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Archaeo-Geography of Former Dwelling Sites in Northern New Caledonia (District of Koumac, North Province)

Dominique Guillaud[1] and Hubert Forestier[2]

In the lower valley of the Koumac River, the ancient dwelling sites are found in the vicinity of limestone formations and are characterised by the presence of circular earth-mounds representing former dwelling platforms, of horticultural structures associated with habitat and, often, of a particular type of vegetation known as sclerophyllous forest. Numerous artefacts are found on the surface of these sites: seashells, pottery sherds and flakes and fragments of various materials (stone, glass), witness to ancient activites of tool-making. A study of these material remains and of the spatial arrangement of dwellings and agricultural structures, cross-checked with ethnographic and historical records dating back to the time of the arrival of the first Europeans, enabled us to reconstruct a general pattern of these settlements and to trace back some of the activities of their inhabitants. This study, furthermore, is used to demonstrate the importance of vegetation and tool materials as datation indicators for ancient occupations.

Key words: settlement patterns; dating methods; stone tools; glass tools; vegetation; agricultural structures; Koumac; New-Caledonia.

Most of the field research which serves as a basis for reconstructing the traditional Kanak domestic environment was carried out in the central districts of New Caledonia's Main Island (Leenhardt, 1930; Guiart, 1956; Doumenge, 1975; Bensa, 1981; Bensa and Rivierre, 1982). The observations usually describe a type of habitat, organised along precise rules, which is well summarised by Bensa and Rivierre (1982: 45):

> Each round hut of the basic territorial unit is set up on a raised earth mound topped by a stonework base..... The men's houses for each family are built upon higher mounds overlooking the other huts (women's houses and other buildings), so that the central alley stretches between several circular mounds, each topped by a dwelling. Strictly speaking, the basic territorial unit ..... thus comprises an alley and one or more earth mounds.

This type of organisation is striking enough to have become implicitly perceived as the model for traditional habitat in the Main Island, so much so that Saussol

[1] ORSTOM Nouméa, Indo-Pacific Archaeology Laboratory; ERMES-ORSTOM, Technoparc 5, rue du Carbone 45072 Orléans, cedex 2, France.

[2] ORSTOM Nouméa; Prehistory Laboratory of the French National Museum of Natural History, CNRS Research Unit 9948 (National Centre for Scientific Research); Human Paleontology Institute, Paris, France.

(in Boulay, 1990-b: 21), describing "Kanak country" as a whole, states that the family hamlet "is organised in space around a central alley, at the end of which the "great house" of the head of the family is erected on its raised mound." In the north-western districts of New Caledonia, where our research takes place, the organisation of the domestic space is less well known and somewhat different; for instance, one seldom finds the central alley as the organizing axis of the village. Godin (1990: 77) has already pointed out that in the north, "hamlets or domestic groups settle around lawns rather than along aisles as in the central or southern districts" of New-Caledonia. We wished therefore to shed some new light on the subject.

To this end, we tried to compare several fields of study, more usually seen operating independently, in an attempt to recreate the ancient landscapes. This is why we would like to call our approach "archaeo-geography"[1]. It focuses on, and analyses, the surface features of the sites and their immediate surroundings, rather than excavating as would be the usual approach to archaeology. Yet it goes beyond the study of spatial relationships, and includes a search for links with material culture, such as the archaeological artifacts collected on the sites and which bear witness to the human activities that once took place there. This approach also refers to the fields of ethnology and history in its attempt to understand the organisation and operation of ancient spaces. Furthermore, studies of the botanical characteristics of today's landscape provides new insights and clues to past usages.

In this regard, one of our major aims was to identify, independently of the standard archaeological laboratory dating methods, site information which might provide chronological clues. Alongside ceramics, already used locally as a dating indicator for human activities (Frimigacci and Maitre, 1981; Galipaud, 1992; Sand, 1994), tools and vegetation can act as promising signposts, as we shall demonstrate.

Finally, we would like to point out that our approach, placed as it were at the crossroads of several disciplines, makes no pretence at replacing any of them. Archaeological excavations, particularly, remain the unescapable next step in the research process.

Earth Mounds, the Remains of Ancient Settlements

Our research has been carried out in the valley of the Koumac river (Northern Province), where more than 15 former dwelling sites are to be found. The sites are located to the middle and lower valley of the Koumac river. This territory covers the extent of the commune of Koumac. This zone is noted for its many karstic massifs and a few basalt hills. The lower valley of the river is liable to be flooded during heavy cyclones.

In this area, we shall describe eight dwelling sites (Fig. 1). They can be identified, first of all, by the presence of a certain number of circular earth mounds, some higher than the others (see Figs. 2 to 9). These are called "ronds de case," litt. "house mounds," and used to be topped by constructions made of wood and other organic materials. A few other structures, less frequently found, have an oblong shape, but they can also be considered as former building platforms.

The earth mounds, easily identifiable by their regular geometric shape, were measured, their respective position mapped using compass and surveyor's tape, then

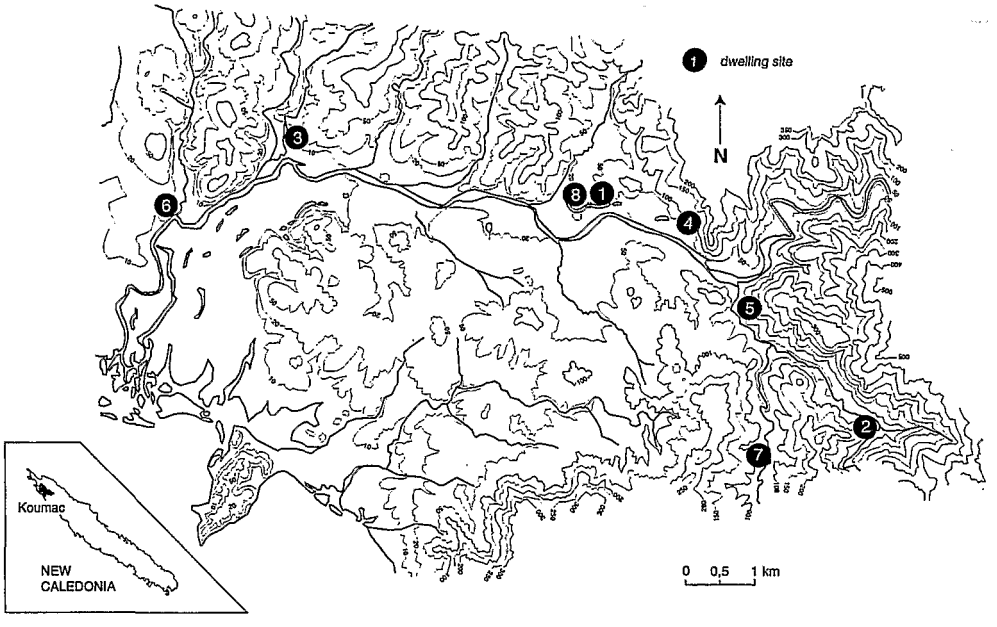

Figure 1. The Valley of the Koumac River and Location of the Archaeological Sites Discussed in the text.

drawn on a schematic map showing their general organization and other similarly surveyed structures. The measures of each earth mound include both its flat summit and its sloping sides. As the area occupied by the actual building on the mound's summit is not known, it appeared more logical to include the sloping sides than to limit ourselves to the flat summit. It is the whole of the raised structure which indicates, among other less differentiated features, the presence of a mound; furthermore, from the point of view of the search for archaeological remains, artifacts are often found within the sloping sides of the mounds, shifted from the summit of the platform by erosion. For these reasons, we chose to measure the raised mounds at the base. As an example, a typical mound, with a base diameter of 7.7 m and a raised height of 0.5 m, had a platform at the summit of 4.5 m in diameter.

