultivation and the interpretation depends entirely on the high predictive value of these traits for an economy based on agriculture. Exceptions, of which the Andaman Islands are a notable one (Cipriani 1966:148), can be found, but they are as rare in recent ethnography as they appear to be in prehistory - the Ertebölle culture of Denmark (Clark 1952:205) is such an exception. The density of flaked stone increases with the introduction of pottery and exotic animals and this I believe may reflect a growth in population associated with the adoption of some form of food production. It is difficult to estimate the probable population in pre-agricultural times in Timor because of the lack of a detailed knowledge of early settlement sizes and distribution, and because existing hunter-gatherer societies for which some, and not always reliable, figures are available on population densities, live in very different environments. But there appears to be a general agreement (e.g. Braidwood and Reed 1959:176; Service 1966:3; Lee 1963:253), that a density in excess of three per km^2 is unlikely for a non-agricultural society except where there are exceptionally rich coastal resources such as on the Pacific northwest of America, in parts of Jomon Japan, and perhaps in the Maritime Provinces of Soviet East Asia.

In Chapter II I have suggested that the population density from the 17th to late 19th century may have been in the order of 11 or 12 people per km^2 and that the increase to the present 32 people per km^2 (about 650,000 in East Timor alone) may have been the result of recent advances in public health and the suppression of internal warfare and slave raiding. By analogy with other hunter-gatherer societies the population of East Timor before 5000 BP may have been reasonably stable (Lee and DeVore 1968b:11; Birdsell 1968:229-30, 240) and in the order of 15,000-30,000. Any increase following the adoption of agriculture could have been substantial and rapid (Clark 1954:8). Such a growth in population may have led to a greater frequency in the use of caves even though they were occupied only as temporary camps by hunting parties and people working in nearby gardens.

The scarcity of flaked stone tools in the upper horizons does not mean that the caves were less commonly frequented in recent times for, as Figure 49 shows, the density of pottery increased towards the surface. Flint is used occasionally for strike-a-lights in Timor today and the evidence suggests that it was abandoned as an important tool-making material at least 2000 years ago.

The caves excavated by Bühler at Nikiniki 1 showed an even more marked decline in the density of stone artifacts in the upper levels than the sites at Uai Bobo. Discussing this, Bühler recognised the possibility that metal tools, traded from centres of Asian civilisation, could have replaced stone long before the Portuguese arrived in the east. But accepting the ideas current at the time, that Southeast Asia was a backward area, marginal to the Asian cultural centres of India and China, Bühler appealed to the Atoni and Belu myths of origin which placed the coming of metal to Timor in the recent past (Sarasin 1936:10-13; Vroklage 1953(I):147-52). He explained the great depth of the stone age material as due to continual deposition of materials rapidly eroded from nearby hill slopes in the monsoon climate (Bühler in Sarasin 1936:13).

If the decline in the use of flaked stone tools marks the introduction of metal into Timor, then the direct evidence for it from my excavations remains negative. Apart from one copper ornament from Uai Bobo 1 in Horizon IIIc and a few nails on the surface, there was no metal in the sites. But knives and swords, brought to the island in trade would be too valuable to leave lying around in a cave and the absence is not altogether surprising. The butchering marks on two pig bones from Uai Bobo 2, Horizons XI and XII (roughly 2000-1500 years old), (Plate 46) lend a certain amount of support for the introduction of metal into Timor well before the arrival of the Portuguese.

A date for the first use of metal in Indonesia is not well established for we depend, for the most part, on comparisons and analogies with mainland Southeast Asia and the excavations at Non Nok Tha (Solheim 1968; Bayard 1980), Ban Chiang (Gorman and Charoenwongsa 1976; White 1982), and Ban Na Di (Higham and Kijngam 1984) in northeast Thailand, as well as in Vietnam (Ha Van Tan 1980), have produced much new evidence but no consensus on the chronology of the Southeast Asian Bronze Age. Before the excavations of the past 20 years a date of about 2000 BP was generally accepted for the arrival of bronze and iron tools into Indonesia, and this is not inconsistent with the evidence from the cemetery at Gilimanuk in Bali (Soejono 1979; Bronson and Glover 1984).

If Timor, though far from the centres of Indonesian culture, was receiving metal tools by about 3000 BP when the popularity of flaked stone starts to decline, the accepted chronology for the Indonesian metal age is very considerably in error. There is, of course, the possibility that flaked stone in these sites was replaced not by metal, but by a perishable material which has not survived in the archaeological deposits. Dr Carmel Schrire (pers. comm.) has suggested bamboo, commonly used for arrow and spear tips in New Guinea (Cranstone 1961:62) and Indonesia in recent times (Burkill 1935:295). And it is not unlikely that some of the large bamboos, common in Timor today, were introduced as cultivated or at least useful plants, at this time. On the other hand, we do know that metal was in use in Timor when western historical records for the area first appeared in the 16th century AD and that metal was commonly exchanged, together with a cotton cloth, for sandalwood and beeswax by the early traders (Stanley 1874:153). If it becomes clear, following future archaeological work in Timor on village settlements and graves where more positive evidence might be expected, that the traditional date of ca. 2000 BP is reasonably correct for the first emergence of metal-using cultures in Indonesia, then this important technological development has left no recognisable impact in the cave deposits so far excavated.

The introduction of metal tools into a few isolated and relatively backward regions is quite well documented in the archaeological and historical literature. In northwest Europe, copper and bronze tools and ornaments were coming into fairly common use by about 2000 BC. Yet as Clark (1952:184-85) pointed out, many cutting tools were made of stone for the next 1000 years. Metal became the sole material for tools and weapons only when the cheaper and more plentiful iron was available. Childe (1944:9-13, 15) has shown that there were great regional differences, within Europe, in the proportion of tools made from metal during the Bronze Age, and that in northern Europe stone knives and scrapers retained an importance somewhat longer than in the lands bordering the Mediterranean. In some instances the introduction of metal appeared to stimulate flint workers into producing more sophisticated and elaborate forms such as the knives of pre-dynastic Egypt (Aldred 1961:102-3, 126), and the swords and daggers of the early metal age in Denmark (Clark 1952:185). The reasons for these rather exceptional developments are far from clear but it does seem that in both cases this occurred in cultures long familiar with metal tools, but denied access to a plentiful supply by the lack of local ore sources. In Denmark skilled craftsmen exploited the situation by copying in stone, for trade with their northern neighbours, those swords and axes which they were receiving from the south. In Gezeran, Egypt, copper and bronze tools were probably made from ores mined near the Red Sea. Transport across the desert can never have been easy, and the finest development of pressure-flaked blades may have taken place as a response to a relative scarcity. In Australia, Aboriginal craftsmen responded positively to the introduction of new materials only in the northwest, where the finest Kimberley points are subsequent to the import of glass and porcelain telegraph insulators. Elsewhere in Australia, and in New Guinea, traded iron soon led to the abandonment of traditional technologies (Spencer 1914:352-54; Brock 1846; Salisbury 1962:1-3) except in a few of the most remote places. However, the rate at which stone gives place to metal does not necessarily depend on the local availability of raw materials, as these ethnographic examples show, and the regular supply of trade goods even over long distances can be sufficient to effect such a change.

In central Africa cave excavations have documented the effect of the arrival of iron tools on the late Stone Age microlithic industries, and Clark (1970:38-39) argues that it led to a degeneration in the stone-working techniques, with a reduction in the proportion of formal tool types, although the debitage remains the same. Traded pottery also appears, and although iron tools are only exceptionally found in caves, changes in the flaked stone element provide a reliable indication of the arrival of people with metallurgical techniques.

The proposition that the traditional flint cutting and scraping tools were replaced by traded bronze and copper swords, knives and axes during the 1000 years before the start of the Christian era may seem radical and unlikely given the scarcity of metal in the deposits and the archaeological experience of other regions. And, in the absence of the positive dated presence of such tools and weapons from Timor, this interpretation can only be offered as a hypothesis, to be refuted or validated in the course of future work.

I have suggested that the two main prehistoric events in Timor revealed by the excavations were the introduction of pottery together with several introduced foreign, perhaps even domesticated, animals, starting about 4500 years ago, and the abandonment of flaked stone between 3000-2000 years ago. Both of these, I believe, would have entailed social and economic changes in the island. However, at this stage we can only speculate about the growth of population, development of settled village communities, and craft specialisation that may have accompanied these archaeologically visible culture traits. Timor is a small island, relatively poor in the natural products and ecological diversity that are to be expected in an area of indigenous cultural innovation and growth. If later research confirms the suggestion provisionally advanced here, that the first of these changes reflects the appearance of some form of food-producing economy, it will be reasonable to assume, I think, knowing how rarely these basic developments have been independently achieved, that they were brought to Timor from areas culturally more advanced, for the presence of several imported animal species at this time is in itself an indication of, at least occasional, foreign contacts. If the appearance of pigs and pottery in the archaeological sequence really marks the introduction of some form of agricultural economy it is important to remember the well documented reluctance of hunter-gatherers to take up agriculture except under considerable pressure and continuous example (e.g. Sahlins 1968) and think in terms of an immigration of agricultural peoples into Timor some 5000 years ago. Timor's island situation rules out the possibility of diffusion by continuous example on a broad front, or steady demographic and geographic expansion of the sort, which can effect such a transition in continental situations. Present knowledge of the development of the early village farming cultures of Southeast Asia is totally inadequate to answer the problem of where these settlers came from. Island hopping along the Lesser Sunda chain is the probable explanation but in all the relevant areas dated stratigraphic sequences are absent.

The decorated pottery which appears in the sequence as stone tools became less common, showing definite if unspecific links with the islands of Indonesia and Philippines to the north, as well as to parts of mainland Southeast Asia; these similarities are discussed later in this chapter.

