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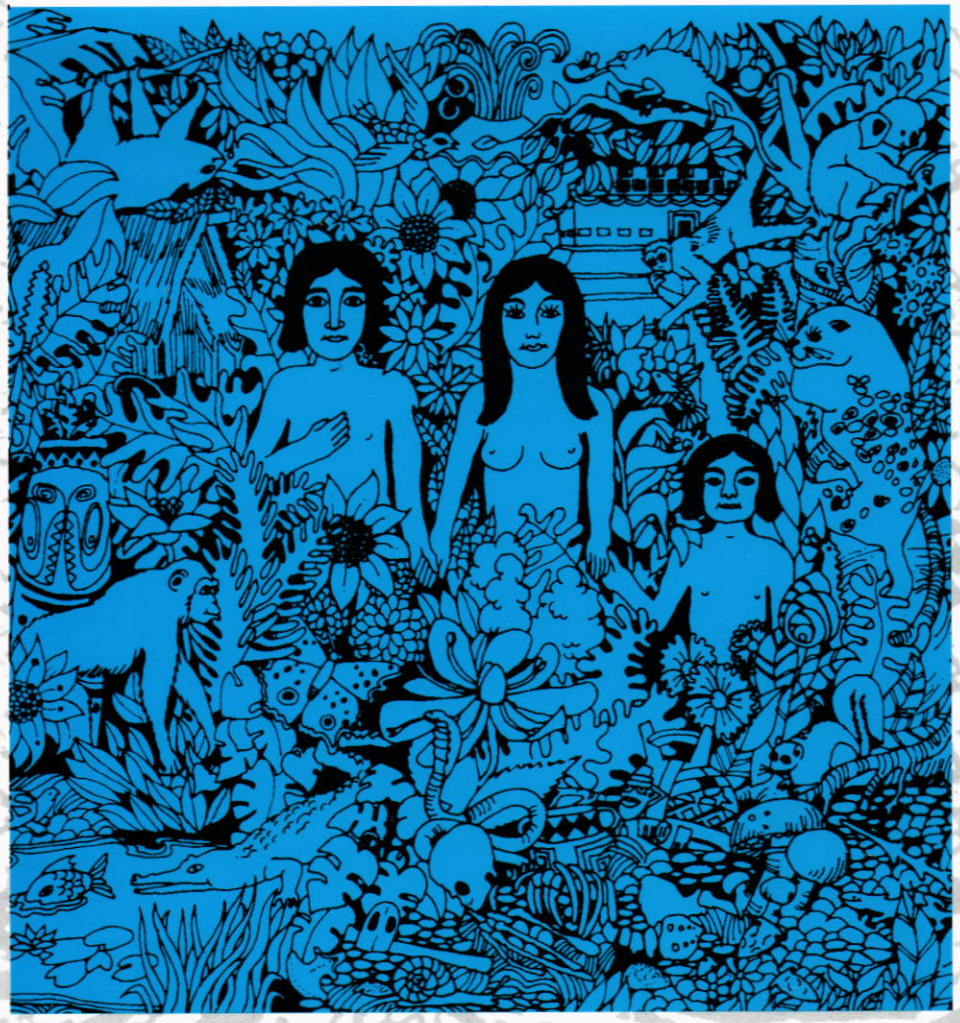
Stuart Bedford, Christophe Sand and David Burley (eds), *Fifty Years in the Field: Essays in Honour and Celebration of Richard Shutler Jr's Archaeological Career*



FIFTY YEARS IN THE FIELD. ESSAYS IN HONOUR AND CELEBRATION OF RICHARD SHUTLER JR'S ARCHAEOLOGICAL CAREER

Edited by Stuart Bedford, Christophe Sand and David Burley

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NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION MONOGRAPH

PREHISTORIC POTTERY MOVEMENTS IN WESTERN MICRONESIA: TECHNOLOGICAL AND PETROLOGICAL STUDY OF POTSHERDS FROM FAIS ISLAND

Michiko Intoh and William R. Dickinson

Micronesia consists of a myriad of small islands. Most of them are small coral islands except for six volcanic island groups, the Marianas, Yap, Palau, Chuuk (Truk), Pohnpei (Ponape) and Kosrae (Kusaie). The islands in the central Caroline Islands are also mostly coral atolls except for a few raised coral islands, like Fais.

Due to the limestone environment, the natural resources obtainable on the coral islands are greatly restricted. For example, lithic or clay sources suitable for the manufacture of stone tools or pottery are absent. Moreover, the poor soil environment does not allow a number of important plants to grow, such as *Colocasia* taro, yam, bamboo, turmeric, hibiscus, and many others. However despite these impoverished terrestrial conditions, coral islands appear to have been occupied by humans for the last 1000 years in the Central Carolines (Lamotrek and Ulithi) and for the last 2000 years in the Marshalls. The strategy associated with the colonisation of such coral atolls is at present poorly understood. Recent archaeological research has demonstrated, however, that the maintenance of contacts with other islands, particularly with high volcanic islands, has been a significant factor in survival on the resource-limited islands of Oceania (see Weisler 1997). This was particularly so for the inhabitants of tiny coral islands scattered across Micronesia.

In historic times, there existed an expansive exchange network, known as the *sawei*, in western Micronesia. The system extended from Yap in the west to Namonuito in the east (Figure 1). A wide variety of materials were exchanged; handcrafts were brought to Yap and, in return, food, plants, pottery, and other materials were brought back to the coral islands (Alkire 1978). It has long been a major anthropological question as to how and when this network was formed and grew into its traditional form. Archaeology has the potential to provide solid evidence relating to this question.