The circular mounds have a flat or slightly concave top, and vary in size. Their diameter is most usually around 8 meters (Table 1). For the record, the flat upper areas of the circular earth mounds excavated by D. Frimigacci and his team at Ilot Vert (district of Bourail) averaged 7 m in diameter for a height of 0.4 m (Frimigacci and Siorat, 1988); those recorded by Sand and Ouetcho (1993) in the Bopope-Tiwaka region varied in size from 3 to 10 m.

Site 1 is classified as NKM 006 (Sand, 1994: 61). The southern end of site 4 was destroyed by grading, and the figures for the seven remaining mounds are only given as an indication. Site 5 is located on the right bank of the Buadio River, not far from the place where it joins the Koumac River and close to the excavated site

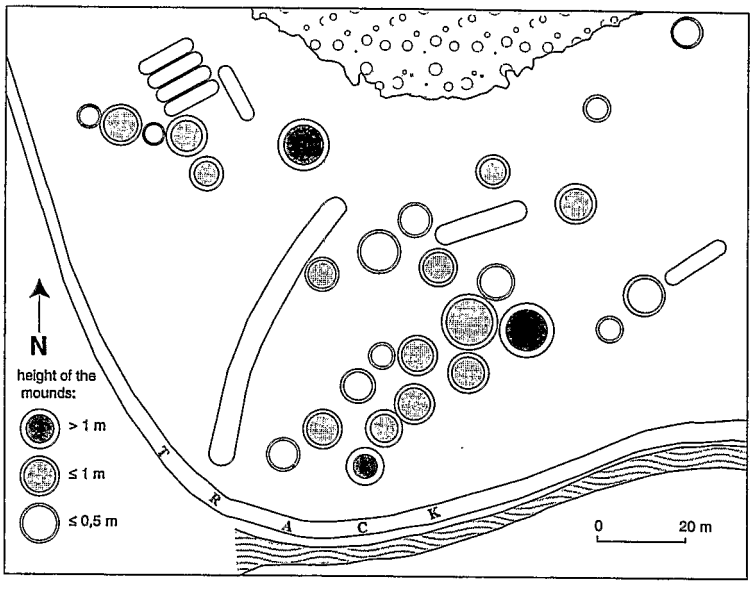

Figure 2. Schematic Plan of Site 1 (House-mounds and cultivation ridges).

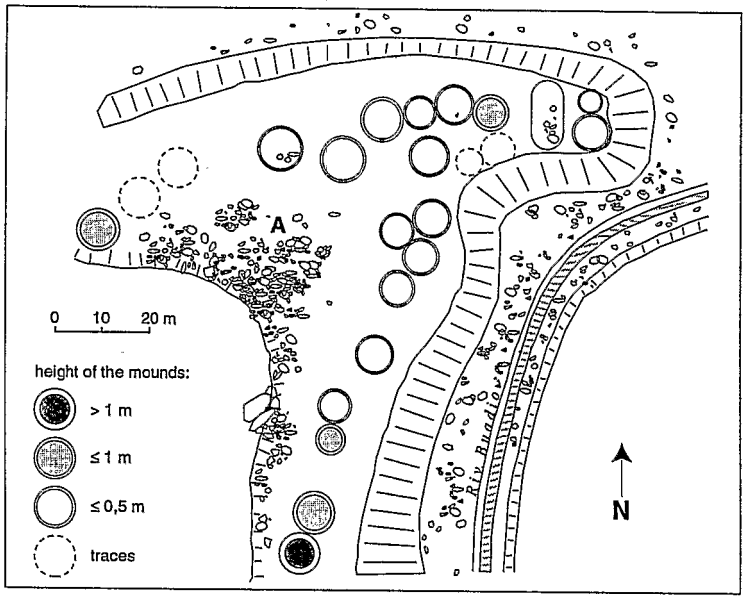

Figure 3. Schematic Plan of Site 2 (House-mounds and cultivation ridges).

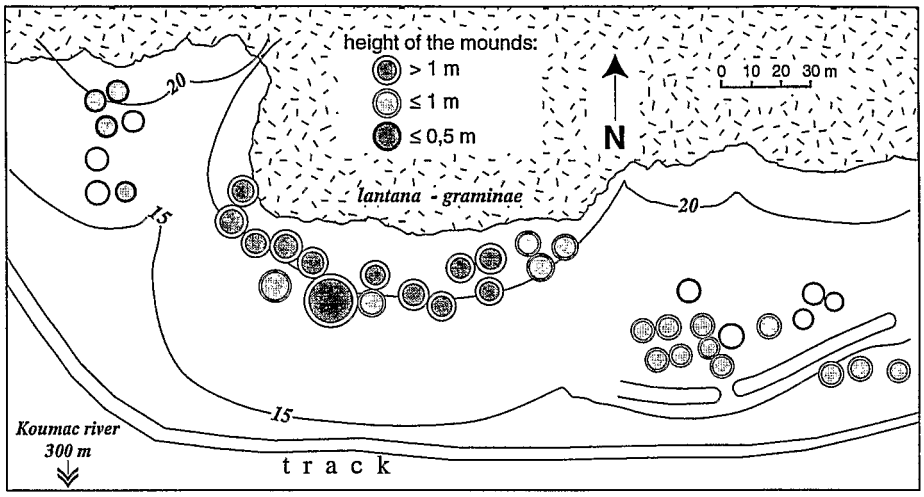

Figure 4. Schematic Plan of Site 3 (House-mounds and cultivation ridges).