The dates suggested for the introduction of the various introduced animals require special comment. In the Uai Bobo sites (Tables 92 and 122), pig and *Capra/Ovis* appear first at Uai Bobo 2 in Horizon VII, and pig alone at Uai Bobo 1 in Horizon III. Dog and buffalo come in later at Uai Bobo 1 in Horizon V and dog alone at at Uai Bobo 2 in Horizon X. The appearance of a pig's tooth associated with a date of 5520 ± 60 BP (ANU-187) at Uai Bobo 2 in Horizon VII is not surprising for the pig has already been recorded at sites in the New Guinea Highlands at a comparable date; in Kiowa, Layer 3, between 6100 ± 60 BP (Y1370) and 4840 ± 140 BP (Y1371) (Bulmer 1966) and at Kafiavana, Horizon IV before 4690 ± 170 BP (ANU-42) (Brookfield and White 1968).

At Bui Ceri Uato (Table 57) apart from the two rather suspect bones, dog and a bovid are the first possible domesticates, appearing in Horizon VI, which I have dated to between 2500 and 3500 BP by correlation of the artifact sequence, in the absence of reliable C14 dates. Pig is next in Horizon VII and *Capra/Ovis* in Horizon VIII.

At all sites dog appears some time after the arrival of pigs and pottery. A parallel situation exists at present in the New Guinea Highlands where White found dog only in the most recent deposits and at only one out of five sites excavated (White 1972:148). In both cases this may be due to the small samples obtained and to the fact that dog was never a common food animal. Nevertheless it is a curious absence for, as White points out, dogs apparently accompanied the first settlers of eastern Polynesia over 2000 years ago and different species of dogs have been found closely associated with man over 9000 years ago in western Europe, western Asia, Japan, North America.

Later excavations in Melanesia have extended the antiquity back to some 2000 years BP (Gollan pers. comm.), but its appearance there still postdates the first arrival of the dingo in Australia by more than 1000 years (Mulvaney 1975:138). Gollan (1980) who has currently reviewed the status of modern and prehistoric dogs in Australia, Melanesia and Southeast Asia has looked at the few excavated dog bones from Timor and sees in them a possible relationship with the Australian dingo.

He noted that two canines from Bui Ceri Uato are large and fall outside the range of those of Melanesia and typical island Southeast Asian dogs, but come within the middle size range for dingo teeth. And in the mandible from Uai Bobo 1, Horizon IX, the alveolar has a lingual groove which is characteristic of the dingo but not of Melanesian dogs.

The surprisingly early appearance of *Capra/Ovis* (probably goat) at Uai Bobo 2 in Horizon VII (5000-6000 BP) and Horizon IX (3500-4000 BP) requires some comment. Both these identifications are tentative and depend on a few and not absolutely diagnostic bones, a deciduous premolar in Horizon VII, and an immature calcaneum and ulna in Horizon IX. Goat bones appear in quantity only at Uai Bobo 1 in Horizon V and at Uai Bobo 2 in Horizon X which are dated to about 1400-1800 and 2000-3500 BP. It may be that the two, apparently earlier specimens, in Uai Bobo 2 have been introduced to those levels through some unrecognised disturbances. On the other hand preliminary examination of the faunal remains from Lie Siri supports the early dating.

In western Indonesia and mainland Southeast Asia I have not been able to find any evidence for the presence of goats in prehistoric times. They are certainly not present in Pleistocene faunal sequences (Hooijer 1958) although these may end well before Recent times, nor in Hoabinhian sites which range from perhaps 20,000-7000 BP (Heekeren and Knuth 1967:106-7; Gorman 1969a, 1969b; Higham 1978:407-9), nor in the best recorded Javanese cave at Guwa Lawa which probably belongs to this period (Heekeren 1972:98-99; Koenigswald 1955).

However, goats were present in Java by the mid-9th century AD, when the first historical sculptural records appear, e.g. on the Chandi Mendut (Krom 1923:306 and confirmed by personal observation). These animals are probably derived from the *Capra hircus* of western Asia (Zeuner 1963:130; Reed 1966:187) which was among the first of all domesticated animals, appearing in sites between Turkestan and the Mediterranean from about 9000 BP (Reed 1966:187-90). Goats appear in archaeological sites in western India well before 5000 BP (Kili Gul Mohammad I, 5300 ± 200 BP from an old, solid carbon determination in Fairservis 1956:356) and in the lower Neolithic of Peninsular India before 4000 BP (Utnur 4120 ± 150 BP BM-54 Allchin 1960:119; Koedekal 4410 ± 105 BP TF-748 Agrawal and Kusumgar 1974:72) and it is conceivable that they were introduced into Indonesia from India about this time. Only further work in the relevant areas will make this clear. Gollan (1980) argues that the Australian dingo has its ancestry in India and that the much smaller dogs of island Southeast Asia and Melanesia have a separate line of descent. The prehistoric dogs of Timor (on the basis of this very small sample) can be related more easily to those of India and Australia, and it is tempting to see a connection between the introduction, to Timor, of goats and dogs both from India, at a fairly remote time in the past. Whether these suggestions for a direct, long-distance connection between India and eastern Indonesia can be substantiated remains for future research to show.

NEW PROBLEMS RAISED BY THE FIELDWORK AND ANALYSIS

In the first part of this chapter I have shown how the results obtained from fieldwork answered the original research aims. Inevitably the work has revealed new problems not previously envisaged. Three of these are outlined below and discussed in some detail.

1. I have proposed that the excavated sequence at all sites spans two major cultural events - the probable adoption of a food-producing economy, and the abandonment of stone cutting tools in favour of some alternative, the nature of which we can only guess at on the present evidence. The question has to be asked, was there any change in the role of caves as a focus for settlement as a result of these changes? Despite the appearance of pigs and pottery in the sequence, little or no change can be seen in the character of stone tools or in the composition of the stone assemblages at this time. Related to this problem is the fact that the characteristic tool types of Timor have not so far been found elsewhere in island Southeast Asia.

2. Decorative designs are applied to a small proportion of the pottery in the middle of the sequence and these can be related to decorated pottery elsewhere. Apart from this, vessel forms, rim styles and manufacturing techniques have changed little up to modern times.

3. The introduction of pigs and pottery marked the beginning of the extinction of a suite of rodents which appear to have been the largest native land mammals in post-Pleistocene times. The causes of these extinctions are discussed in the final section of this chapter.

SITE USE AND ECONOMIC ORIENTATION

In a number of places in the different site reports I have explicitly or implicitly said that I do not believe that there was any substantial changes in the nature of cave use despite the possible subsistence changes which might have taken place. Even today, caves are still used regularly, if only for short periods, in Timor as temporary camps for parties out hunting in the dry season, for travellers on their way to markets, and for family groups planting, weeding, or guarding fields distant from their houses. Although one might expect caves to serve as permanent home bases for hunter-gatherer groups it is rare, in the ethnographic literature, to find records of this. Except, perhaps, in situations of extreme temperatures I think that the balance of available evidence suggests that most hunter-gatherer living sites are open sites, that groups shift frequently and while they may return regularly to the same locality, camps are rarely in exactly the same spot (e.g. Clark 1968:277). This is, I believe, true for the forest dwellers of tropical Southeast Asia (Glover 1972b, 1977) as it is for Africa or Australia.

Only where natural features provide a focus for settlement such as a cave, or resources are unusually concentrated, as at some coastal rock platforms, is re-occupation in exactly the same place to be expected. Thus, as many workers have recognised (e.g. Birdsell 1968:231; Isaac 1968:255), sites which are easily found with satisfactory quantities of material are likely to be 'a very biased sample of the totality which they are used to represent' (Isaac 1968:255). The excavated cave deposits from Timor represent, I believe, such a biased sample of the occupation sites of both the pre-agricultural and later groups. Even after the establishment of effective agriculture at whatever date, wild products must have continued to provide a substantial part of the food supply as they still do today in East Africa, New Guinea and mainland Southeast Asia (Bulmer 1968:345), and no doubt many other places. At a time when stable village settlements existed in Timor it is inevitable that the caves provide an even more biased sample of the total Timorese way of life, for cave occupation reflected mostly the hunting and collecting aspects of life, and a small part of that. Only products in common use can be expected, simple tools for food preparation and for the manufacture and repair of hunting equipment. Such artifacts, with the exception of pottery, are not likely to have been much affected by what we regard as important changes in the subsistence economy. We can expect that pottery, of little use to nomadic forest collectors, had a value with more permanent settlement and was regularly used even in temporary camps. The simple and restricted number of vessel forms found in the excavations suggests that only the most utilitarian cooking and eating ware reached the caves.

A measure of the intensity of occupation of the sites can be made by working out the average number of years for each stone tool with secondary working, and for each pot. In Table 125 rough estimates are given for the four sites based on the assumption that pottery appears at 4500 BP, and that worked stone tools were abandoned at 2000 BP.

Site	Stone tools in pre-pottery levels	Stone tools in pottery levels	Separate vessels
Lie Siri	1 every 33 years	1 every 6 years	1 every 44 years
Bui Ceri Uato	1 every 11 years	1 every 4 years	1 every 55 years
Uai Bobo 1	1 every 30 years	1 every 12 years	1 every 52 years
Uai Bobo 2	1 every 26 years	1 every 26 years	1 every 120 years

Table 125 Estimated number of years per artifact

Except at Uai Bobo 2 stone tools become relatively more common after the appearance of pottery; a reflection, perhaps, of an increasing population. Bui Ceri Uato shows a consistently higher density of stone tools than the other caves, but pottery is remarkably constant between all sites except Uai Bobo 2 which was less intensively occupied than the other caves.

The intermittent and temporary nature of prehistoric occupation is demonstrated by these figures which suggest that the caves were at no time, permanent living sites. Relevant to this is recognition from the archaeological remains of the changes brought to Timor by the colonial period - new materials such as glass, new metals, glazed ceramics, clothes with the buckles and buttons which survive well, guns and so on. But despite the evidence which I have previously discussed for the continuing use of caves today, the colonial period which started in the 16th century in Timor, is marked only by a few fragments of broken glass, wire, nails and Chinese ceramics. Important changes in the subsistence basis which certainly followed the importation of maize, sweet potatoes and manioc have left no obvious traces in the artifacts preserved in the caves.