In the South Pacific region, obsidian has provided critical evidence for demonstrating prehistoric inter-island contacts (e.g. Green 1996; Kirch 1991; Specht *et al.* 1988; Weisler 1990). In Micronesia however, obsidian is not a commonly available resource, so it is to other materials that such evidence must be sought. One of those other materials is pottery, which has previously shown to be useful for the purpose of tracking inter-island contacts (Dickinson and Shutler 1971, 1979, 2000).

In this paper, potsherds excavated from the small coral island of Fais, are analysed technologically and petrologically in the anticipation of reconstructing the nature of interactions between Fais and other islands, particularly with nearby volcanic islands. As Fais was included in the islands that operated the *sawei* exchange system, it was also hoped that archaeological investigations would shed some light on the antiquity of this wide inter-island network.

POTTERY FROM FAIS ISLAND

Fais is a raised coral island (about 20m above sea level) and situated at 9°46' N and 140°31' E in the Federated States of Micronesia (Figure 2). Fais Island is about 2.7km in length and 1.1km in width, comprising a total land area of about 2.8km^2. The Fais Islanders speak a Nuclear Micronesian language like other Central Caroline Islanders. Nuclear Micronesian is spoken in central and eastern Micronesia but not in western Micronesia (i.e. Marianas, Yap and Palau). Despite this difference in language, coral islanders of central Micronesia maintained *sawei* exchange relations with Yap and obtained various materials from Yap as mentioned above.

The nearest island to Fais is Ulithi Atoll, lying about 80km to the west. Farther west from Ulithi, at about 180km, is located the Yap Island complex which is the nearest high island to Fais. Next distant are the islands of Palau (600-700km SW) and the Marianas (600-900km NE). Within the Caroline archipelago, but yet more distant, are the isolated volcanic islands of Chuuk, Pohnpei, and Kosrae (c.1000-2500km E).

In 1991 three sites on Fais Island were excavated by Intoh (1996). The sites are situated on the southeastern

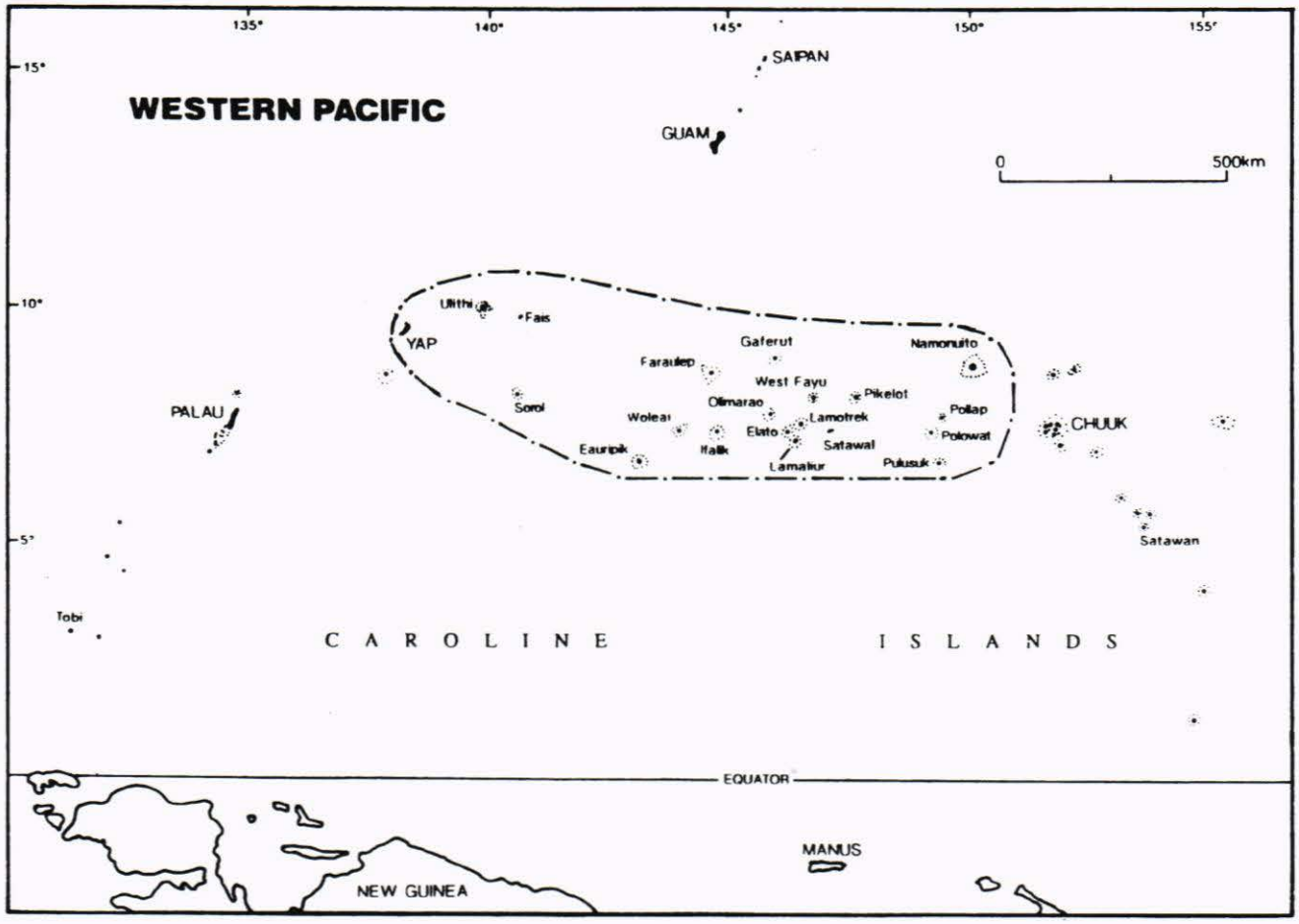

FIGURE 1. Map of Micronesia and the area of the *sawei* exchange system (inside the circled area).