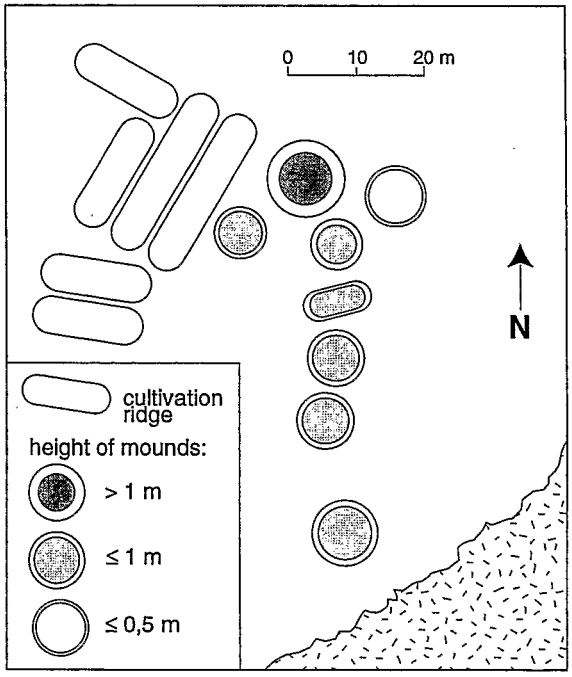

Figure 5. Schematic Plan of Site 4 (House-mounds and cultivation ridges).

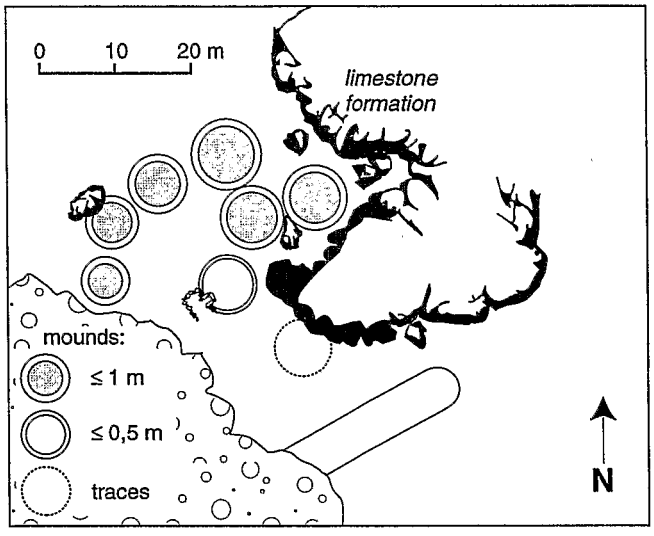

Figure 6. Schematic Plan of Site 5 (House-mounds and cultivation ridges).

NKM004 (known as the "pig shelter," Sémah *et al.*, 1995).

Some of the house mounds feature, on the surface, alignments of stones, arranged in squares or circles, and representing hearths; similarly, many of the scattered stone blocks found on the upper surface of many of the mounds could be the remains of broken-up hearths. Some mounds feature stones arranged as a house threshold. Nowhere on the sites considered did we find traces of stone flooring or stone house bases, although the mounds have not been excavated.

Archaeological Findings

The gathering of artifacts was done by surface collection on the upper surface of the mounds, their sloping sides and their immediate surroundings. Sampling was incomplete from the statistical point of view, since not all objects were collected from the inhabited area; neither were the findings fully located in space, apart from locations within the perimeter of the mound. Nevertheless, the findings provide qualitative data which are partial and scattered witnesses of earlier human activities. Furthermore, the majority of the objects, although lacking the stratigraphic context usual in archaeological methodology, were collected *on the flat upper surface* of the mounds, where they have been subjected to the least possible displacement.

Thus, the presentation of the archaeological material collected on the sites aims at identifying traces of human activity, at providing information on the material culture of the former inhabitants, and at proposing an approximate estimate of the age of the settlements, as is routinely done, for instance, by reference to the New Caledonian ceramic chronology.

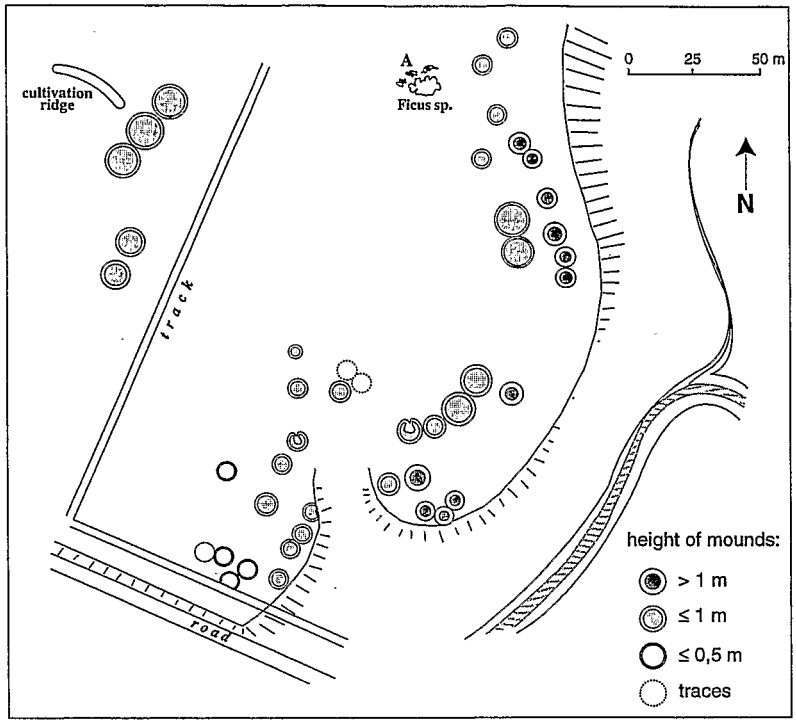

Figure 7. Schematic Plan of Site 6 (House-mounds and cultivation ridges).

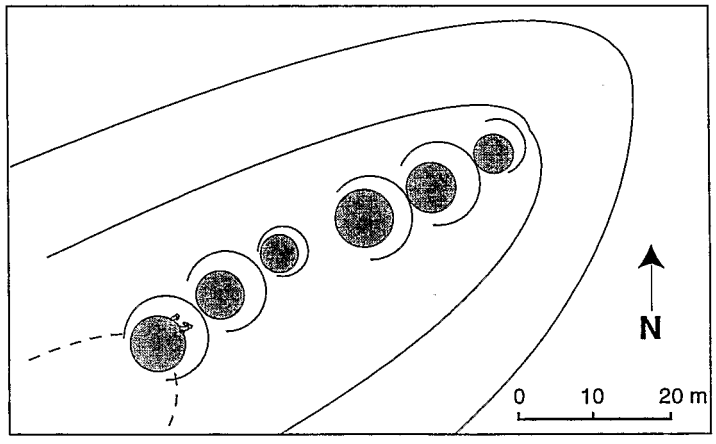

Figure 8. Schematic Plan of Site 7 (House-mounds and cultivation ridges).

Although they were found mixed together *in situ*, we deliberately elected to present the three main category of objects separately: shell fragments, pottery sherds, and stone flakes.