FLAKED STONE TOOLS

Preliminary sorting of the flaked stone tools showed that there was a surprising similarity in the common forms between all the sites, and throughout the 6000 years or so (8000-2000 BP) within which most of the artifacts were made. Typological analysis and metrical analysis of size and edge attributes were able to show only a few small differences. The great majority of worked tools at all sites were side and end scrapers. These are consistently larger in the inland sites than on the coast, although utilised flakes and cores are similar in both areas. In the coastal sites, there is a tendency for all flaked tools to become smaller with time but at Uai Bobo 1 and Uai Bobo 2 no consistent size change was found. At both coastal sites there was a higher proportion of cores to worked and utilised stone (Fig.50) and at Bui Ceri Uato, more waste flakes to worked and utilised stone than at any other site. Stone working was certainly more commonly practised in the coastal sites and particularly at Bui Ceri Uato where the small trench yielded an extraordinary amount of stone.

Typological variations between sites were significant only in the presence of a few tanged points at Uai Bobo 1 in the pottery-bearing levels. Burins, thumbnail scrapers and nosed scrapers were few, and found at all levels. Flakes with silica gloss, but seldom with secondary working, were found in all sites but were more common inland where they comprised about 12% of worked and utilised stone.

I have discussed the possible origin of this silica gloss in the various sections of the site reports. Although experimental demonstration of this is unfortunately lacking, I believe that this gloss or phytolith polish (Kamminga 1979) was caused by cutting silica-rich plant stems. A microphotograph (Plate 47) of a blade with extensive gloss from Nikiniki 1 shows flow lines and comet-shaped depressions pointing away from the cutting edge. The distribution of gloss on the tool edges shows much variation; on some flakes it forms a long narrow strip along the margin, on others a broad area covering much of the surface or, occasionally, a streak running in from the edge on a narrow front (Fig.43g).

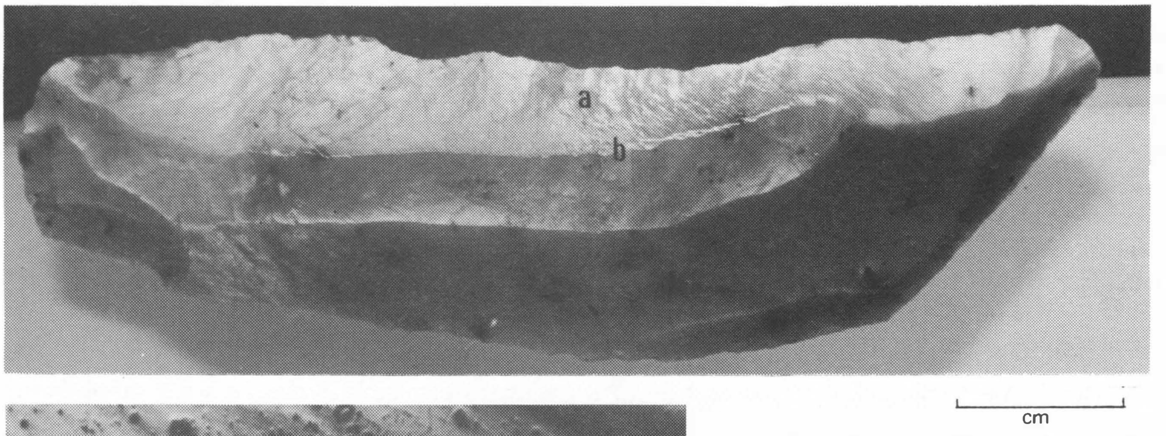
Gloss is usually found on both flake surfaces, but with the greatest area on the dorsal surface and behind it a sharp cutting edge. The few flint sickle blades from Israel with silica gloss which I have been able to examine (Fig.13g, h) commonly have the gloss more evenly distributed on both faces and in a narrow strip along the margin, resulting in a more rounded profile to the cutting edge than was common on the flakes from Timor. A similar pattern was found on a series of Danish neolithic sickle blades which were examined in the British Museum. Although some of the Timorese flakes may have been used for cutting rice or millet, I believe that the gloss results from the cutting or scraping of relatively soft materials which causes little fracturing of the sharp flake edges. Silica in the form of amorphous opal is found in many plants, especially in grasses, bamboos and in some tropical trees (Jones *et al.* 1966); palm leaves in particular are commonly used in Timor for a wide variety of purposes, and I think that the most probable explanation is that mat and basket making was the principal cause of the polish.

A difficulty, at present, in finding any quite satisfactory explanation lies in the rarity of flakes with silica gloss, at least as far as they are so far known in Southeast Asia. In New Guinea where a variety of bamboos and palms grow and find many uses, no such artifacts have been reported from excavations (White 1972; Bulmer 1964). They are not known from Java nor from the mainland of Southeast Asia as far as I know. However, I did find five flakes in the Jakarta Museum collections with small patches of this distinctive gloss. One was from Willems' 1938 excavation at Ulnam in West Timor; two were from Stein Callenfels' 1938 excavation at Panganreang Tudea; and two more flakes with silica gloss, also from Sulawesi, were among the material collected at Kalumpang by Stein Callenfels in 1933 (and which are now in the Museum Pusat, Jakarta (Glover 1972a:Pl.10:5).

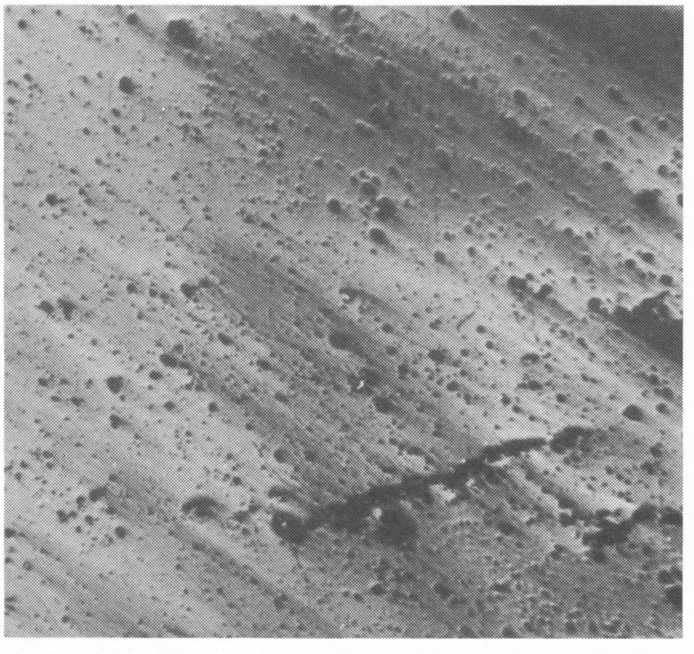
At present the distribution of this distinctive form of use-wear appears to be confined to central and eastern Indonesia and the Philippines. The earliest dated specimens come from Leang Burung 2 Cave, near Maros, south Sulawesi where 31 specimens were found in levels dated from 30,000-19,000 BP (Sinha and Glover 1984). At the nearby site of Ulu Leang 1 similar flakes with phytolith polish are found in all levels from the end of the Pleistocene up to 4000 years ago and they also occur in the slightly more recent site of Leang Burung 1 (Chapman 1981). They have been identified in surface collections from Buad Island in the central Philippines (Scheans *et al.* 1970); from the Tagotong Hill site, Carcar, 50 km north of Cebu City (Tenazas 1985); from Dimolit, a small excavated house site dated to the 4th millennium BC in northeastern Luzon (Peterson 1974:148-51); and finally in a surface collection made at Ruhuwa Village on the south coast of Seram in the Moluccas (Glover and Ellen 1980).

If the hypothesis previously put forward can be substantiated by experiment, I believe that we have inferential evidence here that one of the most typical and widespread among Indonesian craft manufacturers - the making of matting and baskets from lontar, pandanus, rattan, and coryphya palm leaves - has its origins well back in the Pleistocene. But why flakes with this distinctive use-wear are confined to the Philippines and Indonesia and are not also found elsewhere in Southeast Asia and Melanesia, requires explanation.

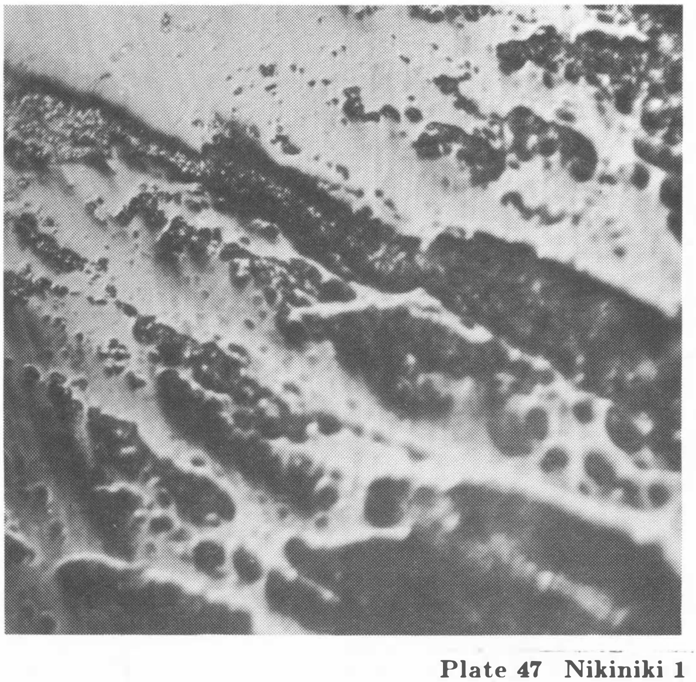
Similarities between the Timorese blade and scraper tradition and other industries are



a 75-135 cm, utilised blade with silica gloss. Basel Museum Catalogue number IIc8143



b Detail of polished surface near edge, enlarged by 44. Flow lines are about 45° to cutting edge



c Surface on central ridge where silica gloss finishes, enlarged by 200

Plate 47 Nikiniki 1

difficult to find. I have already said that no parallels were found with any known Australian industries although, of course, similarities between occasional artifacts are easy to find. Neither the backed blade traditions of south Sulawesi and west Java are found in Timor, nor the varieties of hollow-based points also from Sulawesi and Java.