coast of the island where the present village is located. The site area extends about 50m from the present coastline to about 170m inland (3.6 to 10.2m above the sea level). Five excavation units (FSYE, FSFA-1 and 2, FSPO-1 and 2) were set out and a total volume of around 28 cubic metres was excavated. A variety of artefacts were found from throughout the excavation units. Artefacts included potsherds, fishhooks made of shell and turtle carapace, shell adzes, various shell tools, shell ornaments, worked bone and natural food remains. The distribution pattern of the excavated artefacts indicates that the island was consecutively inhabited. The early dates (uncalibrated) associated with cultural remains were obtained on charcoal samples: (NUTA2167) 1794 ± 152 B.P. and (NZ7885) 1775 ± 73 B.P. at FSFA-2 and (NUTA2347) 1430 ± 110 B.P. at FSPO-2.

A total of more than 800 potsherds (about 12kg) were obtained from the excavations. This amount is remarkably rich compared to that from other coral islands in the Central Caroline Islands, such as Ulithi (Craib 1980) and Lamotrek (Fujimura and Alkire 1984). The importance of the excavated potsherds is clear. They demonstrate that the settlers of Fais retained cultural contacts with the volcanic islands from where the pottery originated. The contacts seem to have started from the beginning of colonisation and to have lasted nearly 1800 years. Sourcing of the potsherds has the potential to demonstrate the nature of inter-island connections between Fais and the volcanic islands. The results are expected to further our understanding of the complex interrelations experienced by the Central Carolinians who had language ties with the eastern high islands despite *sawei* ties with western Yap.

ANALYSES OF FAIS POTTERY

The pottery was analysed by two consecutive methods. Firstly, all the potsherds were examined for their physical features and were classified into four groups. Secondly, a selection of potsherds was examined petrologically by Dickinson. None of the excavated potsherds were decorated.

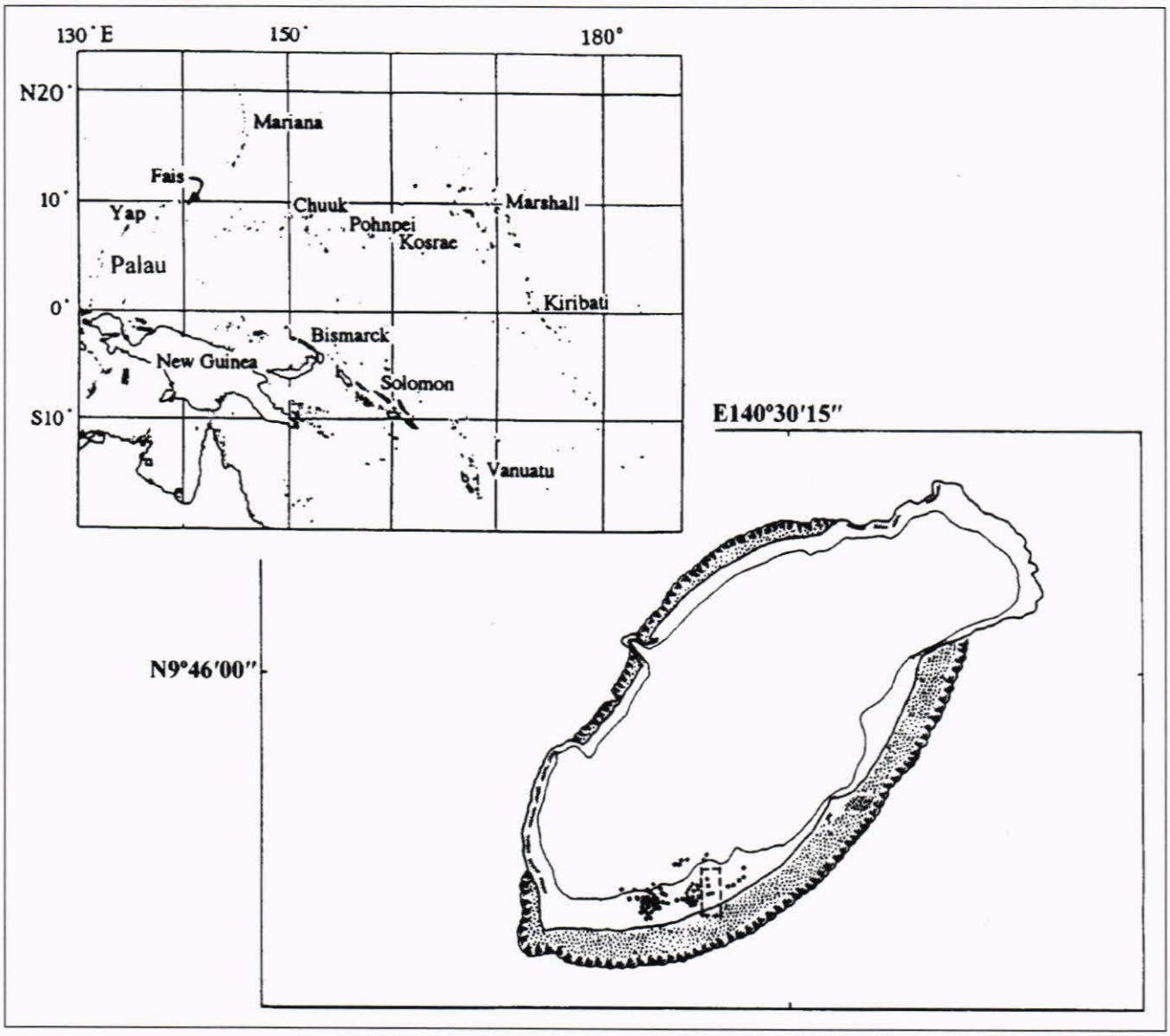

FIGURE 2. Map of Fais Island.