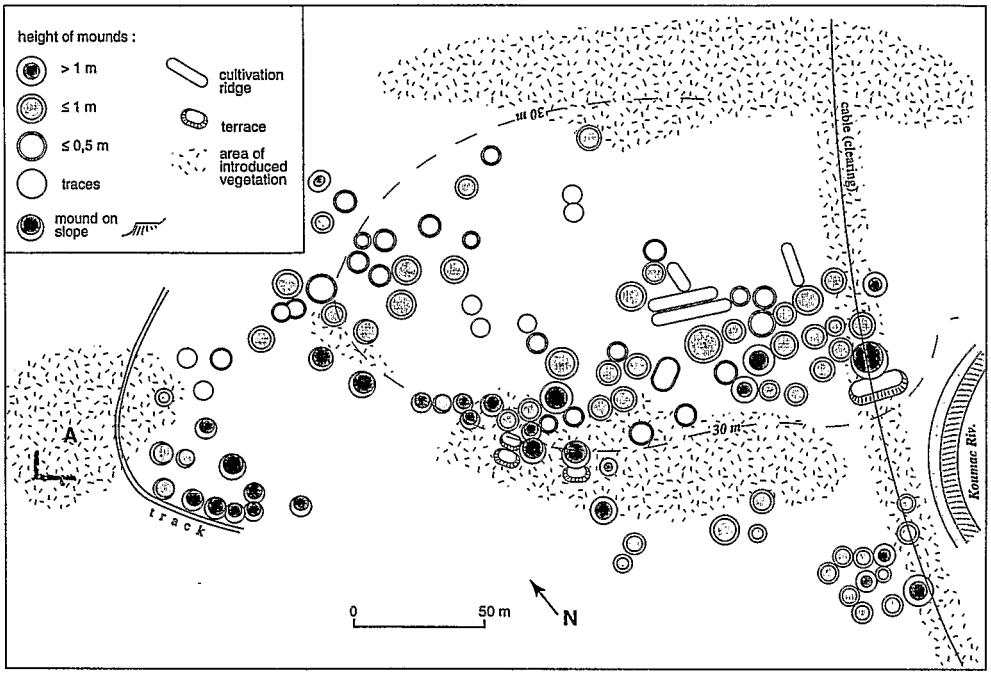

Figure 9. Schematic Plan of Site 8 (House-mounds and cultivation ridges).

Table 1 : Size characteristics of each site of circular building mounds. Number, average height and size, extreme height and size (in meters)

mounds:	number	Av. Dia.	Min. Dia	Max. Dia	Av. Ht	Min. Ht	Max. Ht.
site 1	28	7.8	5	12.5	0.7	0.3	1.7
site 2	24	7.5	5	9.6	0.5	0.1	1.2
site 3	40	8.4	5.6	18.2	1.0	0.3	2.5
site 4	7	8.3	6.1	10.8	0.7	0.5	1.2
site 5	8	7.4	6.0	8.7	0.7	0.1	1.0
site 6	44	8.3	5.1	13.6	0.9	0.3	1.5
site 7	6	7.4	6.2	9.3	1.4	1.0	2.0
site 8	110	8.2	5.7	13	0.9	0.2	1.8

Shell Material

The remains, more or less fragmented, of sea-shells which litter the upper surface of the mounds are easier to see than archaeological artifacts, and their concentration is a good indicator of former dwelling sites. We are not dealing here with "shell middens" as the term is understood among Australian archaeologists. On our sites, the shell fragments do not affect the morphology of the mound, which existed before the shells had been discarded.

Table 2 : Shell families found on the sites, and their habitats

Families	Coral reef areas	Beach front
Spondilidae		*
Strombidae	*	
Arcidae	*	*
Muricidae	*	
Lucinidae		*
Veneridae		*
Tridacnidae	*	
Trochidae	*	*

The various species of molluscs collected were identified and classified into nine families: Spondylae (*Spondylus barbata*), Strombidae (conchs, *Lambis lambis*), Arcidae (ark-shells, *Anadara antiquata*), Muricidae, Lucinidae (*Codakia tigerina*), Veneridae (*Gafrarium pectinatum*), Tridacnidae (giant clams), Trochidae (trocas, *Trochus niloticus* and *Tectus pyramis*). These types of shells are still used today as food, and represent a significant part of the Melanesian domestic economy.

In search of evidence that these were consumed by man, we observed that the gasteropods frequently bore traces of a small "window," i.e. a hole, on the larger turns of their spiral, and that bivalves displayed an unusual fracture of their distal convex edges. The shells were often found in a grey, ashy sediment. It is not impossible that some villages have burned at one time, or that the vegetation covering the sites has been subjected to bush fires. However, the shells are often found compacted together in a dusty, ashy horizon; this might indicate that they used to be tossed in the fire after being consumed for preventing foul smells (Sands, personal communication).

The natural habitats of these shells, which must have been collected and brought back to the site, are well known. Their presence introduces the notion of distant food supply, and implies activities of food-gathering outings or barter.

The families most frequently encountered on the sites are the Arcidae (ark-shells), which live close to the shore in a sandy-silty environment, and the Trochidae (trocas), common throughout the lagoon up to 10 m depths, particularly in foreshore reef areas where the substrate is hard and riddled with holes, and in inter-tidal areas, easier of access. Thus the habitats of these molluscs are mostly located near the shore, in sand, silt or reef environments. This means that the source of supply for the shells we found would be at a distance of 4 to 8 km from the sites (see Fig. 1, above).

Potsherds

The potsherds we found, in denser concentrations on certain mounds, were devoid of decoration, and fairly crude (6 to 15 mm thick). Their material, usually reddish in colour, contained fine to coarse inclusions of mica and quartzite. These sherds probably all belong to the Oundjo tradition (Siorat and Sand, personal communications), a type of pottery "ovoid in shape, large (20 to 40 cm across the widest part), the bottom and the walls being thicker." Oundjo pottery was still being made

in the northern districts at the beginning of the XXth century, using coil techniques followed by smoothing with a paddle (Galipaud, 1992: 191). Unfortunately, this type of pottery does not represent a particularly accurate dating indicator, as it was in use practically throughout the last millennium.

Stone Artifacts

The quantity of stone artifacts collected shows the importance of stone-working activities. Stone was worked in order to obtain blanks, later to become, through fine chipping or through usage, usable tools. The study of stone tool-making in New Caledonia is only just beginning (Forestier, 1994 and 1996); at this time, there is no clearly established classification by type, which would associate, as can be done with ceramics, a particular type of tool with a specific period.

The standard raw material used was the local "flint," a black, blue or red phtanite; rock crystal was also used. Phtanite tending to be heavily fractured, it makes a poor material for tool-making: initial splitting of the core yields a large number of fragments of random sizes and shapes, which we call "debris." Rough splitting of phtanite thus results in a non-standardized production of a mixture of "debris," usable tool-blanks (quadrangular, triangular, etc. flakes) and laminar flakes, such as the item shown in the centre of Figure 10 (Forestier, 1994).