Stein Callenfels (1938), Heekeren (1957:92), and others have linked the Timorese industry with the so-called proto-Toalian found by Stein Callenfels at the base of Panganreang Tudea. Heekeren has pointed out in particular, the presence of tanged 'implements and scrapers of a characteristic shape' (Heekeren 1957:92). The scrapers certainly have something in common with the Timor side scrapers, since some are made on thick blades with steep working on one or both sides (Glover 1981:Figs 7c, f, 8b). The very distinctive single and double notches, however, appear to be less frequent on the tools from Sulawesi.

The tanged or 'pedunculated' points from Tudea have nothing in common with those from Timor; the few I have seen in Jakarta are no more than chance occurrences on broken primary flakes, and show none of the distinctive steep unifacial trimming at both sides of the butt end of a blade which produces the tang. However, elsewhere in Asia, scattered, but similar tanged points have been found which must be mentioned. They show the sort of distribution to be expected from artifacts which have evolved independently for a common purpose. Thus a small number of unifacially worked tanged points of obsidian have been found in the Melanesian islands; on Andra in the Admiralties (Bühler 1949:230), at Talasea in New Britain (Casey 1939:Fig.7), at Missima in the Louisiade group (Seligman and Joyce 1907:Pl.VIII, I), and at Buin, Bougainville in the Solomon Islands (O'Reilly 1948). Further east, bifacial tanged points and flakes have occasionally been found in New Zealand (L. Groube pers. comm.), and are common on Easter Island (Heyerdahl and Ferdon 1961(I):74-75, Pl.33). Bifacial tanged points are also one of the most distinctive artifact types of the Japanese late Palaeolithic, but not of the Neolithic cultures (Serizawa 1965:English summary), as Sarasin (1936:20-21) believed when he compared the Timor points to those figures by Munro (1906). Serizawa (1965:Fig.8) also illustrates a unifacially worked tanged point said to be from Choukoutien, Locality 1. This artifact is identical in shape, size and technique of manufacture to the Timor points. Further to the west, in central India, occasional tanged points have turned up in Chalcolithic levels (Sankalia 1960:114-15); again, no doubt, a local development in response to the common need for an effective hafted projectile point.

Timorese stone tool types are, I believe, almost completely a local development, and were evolved over a long period of time within a single cultural tradition. As general-purpose tools for basic chopping, scraping and cutting tasks, the scraper forms were not affected by the changes which may have come with a more settled way of life. New types, such as the tanged points, were added to the tool kit, using traditional flaking techniques to cope with new requirements. Since these points appear to be confined to the wetter and better wooded areas of central and southern Timor one can speculate that it was the introduction of new and larger game animals, monkeys, cuscus, civets and probably the feral descendants of imported pigs, which provided the incentive for this invention.

CERAMICS

Throughout the analysis of pottery I have stressed the continuity and conservatism shown by the excavated material. Although it is true that the cooking and water pots have much in common across Indonesia there are regional variations greater than any encountered in these assemblages. The only consistent changes found were a tendency towards thinner-walled vessels in the most recent levels at two sites (Bui Ceri Uato and Uai Bobo 2), the virtual disappearance of surface burnishing in modern times at the Uai Bobo sites, an increase in the proportion (always small) of paddle-stamped ware at the coastal sites, the appearance of a few ring bases and painted decoration in recent levels in both areas, and an increased preference for vessels with short, thick and more acutely everted rims in place of less flaring 'collar' rims, over the past 2000 years or so. Superimposed on this slowly changing pottery tradition, for what may have been a brief period, between 3000-1500 years ago is a narrow range of geometric decorative designs (Fig.51) applied, for the most part, in one or two horizontal bands below the neck of the round-based cooking pots.

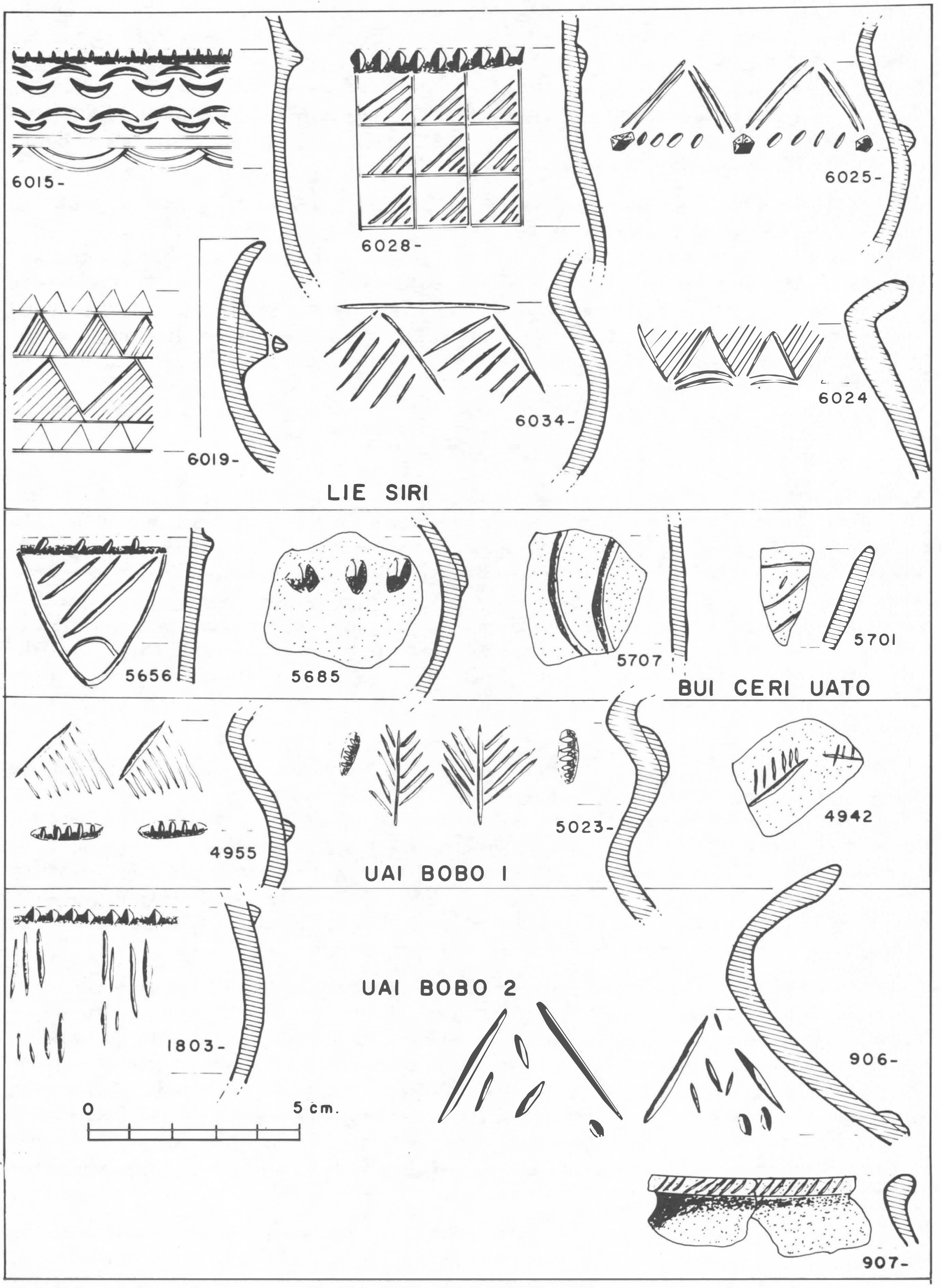


Fig.51 **Decorated pottery from East Timor. Incised, impressed and relief decoration dates to between 1500-3500 BP**

Decorated pottery of this sort is not made in Timor today and all the elements of the designs can be matched among the range illustrated by Solheim as belonging to the Sa-hùynh-Kalanay pottery tradition (Solheim 1961a:102-8, 1961b:158, 1964). The most common single element is the hatched triangle and though this appears to be rare on the pottery which probably belongs to this tradition from Flores (Solheim 1966:Pl.I-IV), Sumba, (Heekeren 1956b:Figs 2-8), Sulawesi (Heekeren 1972:Pl.101-2; Stein Callenfels 1951:Pl.XIV-XVIII), Bali and west Java (Soejono 1962:Fig.1, Pl.III; Heekeren 1956a:198) it is a common element in the decoration on pottery from the Sa-hùynh site itself (Solheim 1961a:Figs 1, 2) as well as in other distinct pottery traditions in Melanesia and western Polynesia (Poulsen 1964:Figs 2, 16, 18; 1967(2):Figs 78, 80; Golson 1972:561).

With such a simple and widespread design element it is obviously unwise to push the implications of these similarities very far. However, Solheim's argument for some sort of historical relationship between a number of widely scattered complexes in Southeast Asia and Melanesia is probably valid (Solheim 1961a:97, 1964:196-209) and the age for this pottery in Timor agrees quite well with the dates so far obtained elsewhere. Further east the Lapita and New Hebrides incised pottery traditions for which Solheim has claimed descent from the Sa-hùynh-Kalanay complex (Solheim 1964:206-9), were definitely established in Melanesia before 1500 BC (Golson 1968:8-13).

THE OUTLINE

A brief summary of the more positive aspects of the excavations in Timor is presented in this final section, omitting some of the qualifications which have already been discussed. The evidence from the caves suggests that Timor was occupied before 13,500 years ago by groups, probably few in number, and who were dependent on naturally-occurring food sources. From bones recovered we can see that large rats and bats were among their principal prey; shellfish were gathered from the fringing reef platforms on the coast and no doubt a large range of indigenous plant foods were harvested including the fruits of a species of *Celtis*, and the Polynesian chestnut (*Inocarpus*). Fruits of the betel vine (*Piper betel*) and Job's tears (*Coix lachryma-jobi*) were among the plants collected but are unlikely to have been cultivated at this time.