Technological examination

The first attempt to classify the excavated potsherds was carried out by examining physical features, such as texture of clay paste, use of temper and breakage pattern. Four distinctive groups were recognised as a result. Each group was named after its characteristic features, namely Laminated, Plain, Coarse and Calcareous Sand Tempered (CST).

Laminated pottery group. This pottery exhibits distinctive lamination in the broken section. The peculiar appearance strongly resembles the breakage pattern of Yapese Laminated pottery (Intoh and Leach 1985) which has not been recognised from anywhere else in the Pacific. The characteristic of its hard clay texture without obvious sand temper is also similar to Yapese Laminated pottery. This type of pottery appeared late in the Yapese pottery tradition (after about 500 B.P.) and persisted into the ethnographic present. Most of the rim sherds indicate that the original pots are in-curved simple bowls and are suitable for cooking.

Plain pottery group. Pottery classified in this group exhibits a wide range of physical features but shows neither lamination nor inclusion of calcareous sand temper. This definition could be too simple and various sub-types might exist. For the purpose of the present study, however, smaller categories are ignored that are not clear in their cultural

Square	Layer	Laminated	Plain	Coarse	CST	Total
FSFA-1	1	8	2		1	11
	2	5	18	1	8	32
	3	7	102	5	65	179
	4	0	1		8	9
total		20	123	6	82	231
FSFA-2	1	16	1	1	0	18
	2	20	26	4	9	59
	3	2	79	3	47	131
	4	1	9	3	43	56
	5	0	8	3	54	65
	6	0	0	0	12	12
total		39	123	14	165	341
FSPO-1	1	18	0	3	0	21
	2	34	7	0	0	41
	3	10	1	1	2	14
	4	0	0	0	1	1
total		62	8	4	3	77
FSPO-2	1	4	0	0	0	4
	2	9	0	0	0	9
	3	8	0	0	0	8
	4	0	0	0	0	0
	5	0	0	0	0	0
	6	3	11	3	3	20
	7	0	21	0	1	22
	8	0	4	0	0	4
	9	0	5	1	11	17
	10	0	0	0	0	0
	11	0	5	3	13	21
	12	0	0	0	3	3
	13	0	1	0	1	2
total		24	47	7	32	110
FSYE		7	1	1	0	9
TOTAL						768

TABLE 1. Distribution of excavated potsherds from Fais Island.

Square	Layer	Potsherds (FS91-)
FSFA-2	2	830,832, 836, 839, 846, 850, 858, 866, 867, 870, 872, 888
FSFA-2	3	895, 897, 966, 968, 990, 997, 999
FSFA-2	4	1030, 1041, 1052, 1061, 1073, 1076
FSFA-2	5	1105, 1106, 1124, 1129, 1141, 1146, 1148
FSFA-2	6	1168
FSPO-2	5	1539
FSPO-2	13	1538

TABLE 2. Stratigraphic information of sherds selected for petrological examination.

meanings. This is why the following Coarse pottery group was originally included in the Plain pottery group.

Coarse pottery group. Pottery of this group has a distinctive dark, nearly black core, covered with thin, buff-colored surface layers. The texture of many potsherds contains very coarse inclusions in the clay paste. It is an extremely hard pottery and is easily distinguished from other Plain potsherds. Considering the results of petrological examination, a category of Coarse pottery was created. The set of physical features mentioned above is distinctive enough to categorise some potsherds into this group. A total of 33 Coarse potsherds were obtained (including 1 surface find) which are about 4% of the excavated pottery from Fais (see Table 1).

Calcareous Sand-Tempered pottery (CST) group. Pottery of this group shows calcareous sand mixed in the clay texture. The grain size of calcareous sand is relatively even within a pot but varies from fine to coarse amongst the group. Due to the soft calcareous grains, most of the CST potsherds are crumbly. The problem associated with firing calcareous sand-tempered pots has been widely known (see Intoh 1990a), but similar prehistoric pottery was widely made in Micronesia (except for Palau) as well as in Melanesia (including Lapita sites).

The distribution pattern of these four types is shown in Table 1 and Figure 1. Obviously, CST pottery dominates in the earlier layers. Then Plain pottery became more dominant while CST pottery reduced in quantity. Close to the historic period, Laminated pottery became dominant while Plain decreased and CST almost completely disappeared. The Coarse potsherds are rare but appeared fairly constantly from the early to late period. This pattern is surprisingly similar to that observed in Yap (Intoh and Leach 1985). The authors argue that without close cultural contacts with Yap, such a similar distribution pattern of imported pottery could not have been occurred.

Petrological examination

A total of 35 potsherds were selected from the four groups mentioned above and were analysed by Dickinson. The stratigraphic information for these sherds is shown in Table 2.

As temper sands in the Fais sherds are composed often primarily or at least partly of silicate mineral grains and rock fragments, the sherds evidently represent wares imported to Fais, where only wholly calcareous sands composed of fresh or reworked reef detritus could be collected. The tempers examined fall into five groups, some with variants that form subgroups (Table 3). All five temper groups correspond to one of the temper groups from Micronesia described in the later section. The name

Temper Group	Pottery Sample Number (FS91-)	Typological Group	
A. Yap metavolcanic temper	A1	836, 968	Laminated, Plain
	A2	846, 1052, 1168, 1539	CST, Plain
B. Yap calcareous temper	B1	830, 897, 999, 1041, 1061,1105, 1124	CST
	B2	1030, 1538	CST
C. Yap quartzofeldspathic temper	C1	839, 895	Plain
	C2	870	Plain
D. Yap grog temper	D1	850	Plain
	D2	866, 997	Plain
	D3	858, 872, 966, 990, 1073, 1141(?),1146	Laminated, Plain
E. Palau grog temper	E1	1129(?)	Plain
	E2	832, 867, 888, 1076,1106,	Coarse
F. Indeterminate temper		1148	Plain

TABLE 3. The relationship between temper groups and typological groups.

of the temper groups of Fais pottery is therefore taken from the possible source on the nearby volcanic island.