The phtanite pieces which are presented on Figures 10 and 11a are mostly flakes showing traces of use. This would have to be confirmed by a more formal functional analysis and an interpretation of traces of micro wear.

We also found numerous fragments and flakes of rock-crystal, evidence that this material was also used in tool-making (see Fig. 11b). The chipping of rock-crystal, first noticed by Sarasin (1917), appears widespread in the northern districts of the Main Island, but the activity has so far been little investigated. Galipaud and Monin (1983) reported the finding of flakes in their excavations at Arama (35 km north of Koumac). Frimigacci also discovered rock-crystal flakes during his excavations at Nessadiou, near Bourail, in central New Caledonia (pers. comm.). Yet, evidence of the use of this material can be found on the surface, sometimes in abundance (site 3), in all the sites we investigated. This relative abundance of rock-crystal in areas fairly distant from the sources of supply also argues for the existence in former times of barter networks.

The presence on the sites of both cores and chipping debris, phtanite as well as rock crystal, is an indication that the manufacture of tools was carried out on the site itself.

Reading the Ancient Spaces

As we did not carry out any excavations, there is no point in giving here an account of the precise distribution of the archaeological findings through the mounds of each site. All the objects found, potsherds, shells, stone fragments and flakes, were mixed together, and indicate clearly the domestic use of the spaces. We shall simply note that certain mounds didn't yield any findings at all and that some others were poor in archaeological remains; these may have borne buildings which served other

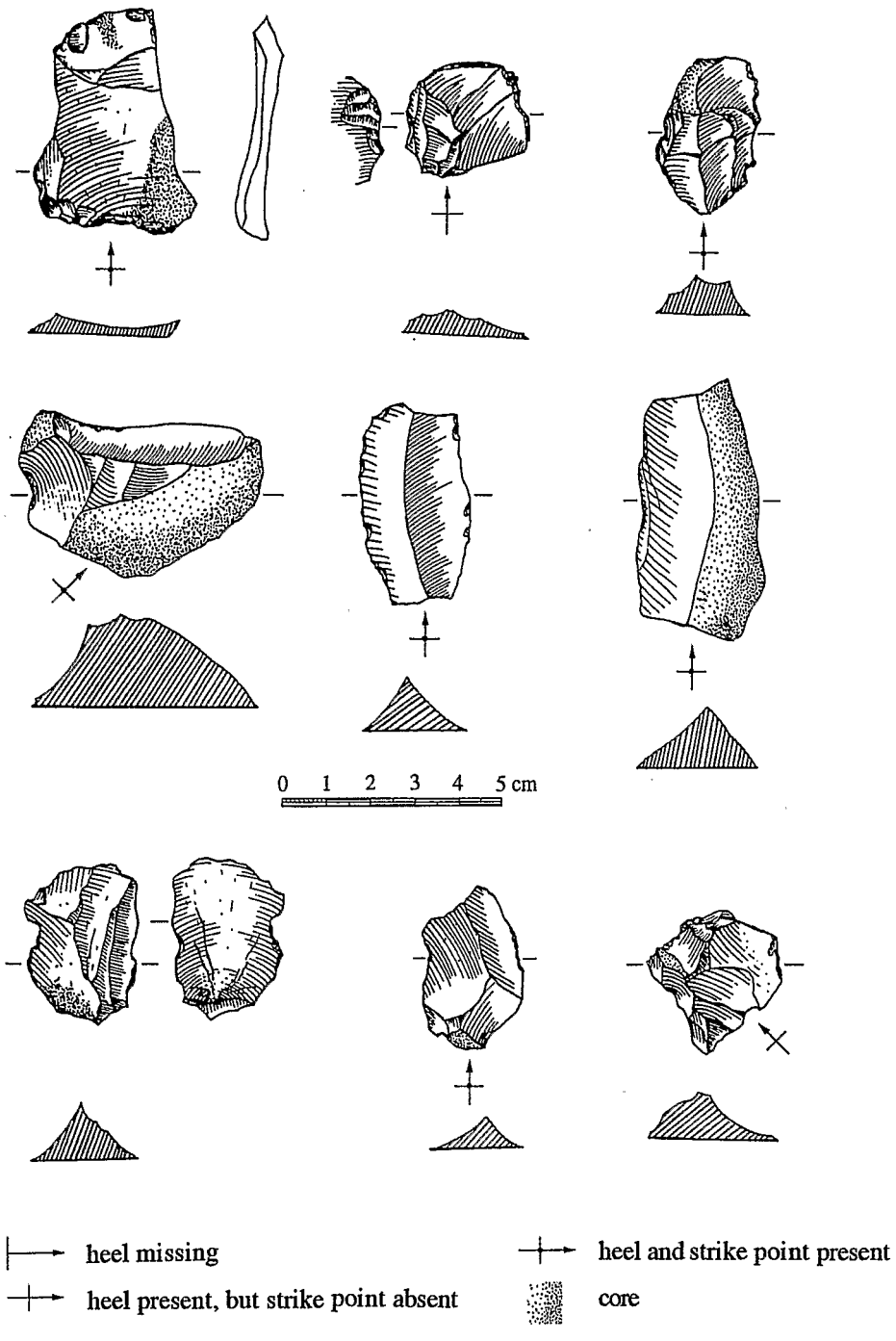

Figure 10. Retouched Phtanite Flakes.