About 4500 years ago substantial changes occurred in the pattern of this archaic Timorese culture, for pigs and pottery then appeared in the archaeological record. Civet cats, the cuscus, goats, dogs and monkeys followed and as the caves came into increasingly frequent use the endemic giant rats became extinct, perhaps as a result of predation by man and the introduced viverrids. Ecological disturbances following the arrival of pigs, whether domesticated or feral, may have played a part in this, together with the development of some form of agricultural economy which undoubtedly took root in Timor about, or after this time; although the dating and nature of its development cannot yet be documented.

About 3000 years ago, Timor may have come into more regular contact with other parts of Southeast Asia for small quantities of decorated pottery at this time show definite, if unspecific, links with the islands of Indonesia and the Philippines to the north and west as well as to mainland Southeast Asia. However, this decorated pottery tradition never took firm root in Timor, as it has done in Melanesia where it was probably introduced about the same time, although the designs survived in the island on other materials. The flaked stone tool tradition shows a long development of locally developed forms which was little changed by the new economic patterns which accompanied the appearance of pottery, pigs and other introduced fauna.

About the time the incised pottery briefly appeared there started a progressive decline in the quantity of flaked stone in all sites so far examined in Timor, and finally in the proportion of carefully retouched pieces. The reasons for this are far from clear but two sorts of explanation may be invoked: (a) that there was a change in the nature of the cave occupation; and (b) that flaked stone was abandoned in favour of some alternative material. There is, from these excavations, nothing to suggest a basic change in the use of the caves, although it must be remembered that the excavations were not directed towards obtaining the appropriate types of evidence. And if flaked stone was replaced by another medium for the manufacture of cutting tools, either it was too impermanent to survive, or too precious to be abandoned in these temporary camps.

So few ground stone tools are known from Timor that it is difficult to say much about them. No edge-ground axes have been found in a pre-agricultural context in Timor, as they have in Australia (White 1967b), New Guinea (White 1972:142) and perhaps in Borneo (Golson 1972). And, as none appear to have been found in the sites excavated by Bühler, Willems, Verhoeven and Almeida it may be that ground stone cutting tools were never in common use in Timor.

There was no evidence for any significant contact with Australasia during the period under review except for the introduction of the sole marsupial, *Phalanger orientalis* or cuscus, which may have been the result of a single trade contact with either New Guinea, the Moluccas, or even Australia, where it occurs in Cape York.

The presence of shell artifacts which have parallels in Melanesia (Lewis 1929) as well as in Flores and Java (Heekeren 1967, 1957a:Pl.26B) and Indo-China (Mansuy 1923:7, Pl.III, 1925:Pl.XIV) show the same sort of unspecific links with neighbouring areas indicated by the decorated pottery.

Given the paucity of any human skeletal remains it is impossible to say on the basis of anatomical studies whether the appearance of pigs and pottery was the result of a migration of people or merely by the introduction of techniques and perhaps feral animals. Timor's island situation, however, seems to rule out the possibility of diffusion of cultural traits on a broad front, or of the steady geographic expansion of agricultural societies such as may be found in continental situations, and I believe that some immigration almost certainly took place. On the other hand, the archaeological materials show a pattern of continuity from the late Pleistocene up to recent times, with the long survival of old forms and the gradual incorporation of the new.

The absence of any remains earlier than 13,500 BP, leaves the question open as to whether Timor was a corridor for the first migration of people into Australia. The finds of *Stegodon*, made by Verhoeven near Atambua in West Timor (Verhoeven 1964; Hooijer 1969) in Flores (Hooijer 1957) and Sumba, and the possible association of this mid- to late Pleistocene placental mammal with flaked tools in Timor (Glover and Glover 1970) suggest that this is still a possibility.

APPENDIX 1

THE ANALYSIS OF LARGER AND DOMESTICATED LAND MAMMALS

After the preliminary sorting all the bones which were thought to belong to domesticated animals, monkey and deer, were sent to Professor C.F.W. Higham, Department of Anthropology, University of Otago, Dunedin, New Zealand, for positive identification and description. The lists given below were supplied by Higham, except for the few additions which are noted as they occur. Unfortunately it was not possible to include the material from Lie Siri, and this will be published later.

In the lists, a question mark denotes a tentative identification only. Where it was possible, an indication is given of age, sex, species and the minimum number of individuals occurring in each horizon. Higham offers the following comments on the identifications:

> The fauna is no more fragmentary than from most cave sites. It is not at all easy to distinguish sheep from goat, but the one diagnostic metacarpal available is certainly caprid (see Higham 1967, 1968b:64-65). Nor is it possible to distinguish bovid and buffalo apart from certain bones, such as the magnum and the horn core. The bovid bones look a little too small for buffalo ... some of the pig and caprovine bones are so small that they could be foetal.

Neither pig nor *Capra/Ovis* are native to Timor and they have been introduced to the island, probably by man. This is more certain for *Capra/Ovis* than for pig which is found in the native wild fauna of Indonesia, as close as Sulawesi. Indeed, both wild and domesticated pigs are present in Timor, represented by quite separate species (Schwarz 1914; Groves 1981). The wild pigs are considered to be a subspecies of the *Sus verrucosus* group, the warty pigs of Java and Sulawesi, while the domesticated pigs belong to the *Sus scrofa* group. However, it is almost certain that they were both introduced to the island by man, no earlier than the 4th millennium BC if the evidence from the cave deposits is a reliable guide. At present it seems possible to distinguish between the domesticated and warty pigs only by comparing certain parts of the skull, or by the cross-section of the mature canines (Groves 1983), and the fragmented bones found in most cave occupation deposits are seldom adequate for this purpose. However, canine fragments identified as *Sus* sp. by Higham were found at Uai Bobo 1 in Horizons VIII and VI (late in the sequence) and in a small trial excavation at Bui Lale (not reported in this volume). Perhaps, when these teeth are re-examined from this perspective it may be possible to determine whether at least some of the pigs in the cave deposits were from the wild or domesticated species. One might also expect to find in Timor feral descendants of domesticated pigs, and given the nature of animal husbandry in Timor one can expect a considerable amount of interbreeding between feral and tended herds. Such a situation must have been common in many early agricultural societies and has acted to reduce the anatomical distinctions between wild and domesticated populations (Higgs and Jarman 1969).

Differences in age structure and sex ratios between such populations have been used many times to distinguish between a hunting economy and animal husbandry in prehistory. The argument generally made is that domesticated animals in archaeological sites include a higher proportion of very young and immature individuals than where a wild population is merely hunted (Reed 1966:187, 1961, 1963; Higham 1967:87-89; Perkins and Daly 1968). Both Higgs and Jarman (1969), and Higham (1968a:19), point out some exceptions to this principle, but it seems to be a useful means of making a preliminary distinction between husbandry and hunting.

Taking the material from all horizons at all sites, a minimum number of 27 individual pigs and 21 *Capra/Ovis* were recognised. In the following table I have grouped these into three rough age grades based on Higham's comments on the material and on the tables for dentition development in European *suidae* and *caprovines* published by Silver (1963:264) and Higham (1967:105-6). Very young includes foetal to about one month for pigs and three weeks for *Capra/Ovis*. Immature includes up to about three years for pigs and two and a half years for *Capra/Ovis*.

Age	*Sus*	*Capra/Ovis*
Very young	5	3
Immature	13	10
Adult	3	3
Indeterminate	6	5
Total	27	21

Table 126 Age grouping of *Sus* and *Capra/Ovis*

Of those whose ages can be determined 18 pig (86%) and 13 *Capra/Ovis* (81%) are very young or immature and only 14 and 19% respectively are adult.

Given the poor nature of the evidence from these Timorese sites, there seems to be little point in comparing these figures with the age structure of wild and domesticated herds, even if figures were available for the region. But the point is made, that the majority of specimens whose ages can be roughly determined, are immature and this is more in keeping with an economy based on husbandry than hunting feral animals if the argument previously outlined is valid, as I believe it is. Among the large murid collection (Appendix 2) Mr J. Mahoney commented on the apparent lack of an age bias, although figures are not available for this.

It is not possible to say anything about the sex ratio, given the high proportion of juvenile individuals in which sexual dimorphism would not be apparent. Only one could be sexed, an adult female *Capra/Ovis* from Uai Bobo 1, Horizon VIII.

In an attempt to determine whether the animals were slaughtered on or near the sites, or whether cuts of meat only were taken to the caves, the identifiable bones were divided into five groups, cranial, forelimbs, hindlimbs, feet and axial skeleton and appendages. Loose teeth account for the large number of cranial bones. The approximate numbers for each site are as illustrated in Tables 127 and 128.

	Uai Bobo 1	Uai Bobo 2	Bui Ceri Uato	Total nos	%
Cranial	22	14	4	40	49
Forelimb	5	5	1	11	14
Hindlimb	2	5	-	7	9
Feet	7	6	1	14	17
Axial	1	8	-	9	11
Total nos	37	38	6	81	100

Table 127 *Sus*: presence of various skeletal elements

	Uai Bobo 1	Uai Bobo 2	Bui Ceri Uato	Total nos	%
Cranial	17	3	3	23	44
Forelimb	4	-	3	7	13
Hindlimb	3	-	2	5	10
Feet	6	1	5	12	23
Axial	5	-	-	5	10
Total nos	35	4	13	52	100

Table 128 *Capra/Ovis*: presence of various skeletal elements

The count and percentages can only be approximate because of the number of broken or slightly doubtful specimens, but it can be seen that whenever the sample is more than about 20, all the main parts of the body are represented and further, that when all the sites are added together (and for Uai Bobo 1 and Uai Bobo 2 separately in the case of *Sus*), there is much the same proportion of different body parts for pig and *Capra/Ovis*, indicating that there was no recognisable difference between the utilisation of the two species at these sites.