Yap metavolcanic temper (A). Six potsherds are classified in this group. Two sherds include typical natural tempers of poorly sorted, unabraded grains (type A1), and four contained added tempers of well sorted and rounded sand (type A2). The dominant grains in all six sherds are foliated metavolcanic rock fragments, composed mainly of plagioclase and amphibole, indistinguishable from comparable grains in sherds indigenous to Yap. The well sorted temper is probably beach sand.

Yap calcareous temper (B). Nine sherds fall into this type. Metavolcanic detritus is subequal in abundance but the calcareous grains are in two sherds (type B2) and predominant in the other seven sherds (type B1). The well sorted and rounded calcareous sands are probably beach sand, and the two temper sands containing a significant proportion of non-calcareous grains (type B2) are evidently transitional to the well sorted variant of Yap metavolcanic temper (type A2).

Yap quartzofeldspathic temper (C). Three sherds are classified in this group. Two sherds contain typical Yap quartzofeldspathic temper (type C1). In another sherd (type C2), sparse metavolcanic rock fragments typical for Yap metavolcanic temper occur with a grain population otherwise characteristic of Yap quartzofeldspathic temper. This tends to confirm the interpretation that the quartzofeldspathic temper is indigenous to Yap. Dickinson's previous interpretation (1982), that the Yap quartzofeldspathic temper might conceivably derive from the Philippine Islands, now seems ill advised (see the discussions below).

Yap grog temper (D). The largest number of sherds, sixteen in all, contain grog fragments as their main temper (types D and E). Such a quantity of grog-tempered pottery was unexpected. Grog is a term that refers to an aggregate of deliberately broken potsherds or fired clay added by potters to clay bodies lacking adequate sand temper for strength. Grog fragments appear in thin section as discrete, sharply bounded areas of clay paste with distinctly different coloration or texture, or both, from the bulk of the clay body.

The presence of characteristic metavolcanic rock fragments in the clay paste and/or within grog fragments in three of these sherds (types D1 and D2) provides clear evidence of derivation from Yap. Seven other sherds contain abundant small quartz and feldspar grains within the clay paste (type D3), as is typical for Yap grog temper. Ten of the grog-tempered sherds are thus interpreted here as imports from Yap, but one of the ten (FS91-1141) is of questionable origin because it is very similar typologically to sherds from Palau (type E). As the siltiness of clay paste can only be regarded as a guide to sherd origins (Yap vs. Palau), and not as an infallible indicator, it is certainly possible that this sherd was derived from Palau, rather than Yap.

Palau grog temper (E). Six grog-tempered sherds lack appreciable non-clay mineral grains in the clay paste (type E), and thus resemble sherds containing Palau grog temper. These sherds are accordingly interpreted here as imports from Palau, and most are typologically Palauan, but one of them (FS91-1129) is of questionable origin because it seems typologically to resemble some typical Yapese sherds. It is certainly possible in this case that a Yapese potter obtained clay locally that was anomalously poor in the silty detritus typical of clay bodies in grog-tempered sherds from Yap.

Indeterminate temper (F). One sherd (FS91-1148) from the older horizon at Fais contains an unfamiliar temper sand (type F) of indeterminate origin. The principal grain types are microporphyritic volcanic rock fragments and mineral grains of clinopyroxene and oxyhornblende. The sand is poorly sorted and may be stream sand of andesitic arc type. Although the origin of this sherd cannot be established on present information, Palau seems the nearest likely source because hornblende is rare in Marianas lavas (Schmidt 1957) but occurs widely in Palau (Corwin *et al.* 1956).

Except for the sherd of indeterminate origin, the sherds examined from Fais all appear to definitely represent wares imported from Yap (n=28) and Palau (n=6). The confidence level for the inference of derivation from Yap is highest for the sherds containing metavolcanic detritus (types A, B, C2, D1, D2), but is still strong for sherds with prominent quartzose detritus (types C1, D3). All of the Coarse pottery group sample fell into the E type. The general coincidence of petrographic and typological indications of Palauan derivation strengthens the interpretation that most sherds with grog temper from Yap and Palau can be distinguished from the contrasting textures of their clay pastes. The uncertain assignment of two of the grog-tempered sherds (queried in Table 3) is a reminder, however, that the wholly empirical criterion of percentage of silty grains in the clay paste may not be an infallible means for judging origin (Yap vs. Palau).

Given the presence of Palauan grog-tempered sherds, the sherd of indeterminate origin (type F) is probably also from Palau, but the confidence level of this inference is low without additional information that is currently not available.