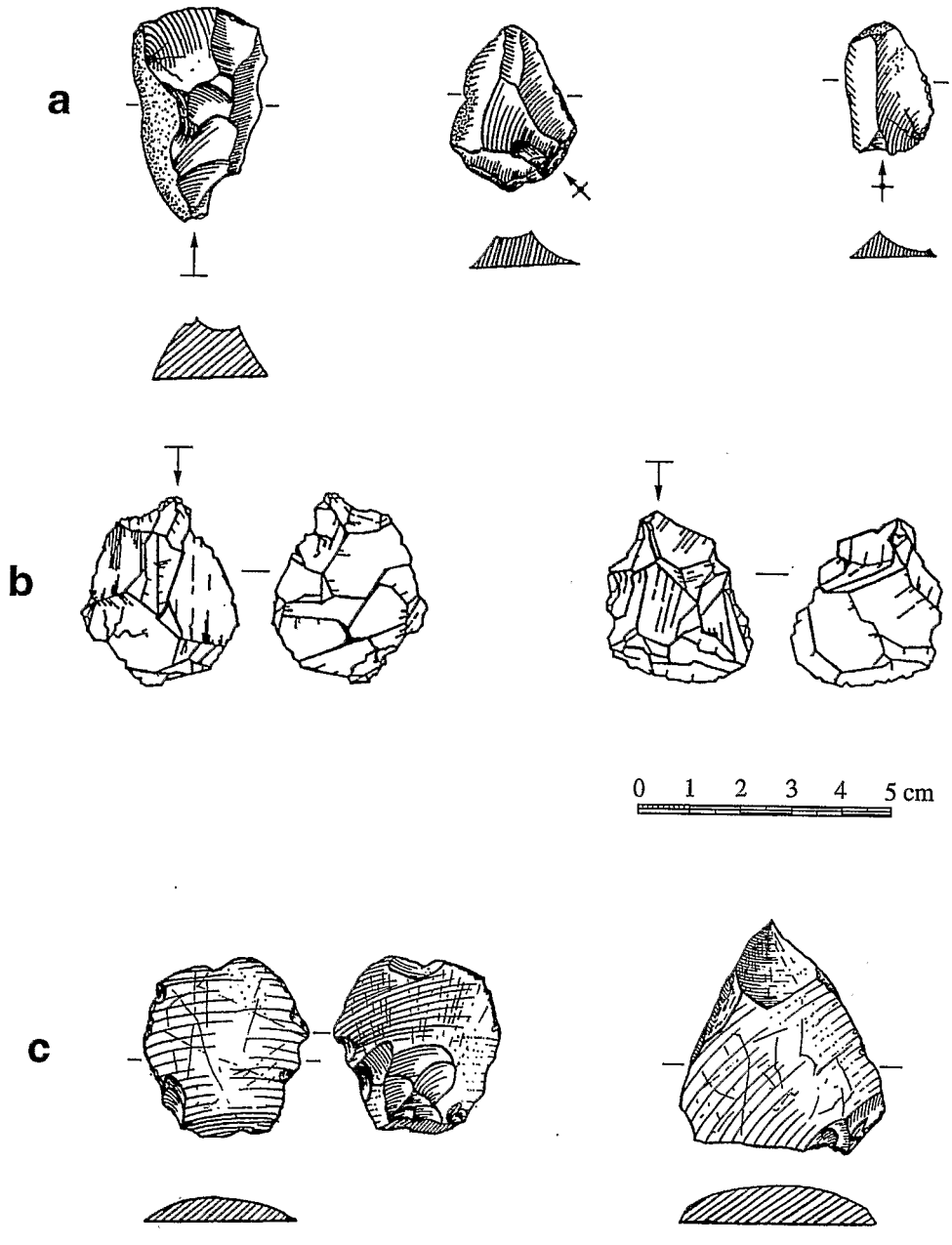

Figure 11. Tools and Raw Materials. a, retouched phtanite flakes. b, alternate quartz chisel point. c(left), tooled glass flake, used, c(right), glass shard, used.

functions: for ceremonies (as is the case of the "great house" frequently described for the Main Island, see Boulay, 1990a: 108-127), for occasional guests or for isolation. It is also possible that they were used for non-residential purpose (e.g. storage-houses).

The Cultivated Spaces

We shall not dwell here on the various types of horticultural structures. These have been well described for the central districts of New Caledonia's Main Island, and the observations apply well enough to the Koumac region. Excellent descriptions will be found in Glaumont (1897), Barrau (1956), Doumenge (1975), etc.

At the dwelling sites themselves (sites 1, 4, 5, 6, 8, see Figs. 2 to 9), or in their immediate vicinity, one encounters features which may be read as ridges for the cultivation of yam and similar crops. On site 1, these are found above as well as below the dwellings; the size of the cultivation ridges varies from 52 m^2 (3.5 m × 15 m) to over 380 m^2 (6 m × 64 m), which leaves the question open concerning the organisation of labour and the share of products.

Sites 2 and 3 (Figs. 3 and 4) lack cultivation ridges, but below the sites we observed the remains of earthen structures at right angles with the natural flow of water; these may represent terraces built to retain moisture and used for the growing of taro. This type of terracing, consisting of wide flat areas on the side of gentle slopes (Fig. 12) did not appear to have required any reinforcements with stone or timber –at least there is no surface evidence of it.

The presence of taro fields or yam cultivation ridges in the immediate vicinity of dwellings reveals a great interpenetration of the domestic and agricultural spaces. This does not mean single dwellings scattered throughout cultivated fields, but rather clustered habitations on well defined sites (see further). The arrangement brings to mind a description by Rougeyron (1846), which makes a sharp distinction between "house gardens" and the more distant cultivated sites.

> ... near their dwellings, they cultivate certain pieces of land as gardens; they take care to plant a few banana trees or other fruit-bearing trees which also provide them with cool and pleasant shade (...) the fields located near the huts are usually used for providing nourishment to visiting friends; they have other fields, further removed from their dwellings, which they do not normally harvest, and these are considered as reserve fields (Rougeyron, 1846:).

Similarly, today, the Kanaks of the Koumac district cultivate at the same time fields that are adjacent to their houses, and more distant lands belonging to their clan or for which cultivation rights have been granted by host clans.

Indeed, at some distance from the recorded sites and although it is not possible to associate these systematically with the sites, we encountered evidence of different types of agricultural complexes (Fig. 12):

(1) On steep slopes (40% or greater), stone-faced terraces for the growing of taro, irrigated by lengthy channels bringing water from springs or streams. Their mode of construction and of operation are well documented; see Curry, 1962; Barrau, 1956; Spriggs, 1979; Saussol (in Boulay, 1990b);