During the preliminary sorting, only one bone of civet cat was recognised: a right mandibular ramus from Uai Bobo 2, Horizon VII. This was tentatively identified as *Paradoxurus hermaphroditus* by Mr J. Mahoney and was sent to Lord Medway, formerly at the School of Biological Sciences, University of Malaya, Kuala Lumpur, for positive identification. However, the collection sent to Higham contained postcranial bones of another possible eight individual civets, all from the inland region, where they are common today.

The following identifications and descriptions were supplied by Higham.

BUI CERI UATO

Horizon X

Canis	Phalanx 1
Capra/Ovis	Radius, distal end unfused, <3 years

Horizon IX

Canis	Burnt mandible Phalanx 1 and metapodial fragment
Sus	Mandible fragment and distal end metapodial
Capra/Ovis	Metatarsal fragment Radius shaft fragment Metacarpal, adult Tibia, adult Metatarsal, shaft fragment Upper molar, well worn Tibia, cut and split lengthways
Cervus timorensis	M_3, well worn Incisors, four specimens
Macaca	Mandible, M_2 unerupted

Horizon VIII

Bos (2 individuals)	M_1, M^1, well worn Lower molar fragment, unworn
Macaca	One mandible, immature One molar Skull fragment

Sus	Radius, very young
(2 individuals)	Mandible, M_2 just in wear
Capra/Ovis	Metatarsal, shaft fragments
	M^3
	Molar fragment
Canis	Incisor

Horizon VII

Canis	One PM4
	Axis
Sus	Two lower incisors
(?2 individuals)	
Bos	Phalanx 1, fragment

Horizon VI

Canis	One canine
Bos	Vertebra fragment

Horizon IV

Capra/Ovis?	Cut and polished fragment of radius, probably *Capra/Ovis*

Horizon II

Capra/Ovis	Magnum

UAI BOBO 1

Horizon VIII

Bos taurus	M^2 permanent, adult
(2 individuals)	Metapodial, distal epiphysis, sub-adult

Sus (2 individuals)	Pelvis Radius, very young, foetal? Lower incisor, adult Upper incisor Canine, three fragments Molar, fragment
Civet? (1 individual)	Calcaneum Ulna Mandible
Capra/Ovis	Pelvis, acetabulum fragment, adult female Pelvis, acetabulum fragment, adult female Mandible, PM2 and PM3 in primary wear Lower deciduous, PM3 (two specimens) in primary wear, immature Lower deciduous, PM4, heavily worn M_3, in primary wear Lower incisor, six specimens $M^{1,2,3}$ Sacral fragment Tibia fragment Skull fragment
Macaca	Two upper premolars

Horizon VII

Bos	Upper premolar, adult
Capra/Ovis	Maxilla, M_3 in eruption
Sus	Skull fragment, cut PM^4, two specimens PM^3 Humerus, very young
Equus?	Upper incisor
Canis	Calcaneum 1st Phalanx, 3 2nd Phalanx, 2

Horizon VI

Capra/Ovis (3 individuals)	Radius, distal end chewed by dog Mandible, M_2 in primary eruption Mandible, M_1 in primary eruption Radius, extremely young specimen Metacarpal, extremely young specimen Metacarpal, definity goat

	Astragalus
	M^3, unworn
	Phalanx 1, unfused
	Upper premolar
	Deciduous PM_4 worn, two specimens
	Lower incisor, three specimens
	Metapodial shaft fragment
	Radius, with cut marks
Canis	Complete pelvis
Sus	Maxilla, M^1 in primary wear
(1 individual)	Molar, fragments of unerupted specimen
	Canine, two fragments
	Incisor
Civet	Calcaneum
	Ulna

Horizon V

Capra/Ovis	Calcaneum unfused, <2.5-3 years
(2 individuals)	Humerus, extremely young, foetal?
	Tibia, extremely young, foetal?
	Pelvis, extremely young, foetal?
	Mandible, adult
	M^2
	Fragments of dentition
	Metatarsal, shaft fragment
	Scapula, cut
Sus	Femur, distal end unfused, <3.5 years
(1 individual)	Mandible, M_1 in primary wear, 1-2 years
	Calcaneum, fragment
	Incisors, various
Macaca	Fragment of foramen magnum
	Skull fragment
	Mandible fragment
Cervus?	Phalanx 2
Canis familiaris	Canine, half bored and split?
Bos	Fragment of upper premolar

Horizon IV

Sus	Skull fragment, supraoccipital
(1 individual)	Radius, proximal end (fused)

	Phalanx 1 ii/v, proximal end, fusing, 2 years
	Phalanx 2 iii/iv
	Mandible, M_1 in primary wear, 1-2 years
	Metacarpal iii/v, proximal end fragment
Civet	Humerus, distal end fragment

Horizon III

Sus	Humerus, distal end fused, >3.5 years
(2 individuals)	Femur, distal epiphysis, <3.5 years
	Skull, fragment of foramen magnum
	Metatarsal iii/iv, distal end unfused, <2.25 years
	Phalanx 1 ii/v, burnt
	Metapodial iii/iv, burnt
	Mandible, two fragments
	Skull fragment
	Lower incisor, three specimens in primary wear
	Molar fragment
	Upper deciduous premolar
	Upper incisors, three specimens
Cervus?	Upper molar fragment
Civet	One lower canine

UAI BOBO 2

Horizon XIII

Sus	Tibia, proximal end unfused, <3.5 years, cut
(2 individuals)	Pelvis, <3.5 years, cut
	Metacarpal iii/iv, adult
	Radius
	Tibia, extremely young
	Pelvis fragment
	Foramen magnum fragment
	Lower incisor
Cervid?	Upper molar and incisor

Horizon XII

Sus	Pelvis
	Femur, unfused proximal end, <3.5 years
	Scapula fragment
	Metapodial ii/v, unfused distal end, <2 years

	Skull fragment Upper incisor
Capra/Ovis	Mandible, PM_3 deciduous, just in wear, 3-6 months
Macaca	Phalanx 1

Horizon XI

Sus (2 individuals)	Humerus fragment, with cut marks Vertebra, with cut marks Lower incisors, two Tibia, extremely young Radius, extremely young Ulna, extremely young Scapula, extremely young
Macaca	Lower incisor
Civet	One molar

Horizon X

Macaca	Pelvis, plus six tail vertebrae Two skull fragments Deciduous lower incisor?
Sus	Radius, distal end unfused, <3.5 years Metacarpal iii and iv, distal end unfused, <2 years Metacarpal ii or V, distal end unfused, <2 years Maxilla fragment
Civet	Tibia Axis
Capra/Ovis	One incisor
Canis?	One fibula (sent to Higham, but so far not positively identified)

Horizon IX

Sus	M1 or M2 (probably latter) in primary eruption Ulna, very young specimen, foetal? Vertebra Mandible fragment Skull, two fragments Metacarpal iii/iv, proximal end fragment

Capra/Ovis?	I am very uncertain about these immature specimens of calcaneum and ulna
Civet	Astragalus ?Ulna, very uncertain

Horizon VIII

Sus (?2 individuals)	Deciduous PM4 in secondary wear, 1-12 months Lower incisor Lower deciduous premolar Vertebra Astragalus
Primate, ?*Macaca*	Radius Scapula Vertebra
Civet	Radius, two specimens Calcaneum

Horizon VII

Sus?	Upper molar
Capra/Ovis?	Deciduous upper premolar
Civet?	1 right mandibular ramus with PM_2

APPENDIX 2

THE ANALYSIS OF MURIDS

Murid rodents were by far the most common animals found in the deposits, and the recovery, sorting and analysis of these presented special problems.

The aim in excavation was to achieve a reasonable compromise between the speed necessary to dig enough deposit to obtain an adequate sample, and the painstaking care required to recover as many unbroken specimens as possible. A measure of this difficulty can be made by calculating the number of bones in each site based on a ratio of bone weight to numbers. Large mammal bones were excluded. The approximate numbers, of what were mostly postcranial bones, of small rodents, for each of the four main excavated sites are:

Lie Siri	9,500
Bui Ceri Uato	500
Uai Bobo 1	23,000
Uai Bobo 2	57,000
TOTAL	90,000

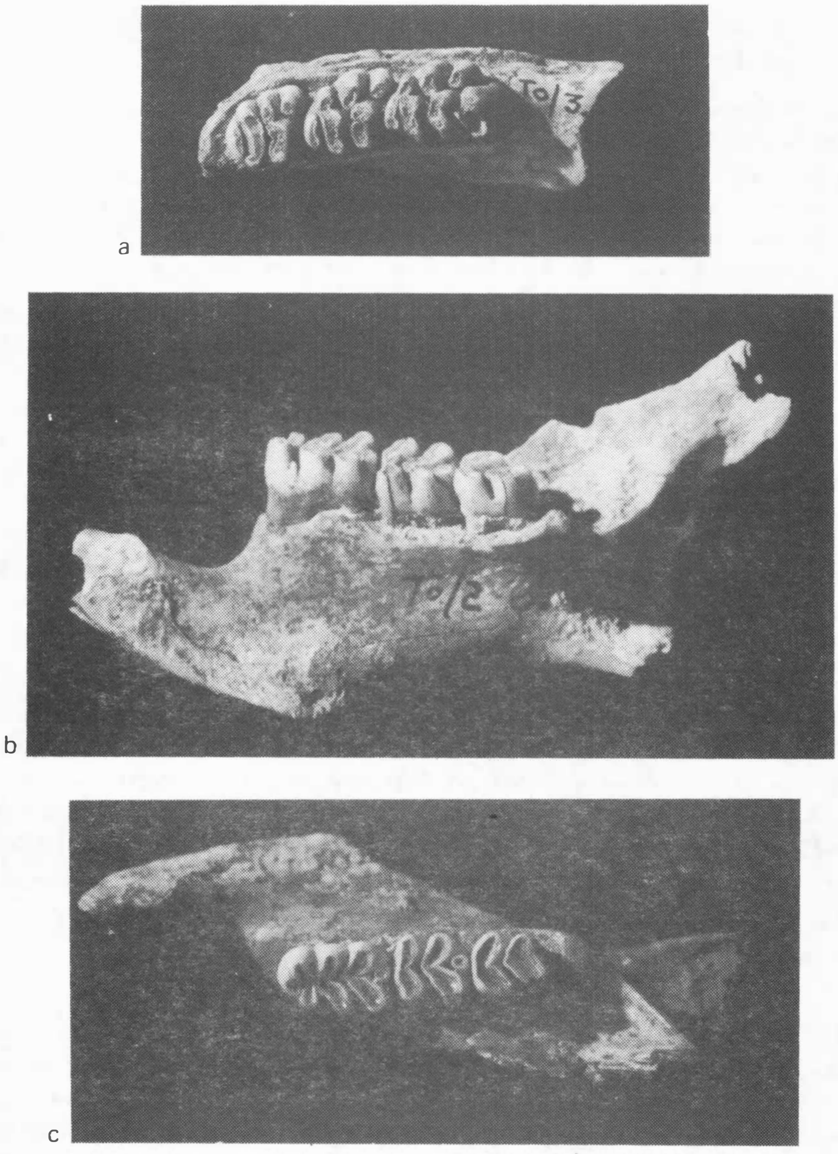
When murid cranial bones and the remains of larger mammals, birds and reptiles are added to these, the number of bones brought from the field would have been between 95,000 and 100,000. It is a tribute to the patience of the Timorese workmen that so many small bones were recovered and so few were damaged during excavation and sorting.