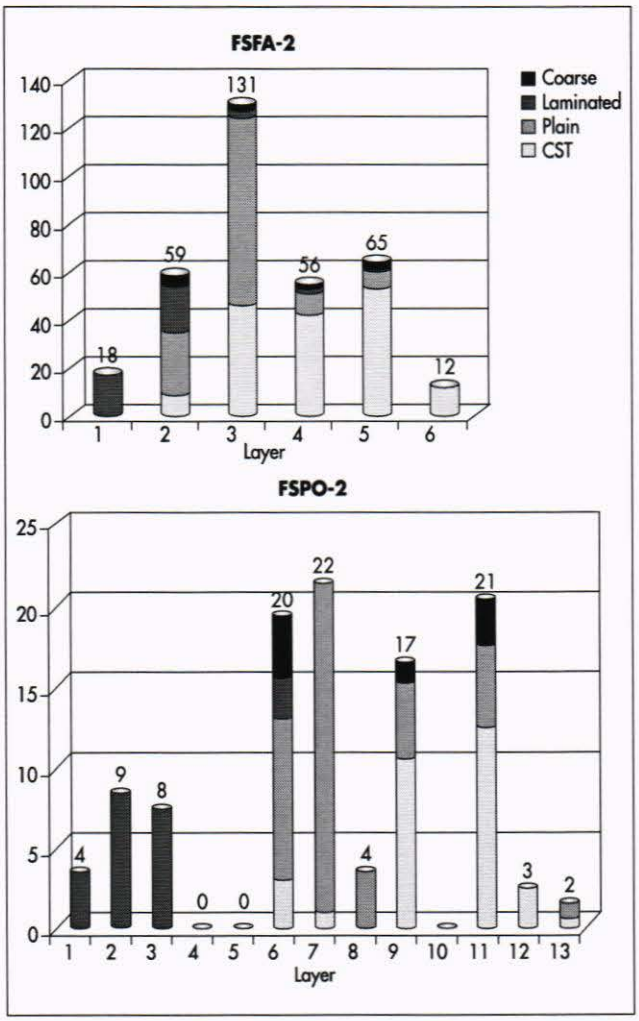

FIGURE 3. Distribution diagram through time of three types of Yapese and possible Palauan pottery excavated from Fais.

Synthesis

Table 3 shows the combined results from the technological and petrological examinations. Both results fit together reasonably well, but specific discussion is necessary in some cases.

All CST pottery fits with the Yap calcareous temper group except for one sherd (FS91-846) which was grouped with Yap metavolcanic temper. As calcareous sand grains contained in this sample are sparse, no grains of calcareous sand could have appeared in the examined thin section. In other words, the clay body to which calcareous sands were intentionally added is identical to the Yap metavolcanic temper group.

Plain pottery exhibits a variety of tempering techniques. This corresponds well with the technological changes observed in the Yapese pottery tradition. Intoh has pointed out that the technology of Plain pottery making was in the stage of adaptational changes prior to the development of the characteristic technology of Laminated pottery making (Intoh 1990a, b).

All the Coarse pottery was grouped with the Palau grog temper. As this pottery has such distinctive physical features, it is reasonably easy to distinguish this probable Palauan pottery from Yapese.

Laminated pottery was grouped into two: Yap metavolcanic temper and Yap grog temper. Intoh is puzzled by this result, however, because no ethnographic data on Laminated pottery making have reported the use of tempering material (Gifford and Gifford 1959; Intoh and Leach 1985; Müller 1917). Regional variance in technology could be one explanation since the villages involved in the *sawei* exchange system were in northern Yap while the village where ethnographic records were made is in southern Yap. Another explanation is that the

clay had contained grog-like clay grains naturally. Yapese potters do not have a stage of rigid kneading. Examination of fired clay samples may solve this problem in the future.

MICRONESIAN POTTERY: COMPARATIVE DATA

Yap

The geological position of Yap is unique in having exposures of pre-Tertiary metamorphic basement unknown elsewhere in the Pacific. This is a very useful advantage for researchers looking for evidence of transported pots outside Yap.

Yap pottery contains four different types of temper, Yap metavolcanic, Yap calcareous tempers, Yap quartzofeldspathic and Yap grog tempers. While the first two are clearly indigenous to Yap, the latter two are inferred to be indigenous to Yap on less conclusive grounds.

Yap metavolcanic temper. The most characteristic sherds from Yap contain poorly sorted and generally unabraded sand composed mainly of foliated metavolcanic rock fragments, as well as mineral grains of plagioclase feldspar and actinolitic amphibole derived from similar metavolcanic rock. This diagnostic Yap metavolcanic temper is interpreted as natural temper sand enclosed within residual clay deposits formed by deep weathering of local bedrock. The dominant bedrock terrace of Yap is a structurally complex assemblage of metavolcanic greenschist and amphibolite formed by processes related to subduction along the Yap Trench flanking the Yap Island arc (Hamilton 1979:275-277; Hawkins and Batiza 1977; Johnson *et al.* 1960; Shiraki 1971).

Yap calcareous temper. Subordinate sherds from Yap contain a deliberately added temper sand composed mainly of calcareous grains probably derived from modern reef detritus (includes temper types C and E of Dickinson 1982, from the site at Pemrang near the south end of Yap). The well sorted and rounded nature of the calcareous grains suggest that they were collected as beach sand, and this impression is strengthened by the occurrence of a significant proportion of opaque iron oxide grains representing an admixture of black placer sand, common on island beaches. The presence, as silicate sand grains in the clay paste, of amphibolite rock fragments, identical to those of the Yap metavolcanic temper, serves to link the Yap calcareous temper unambiguously to its place of origin.

Yap quartzofeldspathic temper. A third Yapese temper type is a poorly sorted and generally unabraded sand composed of individual quartz and feldspar mineral grains (monocrystalline), aggregate quartz-feldspar grains (polycrystalline), and rare aggregate epidote grains. This problematical quartzofeldspathic sand is not noted in existing accounts of Yap geology. It is probably a natural temper contained within residual clay and derived from quartz vein systems which cut deeply weathered volcanic rocks that overlie the metamorphic basement of Yap. The local occurrence of quartzose detritus on Yap is documented, by the presence of quartz grains in some of the fired clay samples studied by Kawachi (1985).