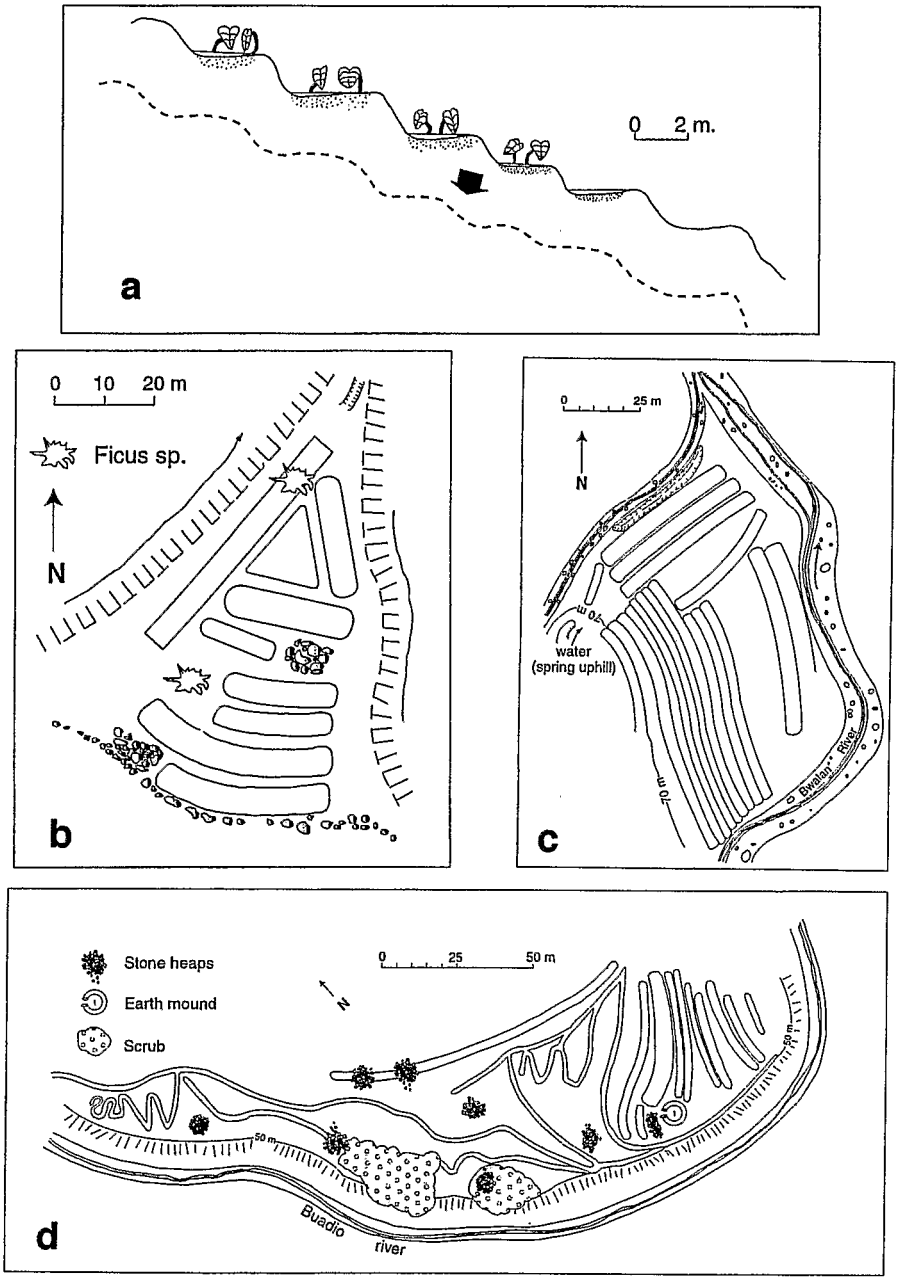

Figure 12. Cultivation Structures. a, section through a terraced taro field without stone facing (artist impression based on the current topographical features shown as dotted line), b, plan of a complex of yam cultivation mounds (on a level area at the foot of a hill), c and d, plans of complexes of yam cultivation ridges and taro fields near the river-bed (one house-mound on plan d).

Table 3 : Some characteristics of the dwelling sites (in meters)

Site	Altitude	Height above stream level	Distance to stream	Distance to limestone formations	Height below limestone formations
1	29-35	7	10	600	70
2	70-75	8	50	600	90
3	15-23	5	300	600	70
4	25-31	3	100	50	10
5	37-40	10	80	0	0
6	15-17	8	30	> 1000	–
7	110-118	45	150	700	160
8	25-30	10	20	400	30

(2) In locations that are always slightly above the level of the river, groupings of yam cultivation ridges;
(3) In areas liable to flooding and almost flat areas, low-land taro fields with sinuous and irregular patterns.

Choice of Location for the Implantation of Dwellings Sites

Looking at the various dwelling sites, we noted a number of parameters governing the choice of a location. These are summarised in Table 3. The following three characteristics can be notice from it.

(1) All dwelling sites, as might be expected, are located close to a stream. The first three are even located at the junction of two streams and thus control the access to a valley or a part of a valley;
(2) All are set slightly higher than the water level in the main stream bed, and are thus safe from occasional flooding;
(3) Almost all are located in relative proximity to an area of limestone spurs and outcroppings characteristic of the district's limestone and phtanite eocene formations described by Arnould and Routhier (1964). These offer a multitude of rock shelters and openings. At the time of arrival of the first Europeans, they were used primarily for burials, but also served occasionally as places of refuge. It is not impossible that the limestone formations, before being devoted to burial, had been used for habitation. As one encounters an abundance of stone flakes, shell remains, traces of cooking fires and potsherds among these limestone formations, it can be surmised that, during a certain period, they were occupied in a relatively permanent fashion. This does not necessarily mean that they represent a *usual* mode of occupation.

Organisation of the Dwellings

The internal organisation of the clusters of dwellings does not appear to follow the "classic" pattern of the broad central path which divides the space symbolically.

Yet the concept of the central aisle in not wholly unknown in the district: in 1846, as he was travelling through the area, Douarre noted that at Koumac, the chief's house stood "at the end of an alley of coconut palms." The sites studied here retain no trace of earlier plant material (such as alignments of coconut trees or other plants) which might suggest the presence of such alleys. This could be explained by the sites having been abandoned for some considerable time, or by the destruction of the plants concerned: when the inhabitants of a village were defeated in battle, the victors used to burn the dwellings and cut down their coconut palms (Rougeyron, 1846). However, the highly symbolic value of the broad central path (Boulay, 1990-b: 47-48) ought to endow it with a sufficiently predominant position to make it difficult to overlook. Yet, neither on the sites described here nor anywhere else in the valley, have we observed anything which might be construed unambiguously as a village central alley; other researchers working in the northern districts also fail to mention any such finding.

Scale of the Dwelling Sites

Four of the sites studied were remarkable for their scale, three with between 24 and 40 earth mounds and one with more than 100. This represents a large number, bearing in mind the accounts of the early European visitors, all of which commented on the small scale of the villages in the north of the Main Island (Boulay, 1990-b: 22, 34-40). The most detailed early account on record for Koumac gives a geographical description of the area which can be presumed to be accurate and comprehensive: it was recorded by the commanding officer of a punitive expedition launched against the high chief of Koumac, and includes information gathered from local white settlers. It states that "about thirty villages, of eight to ten houses of varying sizes set under coconut palms, were scattered through the plain" (Mathieu, 1863).

We should first point out that there is nothing to indicate that all the earth mounds of any one site were necessarily in use simultaneously, nor that all of the mounds on a site belong to a single settlement. For instance, the three earth mound groupings shown on Figure 7 could represent a hierarchy of dwellings according to the classic divisions of Kanak society and kinship lines (e.g. an elder and a younger branch of the same clan), or could as easily belong to two distinct phases of human settlement. Similarly, excavations carried out at Boirra, on the waterfront at Koumac, under D. Frimigacci and J.C. Galipaud showed that all parts of that particular site were not occupied at the same time (Frimigacci, 1978; Galipaud, 1988; Sand, 1994).

It does not seem likely, however, that the settlements discussed here would have been omitted on account of being outside of the area of influence of the Koumac chiefdom. In fact, in the middle of the 19th century, the chiefdom extended most probably at least as far as the caves at Kun, these having been visited by Bishop Douarre and his retinue in 1846 while they were the guests of the Koumac high chief (Douarre, 1846). If these settlements were not reported by the early European visitors, it may be simply that at the time they were already long abandoned. It is possible to put this hypothesis to the test by seeking clues to help define the period when they were last occupied.