In the laboratory, all bones were sorted twice by different workers into the various orders or genera, and all murid cranial material was separated for later identification. Mr D. Witter undertook the preliminary identification of the murids and recognised provisionally, four genera and/or species of large rats, and three or four smaller rats, of which one was *Melomys* sp., one *Rattus exulans* and possibly two *Rattus* sp. On Mr Witter's return to the United States all further work was undertaken by Mr J. Mahoney who supplied the numbers of individuals of the different genera which are included in the respective site reports.

Minimum numbers were calculated by counting whichever was the most of right or left mandibles, maxillae or cranial fragments. The size and state of tooth wear was also taken into account.

Mr Mahoney (Dr G. Musser, American Museum of Natural History, has agreed with Mr Mahoney to take over the study of the Timorese sub-fossil rodents), will be publishing separately a detailed description of the various genera, but in the interim, he reports that there are four large murids present which belong in four different genera, one of which is to be identified with *Coryphomys bühleri* Schaub. The other three, which have not previously been described, are called A, B, and C in the tables, pending Mr Mahoney's description. Their dentition is illustrated in Plates 48-51.

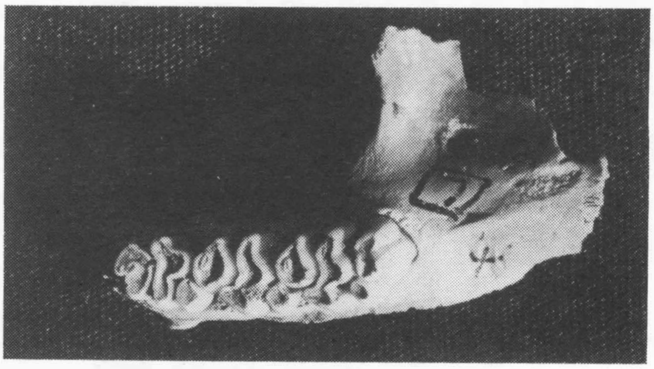
Of the smaller rats, there are two species of *Melomys* (including *Pogonomelomys*) which have not previously been recorded from Timor, *Rattus exulans*, and two *Rattus* sp. of which one is most probably *Rattus rattus*. The taxonomy of small murids in Indonesia and Melanesia is complicated and confused and Mr Mahoney reports that it is unwise, at present, to give specific identifications of the small rats, other than *Rattus exulans*. Many of the large murid bones are charred and broken and most came from adult or sub-adult individuals. On these grounds it is almost certain that most of them represent human food remains and they do not come from owl pellets, since adults of all four species would have been too large for owls to take. The small proportion of juveniles among the large murids also suggests that they were not living in the caves. On the other hand, it is probable that most, if not all the smaller rodents were brought in by owls or other predators. In Figure 49 the density of small rodents is separately plotted against measures for the occupational density of sites Lie Siri, Uai Bobo 1 and Uai Bobo 2.



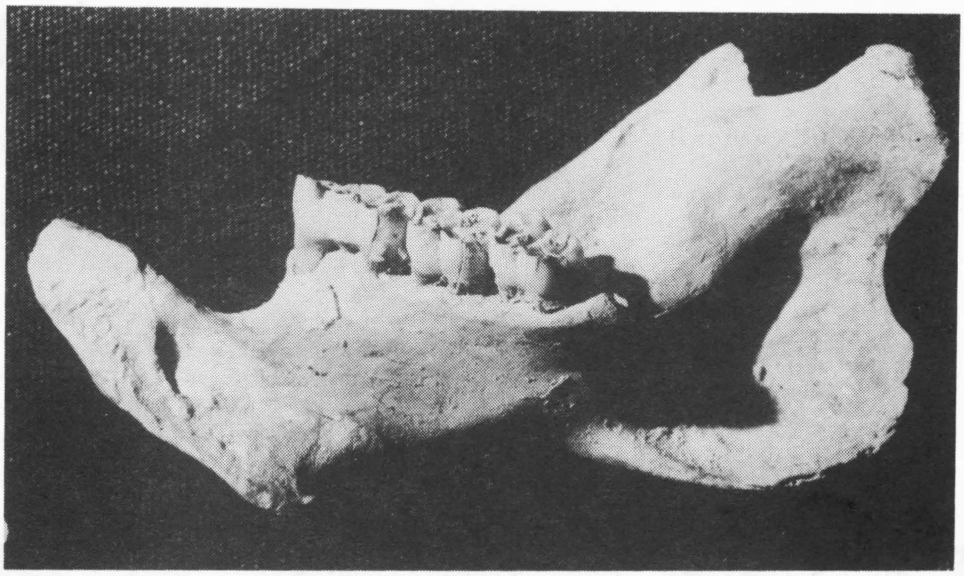
Scale in mm

Plate 48 *Coryphomys bühlerei* Schaub

a left maxilla
b right mandible
c left mandible



a



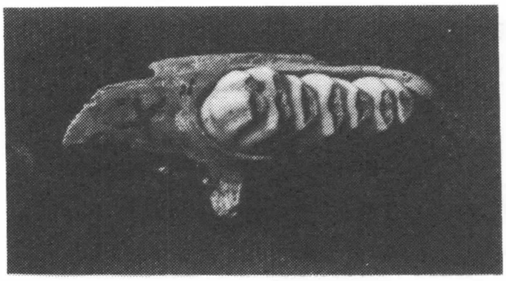
b

c

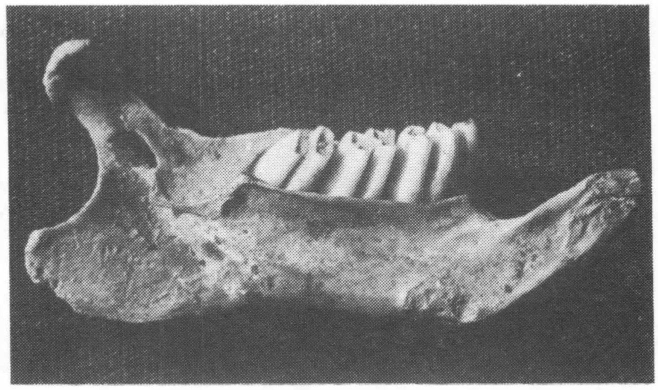
Scale in mm

Plate 49 Large murid, genus A

a left maxilla
b right mandible
c right mandible

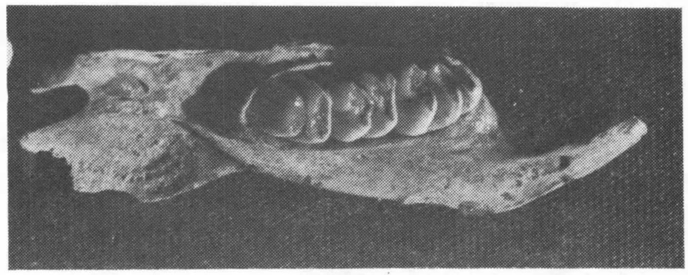


a



b

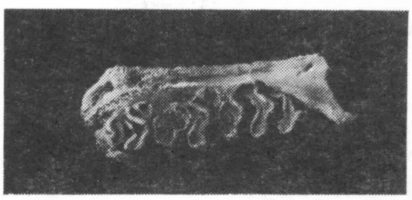
Scale in mm



c

Plate 50 Large murid, genus B

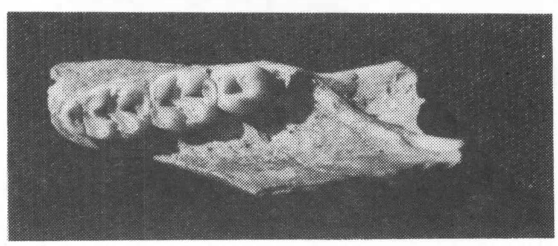
a left maxilla
b left mandible
c left mandible



a

b

Scale in mm



c

Plate 51 Large murid, genus C

a right maxilla
b right mandible
c left mandible

APPENDIX 3

THE ANALYSIS OF CHIROPTERA

Identifications were made by Mr J.L. McKean of the Division of Wildlife Research, CSIRO, Gungahlin, ACT and the report is written on information supplied by Mr McKean.

Identifications were generally made to generic level except in a few cases where well preserved bones permitted the species to be identified. The reference collection contained specimens from Australia, New Guinea and island Melanesia only, as no collections from Timor, or elewhere in eastern Indonesia were available to Mr McKean. In 1968, however, Professor R.E. Goodwin, from Colgate University, Hamilton, New York, USA, made a collecting trip to Timor and kindly supplied Mr McKean with a provisional list of bats which he obtained, together with information as to those species found to be cave dwellers on the island. Professor Goodwin will be publishing separately on the dates of Timor.