Three fired clay samples collected from natural clay deposits from the northern part of Map Island in Yap and along the southern coast of Yap Island were prepared by Intoh for thin section examination. None of these closely resemble the clay paste in any of the prehistoric sherds. However, the examination did confirm that grains of quartz, chert, and felsite occur in residual clays of Yap soils. Quartzose and cherty detritus in Yap clays may be derived in whole or in part from blocks of sedimentary rocks in exposed tectonic breccias that resemble melange (Hawkins and Batiza 1977), a term applied to disrupted strata deformed within subduction complexes. The melange apparently also includes blocks of plutonic rock that might be large enough to provide a source for the Yap quartzofeldspathic temper.

Yap grog temper. A final type of temper in selected sherds from Yap is grog, dominant in some sherds from Pemrang (temper type H of Dickinson 1982). Small mineral grains of quartz and feldspar embedded in the clay paste, together with microcrystalline felsite rock fragments, suggest that the clay bodies may be residual clays from the weathering of volcanic strata that locally overlie the bedrock of Yap (Hawkins and Batiza 1977; Johnson *et al.* 1960). The abundance of grog temper in sherds from nearby Palau raises the alternate possibility that the grog-tempered Pemrang sherds were imported from Palau. There seems no way to make a fully definitive judgment on this point, but grog-tempered sherds from Palau uniformly lack the abundance of non-clay silicate sand and silt grains present in the clay paste of sherds containing the Yap grog temper. Interpretation of the grog temper in sherds from Pemrang as indigenous to Yap, rather than Palau, is strengthened by the fact that one grog-tempered Pemrang sherd (type G of Dickinson 1982) also contains a few metavolcanic rock fragments indistinguishable from those in the Yap metavolcanic temper.

Marianas

Sherds examined from Guam, Rota, Tinian, and Saipan in the Marianas Islands contain related temper sands of andesitic arc type (Dickinson and Shutler 1968, 1971, 1979). Sources of the silicate grains in the sand tempers are Paleogene volcanic units of the various islands (Cloud

et al. 1956; Schmidt 1957; Stark 1963; Tracey *et al.* 1964). Some sherds from each island contain calcareous temper sands in which the dominant grain type is reef detritus. Subordinate silicate grains in each case are similar to grain types in local volcanic sand tempers of the island in question. These calcareous tempers are grouped together and called Marianas calcareous.

The various sources of diverse Marianas volcanic tempers have been discussed recently by Dickinson *et al.* (2001). Although there is robust evidence for inter-island transfer of pottery within the Mariana Island group, there is no temper evidence for importation of pottery into the Marianas from elsewhere, nor any temper evidence for the presence of pottery made in the Marianas elsewhere in Micronesia.

Palau

Grog is the most abundant type of temper in sherds from Palau (Dickinson *et al.* 1979), and non-clay constituents of any kind are exceptionally rare in the clay paste of this grog-tempered sherd assemblage. Additional sherds contain well sorted, rounded to subrounded volcanic sand, probably beach sand but possibly stream sand, composed exclusively of the following grain types:

(a) partly glassy microcrystalline volcanic rock fragments of vitrophyric to hyalopilitic texture, (b) pyroxene mineral grains, mainly augite but including subordinate hypersthene, (c) plagioclase feldspar mineral grains, commonly with glass blebs as inclusions, and (d) opaque iron oxide grains.

Plagioclase and pyroxene grains jointly form half to two-thirds of the grain population, and volcanic rock fragments typically form a quarter to half of the grain population; opaque grains range from only a trace to nearly a quarter of the grain population. The Tertiary (Paleogene) andesitic sequences of Palau (Corwin *et al.* 1956) are probably the source of the volcanic sand. The two temper types are here termed Palau grog temper and Palau volcanic temper, respectively.

Chuuk (Truk)

Temper sands in sherds from Fefan in Chuuk are composed dominantly of calcareous grains, but nearly all contain a minor admixture of volcanic detritus (Dickinson 1984). Grains of volcanic derivation include plagioclase feldspar, clinopyroxene, opaque iron oxides, and a variety of volcanic rock fragments, many composed wholly or partly of glass, with vitric, intersertal, intergranular, and trachytoid textures. The volcanic detritus was derived from remnants of a subsided shield volcano that protrude as islets from the Chuuk Lagoon (Stark and Hay 1963). The volcanic materials in the Chuuk calcareous temper are of oceanic basalt type (Dickinson and Shutler 1968, 1971, 1979), and contrast petrologically with the constituents of andesitic arc tempers in Palau and the Marianas.

Pohnpei (Ponape)

Pohnpei, the largest volcanic island of the Carolines, is composed of alkalic basalt lavas and breccias (Yagi 1960). Several variants of the Nan Madol temper, of oceanic basalt type (Dickinson and Shutler 1968, 1971, 1979) in sherds collected at the surface near Nan Madol (Athens 1980), contain volcanic detritus evidently derived from local bedrock (unpublished data). The most common grains of volcanic derivation are varied volcanic rock fragments, many vesicular or amygdaloidal and some containing red iddingsitic olivine crystals. Mineral grains of plagioclase, clinopyroxene, and opaque iron oxides are also present. In most sherds, volcanic rock fragments are predominant over all mineral grains, but clinopyroxene grains, perhaps concentrated by placer action, are nearly as abundant as the polycrystalline rock fragments in a few of the sherds. In a majority of the sherds, grog is more abundant as temper than the volcanic detritus. In a subordinate number, the volcanic rock fragments are mixed with significant or dominant proportions of calcareous grains. Although the volcanic detritus in the Nan Madol temper is similar petrologically to the minor volcanic component of the Chuuk calcareous temper, the prevalence of grog temper and the paucity of calcareous grains in most variants of the Nan Madol temper seem diagnostic of systematic differences between the two.