Botanical Transition: Primary Sclerophyllous Forest to Introduced Species

Remarkably, the vegetation which now covers some of the sites has been identified and confirmed[2)] as sclerophyllous forest. This type of vegetation is characteristic of dry climates (less than 1100 mm yearly rainfall, long dry season) in the west of the Main Island, growing at low heights (2 to 300 m) in sedimentary ground (Morat *et al.*, 1981). The sclerophyllous character of this forest is due exclusively to water shortage (Jaffré *et al.* 1993: 110). Generally speaking, sclerophyllous forests is a closed formation, with a low (max. 15 m) discontinuous canopy, and a dense, often scrubby, undergrowth. Plants with glossy coriaceous leaves predominate, and there is a profusion of vines.

Once covering vast areas, this type of forest vegetation, known as climactic for the zone, is now considered as a sort of botanical relic by botanists: "it has been much reduced by the action of fire and deforestation, and most of it has by now given way to extensive pastures. Today it is limited to small isolated fragments, separated by areas of secondary growth" (Jaffré *et al.*, 1993: 112).

The nearly systematic presence of sclerophyllous forest on ancient dwelling sites begs a re-assessment of our understanding of its nature as a growth threatened with irreversible distruction at the hands of man. It also raises questions on the factors which may have encouraged, even locally, its survival and rejuvenation.

On the dwelling sites themselves, the canopy almost invariably includes *Diospyros fasciculosa* and *Aglaia elagnoidea*, both indigenous species typical of sclerophyllous forests. Other species, also characteristic, are present, varying with each site, giving a certain diversity to the plant cover. Depending on the state of preservation of the undergrowth, which may have been used for grazing, one finds either a sparse distribution of bushes and small trees (sites 1, 3 and 6), or a dense tangle of stems, small trees, shoots and vines (sites 2 and 4, and a great part of site 8). A type of passion-flower, recently introduced, often proliferates at the lower level.

Over sites 1, 2, 4 and 6 discussed here, the sclerophyllous forest, even where it is somewhat degraded, is made up almost exclusively of native or endemic species. The other sites, partially or totally, present a slightly different picture; here, the surrounding secondary growth formations, although retaining some of the characteristic species of the original sclerophyllous forest, abound with other species resulting from deliberate or accidental dissemination in a fairly recent past: "Cayenne cherry" (*Eugenia uniflora*), planted toward the end of the 19th century to provide shade for the coffee tree, "Flame tree" (*Delonix regia*), "False castor" (*Jatropha gussipifolia*), "False sweet-basil" (*Occimum basilicum*), "Siratro" (*Macroptilium artropurpureum*) planted as pasture improvement, Indigo (*Indigofera suffructicosa*), and various other leguminous plants. So that, outside the sites proper, one finds a more diversified vegetal landscape where the European influence can be clearly seen, and where introduced species proliferate in an environment which had long been protected by its insularity.

On these sites, a study of the artifacts that were found on the mounds or in their vicinity confirms the clues provided by the vegetation.

Technological Transition: The Use of Glass for Tool-Making

Its nature and structural configuration make glass a material that can be used in tool-making, just "as-it-is" on account of the sharpness of its broken fragments, and as raw material for the manufacture of chipped flakes in the manner traditionally used with stone. Leenhardt (1930: 26), discussing tool-making, mentions that quartz flakes had been supplanted by glass shards.

Thus, the flake on the right on Figure 11c supra was used just "as-it-is," while the flake on the left was shaped; on this latter, we can observe all the signs of chipping, and the markedly concave upper surface, which was used as the chipping plane, appears to have been the base of a glass container (bottom of a bottle?). It is quite evident that glass shards formed an integral part of the stock of tools belonging to the former occupants of the sites, and this can be used unambiguously as a dating marker for the occupation of these sites, indicative that they would have been active after the arrival of the first European, i.e. posterior to James Cook's first visit of 1774.

On these sites, plain and chipped glass fragments coexist with chipped phtanite flakes; the juxtaposition of glass and chipped stone tools has been observed on other sites, such as NKM 004, where other objects of obvious European origin were also found (metal nails, a fragment of a tobacco pipe). The stratum where these objects were discovered was carbon-dated as approximately at the end of the 18th century (Reference β n° 69687) (Sémah *et al.*, 1995).

After a certain time, stone and glass were abandoned in favour of metal tools. It must be remembered also that the turn of the century saw the forcible shifting of all Melanesian populations to reservations, putting an end to the existence of scattered small villages. We may therefore say that this site was abandoned around the time of the beginning of systematic European colonisation, i.e. ca. 1900.

Usefulness in Site dating

To summarize, certain archaeological sites have played the role of a botanical museum for the original vegetation, while others have not. Yet, logically, there can only be two explanations for the untainted primary growth to have reclaimed the abandoned sites:

(1) The soil conditions provided by the abandoned dwelling sites were suitable only to the growth of the native sclerophyllous species; yet, barring a vast difference in soil structure between the sites studied - and such a difference has certainly not been immediately apparent - the hypothesis would seem highly unlikely, particularly since some of the introduced species such as the flame-trees or the lantanas are fast growing and not especially fussy about their growing conditions, and display a marked tendency to take over the areas they inhabit to the quasi-exclusion of other types.

(2) The site was abandoned at the time and the natural vegetation began to take over the area, there were no plants of foreign origin capable of competing with the indigenous species, which could then reclaim the grounds at their own slower

pace. This can only have been the case before the arrival of the first Europeans, or, at the latest, at the very beginning of colonisation. Some early descriptions seem to indicate a proximity between dwelling sites and forest, making the reclaiming of abandoned sites easier; one of these description mentions "woods within which were established several villages" of the Koumac people (Mathieu, 1863).

Therefore vegetation, as long as it has not been extensively tampered with or damaged, notably by bush fires, appears to provide clues for dating the end of occupation of a site. These clues are all the more reliable when corroborated, even without the benefit of excavations, by material findings. The absence of any sign of glass shards and, generally speaking, of any object or substance of European origin on the four sites discussed in this article would seem to confirm that these were abandoned in pre-European times. Further corroborating intelligence could be obtained from the current Kanak residents of the area, were they to clearly identify other locations as the remembered sites of their ancestral establishments, but many clans exist no longer, and native population relocation was once common practice.[3)]

Notes

1) The term "geo-archaeology", already in use among our Anglo-saxon colleagues, refers to the micro-morphological study of soils (Fedoroff *et al.*).
2) The identification of plant samples was carried out in Noumea by J.M. Veillon of ORSTOM's Botanical Laboratory. J.C. Pintaud, member of the same lab, came to the site in order to confirm the botanical identification and complete the collection of samples (Pintaud and Veillon, 1995). The work of MacKee (1994) was used as the main reference for introduced vegetation.
3) Sites II, IV and V are located on private property. Site I is on government land, and site III is within the native reserve. In each case, permission was sought from the owners prior to survey and study.

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