In addition to those species listed by Laurie and Hill (1954) for Timor, Goodwin collected the following:

Megachiroptera	*Eonycteris spelaea*
	Macroglossus sp.
Microchiroptera	*Taphozous melanopogon*
	Taphozous sp.
	Rhinolophus sp. (*borneensis* group)
	Rhinolophus sp. (*arctuatus* group)
	Rhinolophus sp. (*philippinensis* group)
	Hipposideros bicolor
	Miniopterus sp.

He did not encounter the following species listed by Laurie and Hill:

Microchiroptera	*Nyctimene cephalotes*
	Hipposideros cervinus
	Myotis mystacinus
	Tylonycteris robustula

Nyctophilus timoriensis which is listed for Timor by Laurie and Hill, is mistakenly attributed according to Mr McKean, as this is an exclusively Australian species.

The following genera were recorded as cave dwellers in Timor by Goodwin: *Rousettus*, *Dobsonia*, *Taphozous* (2 species), *Rhinolophus* (3 species), *Miniopterus* (2 species). *Eonycteris* is a cave bat elsewhere and its relative rarity could account for Goodwin's not encountering it in caves in Timor. However, *Cynopterus* is a common species in the island, and although known to inhabit caves in certain parts of its range, it was not found to do so in Timor, but was commonly found in hollow trees and folded palm leaves.

Examination of the excavated remains by Mr McKean revealed the following genera and species:

Megachiroptera	*Pteropus* sp.
	Pteropus? griseus
	Pteropus vampyrus
	Nyctimene cephalotes
	Dobsonia peroni
	Acerodon sp.
	Acerodon? mackloti
	Rousettus amplexicaudatus

Microchiroptera	*Hipposideros diadema*
	Hipposideros sp.
	Rhinolophus sp.
	Taphozous sp.

The identified remains included complete and partial mandibles, cranial fragments and loose teeth. The minimum numbers of each identified group in each horizon were calculated by counting the highest number of either left or right mandibles, or left or right cranial fragments. In the few cases where the numbers are uncertain due to the high percentage of small broken fragments, a conservative estimate has been made and the doubt is shown by the question mark following the figures in the tables.

Only one of the excavated caves included in this report, Lie Siri, contains a bat colony today, and Lie Siri is the only major excavation where bat bones are found up to the surface. Considering this, and the point made by McKean, that the excavated remains included a surprisingly high proportion of megachiroptera (*Rhinolophus* sp. is the only really small bat found), it is a reasonable supposition that the majority of specimens represent remains of bats taken into the caves for food. This is almost certainly so for the non-cave dwelling species, and even those species which might have lived in the cave were probably incorporated into the occupation deposits at the front of the caves by human action.

While collecting in Timor, Goodwin obtained information on the use of bats as food which he has kindly made available to me.

Pteropus, *Acerodon* and *Dobsonia* were most commonly eaten, probably because of their large size. However, people will eat any kind of bat that they can capture, including on rare occasions, even the smallest species.

In the area around Ossu and Venilale, the Timorese will go into caves for bats. Large bats are killed with a blow gun, and for small ones long bamboo poles are used with a fagot of thorn bushes bound at one end. By waving these back and forth, flying bats became impaled on the thorns.

Large bats are neither skinned nor eviscerated before cooking, but are pounded with a heavy rock and thrown onto a blanket of fresh palm leaves to roast. Even the most disagreeably odoriferous species (due to scent gland secretions) such as *Dobsonia* and *Pteropus vampyrus* were rendered quite palatable when presented in this way. Goodwin was told that small bats were stewed without any preparation and that the finished product was not only delicious, but healthful. Goodwin remarks that such methods of capture and preparation must be very ancient and perhaps similar to those used by the early inhabitants of the island whose food remains are found in the caves.

These notes agree with, and supplement my own observations, with the reservation that bats are not so readily eaten in all parts of eastern Timor. The Uai Ma'a speaking people of the western side of the Baucau Plateau said that they never ate bats, and refused to collect them for me from caves there. This is, I believe, related to the role played by caves in the cult of the ancestral ground spirits. In the Baguia region east of Mt Mata Bea, on the other hand the Makassai speaking villagers whom I employed, preferred bat hunting to excavating, and after each days 'work' we returned to the village with plastic buckets full of half-dead bats caught in the manner Goodwin describes. In the Venilale region I found that people ate bats only when nothing better could be obtained, and that monkey and even cuscus were preferred as wild foods. To some extent these differences are the result of the degree of acculturation of the Timorese to European values and not all those that eat bats, will readily admit to it to a *malae*.

APPENDIX 4

EXCAVATED PLANT REMAINS

The plant identifications in Tables 129-132, supplied by Dr D. Yen, were made by him in cooperation with Drs P. van Royen and H. St John, all of the Bernice P. Bishop Museum, Hawaii. Identifications were made to generic level only although Yen comments that the *Zea* is almost certainly *Zea mays* L. Yen comments that most of the identified remains are those of 'useful' species but the lack of cereals is surprising.

The most common plant represented is *Celtis*, family Ulmaceae, identified by Dr H. St John. It occurred in relatively large numbers and particularly towards the base of the cave deposits. St John remarks that this plant, in its various species, has a range of uses - for making bark fibre, in medicine and so on. Burkill (1935:506-7) described *Celtis* as a genus of trees or shrubs which is distributed from the temperate regions of the northern hemisphere to neighbouring subtropical regions. A number of species occur in India, Malaya and Indonesia. The fibrous bark of some of these have been used to make bark cloth, while others have magical or medicinal uses. The fruit of *Celtis australis* Linn. (Burkill 1935:506) is sweet and might be eaten although Burkill does not mention this. St John also comments that fruit of the American species are edible.

In the list, the 'status' column is used to indicate Yen's level of confidence in the identifications. He remarks that the *Bambusa* listed for Uai Bobo 2, Horizon IX is probably *saccharum* but he is not completely certain.

Horizon	Location	Description	Nos	Identification	Status
VII	D	Fibrous shell, intact	1	*Cocos*	Good
		Small, partial cobs, 5 cm and 2.7 cm, 10 row corn	2	*Zea*	Good
VII	A	Maize cob base	1	*Zea*	Good
		Cob, 10 row corn	1	*Zea*	Good
		Well preserved fruit	1	*Garcinia*	Good
		Coconut shell	1	*Cocos*	Good
		Well preserved, brown shiny seeds	many	*Anona*	Good
VIb	B	Seed cases	5	*Celtis*	Good
VIa	A B E	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
Vc	A B D F	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
Vb	A B D E F	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
Va	D E F	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
IVb	A B D	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
IVa	A	Whitish spherical seed cases, pointed at distal end	many	*Celtis*	Good
IVb	B	Seed, broken in half	1	*Arachis*	Possible
III	B	Seed case	many	*Celtis*	Good
II	B D F	Seed case	many	*Celtis*	Good

Table 129 Lie Siri: identified plant remains

Horizon	Location	Description	Nos	Identification	Status
VII	N6W1 (5)	Small piece of wood	1	*Cocculus*	Possible
VII	N6W1	Seed, young stage of development	1	*Areca*	Fair
IV		Small, eroded seed	1	?	

Table 130 Bui Ceri Uato: identified plant remains

Horizon	Description	Nos	Identification	Status
VIII	Fragments of shell, about 2.5 cm square, worn surfaces	many	*Cocos*	Good
	Seed case, with angled corners	1	?	-
	Fragments of shell	5	*Lagenaria*	Possible
	Cob parts, 2.5 cm sections, cob part 8 cm, 10 row	3	*Zea*	Good
VII	Peanut shell	1	*Arachis*	Good
	Small stem (petiole, 2.3 cm) of drupe fruit; surface rough with lineal marks	1	*Areca*	Possible
	Shell fragments	1	*Lagenaria*	Possible
VI	One half peanut shell and 3 shell fragments	4	*Arachis*	Good
	Fragment of twig	1	*Bambusa*	Possible
V	Twig	1	*Gramineae*	-
III	Seed cases, broken and complete	5	*Celtis*	Good
	Small pieces of bark	2	?	-
II	Seed case halves	4	*Celtis*	Good
	Seed case halves, thicker wall than *Celtis*	2	?	-
	Seed case halves	2	*Piper*	Possible
I	Seed case halves	6	*Celtis*	Good
	1 white round seed	1	*Piper*	Fair
	Seed case halves, smooth	2	?	-

Table 131 Uai Bobo 1: identified plant remains

Horizon	Location	Description	Nos	Identification	Status
XIII		Seed case pieces	4	*Aleurites*	Good
XII		Carbonised wood, jointed and hollow like bamboo	3	*Bambusa*	Probable
		Carbonised fruit or seed, broken	1	*Prunus*	Possible
		Large flat seed, appr. 3 cm across	1	*Inocarpus*	Good.
XI		Seed case, broken	1	*Celtis*	Good
X		Seed case halves	6	*Celtis*	Good
		Seed case half, very smooth and brown, millet-like	1	*Setaria*	Possible
IX		Seed case	1	?	-
VII		Seed case halves, poor condition	2	*Celtis*	Good
VI		Seed case half	1	*Celtis*	Good
V	B (29)	Seed case half, resembles pumpkin or *Momordica*	1	*Cucurbitaceae*	Possible
		Carbonised fruit fragments	many	?	-
		Carbonised fruit fragments	2	*Inocarpus*	Possible
IV		Seed case, small fragments	3	*Celtis*	Good
		Wood, 1.5 x 2 cm, end smooth	1	?	-
III		Seed case, longer form of ? *Celtis*	2	*Celtis*	Possible
II		Seed case, 1 complete, 1 fragment	2	*Celtis*	Good
		Seed, black and brown	1	*Piper*	Possible
I	IK (8)	Seed, pierced longitudinally	1	*Coix*	Good

Also from Horizon I, 11 gm of broken seed cases, probably all *Celtis*, used in radiocarbon sample ANU-238

Table 132 Uai Bobo 2: identified plant remains

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