Kosrae (Kusaie)

Sherds from Lelu Island off the east coast of Kosrae, the easternmost volcanic island of the Carolines, contain well sorted calcareous sand temper that was probably collected from local beaches. This calcareous temper was added by ancient potters to a silty, poorly sorted clay body containing a sparse volcanic sand component composed of glassy volcanic rock fragments, plagioclase and clinopyroxene mineral grains, and opaque iron oxides. This pottery is thus called Lelu Calcareous Temper pottery. In a majority of the Lelu sherds, the calcareous sand grains have been removed by post-burial dissolution to leave small pits or empty cavities in the clay paste. This is very similar to the sherds excavated from the mangrove swamp of Gachpar in the east of Yap Island (Intoh and Leach 1985:85-87).

The volcanic detritus in the Lelu sherds was derived from oceanic basalt bedrock, and is thus broadly similar petrologically to detritus in sherds from Chuuk and Pohnpei. The Lelu sherds of Kosrae are stylistically

distinct, however, from the Nan Madol sherds of Pohnpei (Athens 1990), and there is no evidence in the former of the grog fragments so common in the latter. Sherds with calcareous temper from Chuuk differ consistently from the Lelu sherds of Kosrae by containing finer grained, less silty clay paste, coarser sand grains of volcanic detritus, and generally more voluminous calcareous sand grains. Moreover, all the sherds from Lelu islet off Kosrae contain tiny thin flakes of strongly pleochroic, reddish brown mica (biotite or phlogopite) embedded in the clay paste. Mica is absent in sherds from Chuuk and Pohnpei, and is rare on most oceanic basalt islands, but occurs as microphenocrysts in the main lava series of Kosrae (Mattey 1982). Its occurrence is thus not only characteristic, but probably diagnostic, of Kosrae origin.

PREHISTORIC POTTERY MOVEMENTS IN MICRONESIA: DISCUSSION

Origin of Fais pottery

The results from the analyses of the pottery assemblage excavated from Fais, both typological and petrological, strongly indicate that a large proportion of Fais pottery was transported from Yap and that a much lesser quantity was possibly brought from Palau. No potsherds imported from the Marianas or from the eastern high islands, such as Chuuk, Pohnpei or Kosrae were unearthed.

It is particularly interesting to find no trace of imported pottery from the east, because the coral islanders of the Central Carolines are considered to have dispersed from the eastern high islands based on their common language, Nuclear Micronesian. One of the possible explanations could be that pottery making on Chuuk and Kosrae had ceased soon after their colonisation around 2000 years ago (Athens 1990; Shutler *et al.* 1984).

It is most likely that pottery was transported to Fais in its final form. The possibility of importing raw clay and making pots on Fais is unlikely considering the other materials required for pottery making, such as fresh water and a large amount of firewood. It must also be pointed out that most of the imported pots were ordinary cooking pots since no decoration was observed. In other words, these were not specially made trade pots.

The similar distribution pattern of three types of Yapese pottery (Laminated, Plain and CST) through time both on Yap and on Fais indicates that Fais Islanders kept close contacts with Yap throughout the habitation history of the island (Intoh 1996). This is an interesting example where archaeological evidence does not match with linguistic models (Intoh 1997). Interactions had been maintained across the language boundary for such a long period, but the language barrier remained. The nature of the interaction should be a key to the explanation of this situation. Two possible hypotheses are suggested here.

The first hypothesis is that Fais was colonized from Yap. When archaeological evidence alone is examined, the result of this study corresponds to a typical Austronesian colonisation strategy observed at Lapita sites in Melanesia (Green and Kirch 1997). The colonisation model indicates that the initial colonists kept cultural contacts with their home island until the new environment became self-sustainable. In this case, the colonists settled on Fais kept contact with Yap for pottery and other necessary materials. Despite continued cultural connection between these islands the language of Fais was replaced by Nuclear Micronesian at some stage.

An aspect of this hypothesis that must be considered is whether or not Yapese settlement on Fais was permanent. Transporting pottery to the island indicates that it was more than simply a camping place. However, other artefacts, such as food processing tools or ornaments, are very rare from the early cultural horizons. This may suggest that Fais was originally inhabited by a group of Yapese. If the Yapese use of the island was temporary or by a very small population, population replacement could have easily occurred later. It may not be easy, however, to detect archaeological evidence of language replacement.

A second hypothesis is that the original settlement of Fais was made from the east by Nuclear Micronesian speakers as the linguistic studies indicate. As soon as they colonised Fais, they expanded further west to Yap where they found richer resources and communities that made pottery. Pottery and possibly other materials were carried back to Fais. Contacts between the islands were constantly maintained despite their language differences.

With either scenario, the inter-island network, the *sawei*, could well have developed from continued cultural links. Taking into consideration the evidence for the extensive interactions Fais Islanders have with other islands in materials other than pottery (Intoh 1996), this whole issue needs to be much further developed in future studies.

A consistent component of Palauan pottery, albeit a small quantity (about 4%), was also noted amongst the Fais collections. It may indicate that either Fais Islanders had constant transactions with Palau, or alternatively they obtained Palauan pottery through the *sawei* from Yap. Considering the fact that some Palauan potsherds may occur on Yap (see the Yapese section above), the latter possibility should also be considered. Other examples of transported pottery within Micronesia are outlined below.

OTHER EXAMPLES OF PREHISTORIC POTTERY MOVEMENTS IN MICRONESIA

Lamotrek

A small quantity of potsherds was excavated from Lamotrek Atoll in the Central Caroline Islands (Fujimura and Alkire 1984). This atoll was also included in the *sawei* system. Six sherds were sent to Dickinson and were examined in thin section. Two distinctly different temper types were identified. Both include non-calcareous materials that could not have been obtained on Lamotrek Atoll. Although a previous study (Dickinson 1984) suggested that one set of exotic sherds came from Yap and the other from Palau, careful re-examination indicates that both probably came from Yap.

In two of the sherds, calcareous grains are dominant, and equally undiagnostic opaque iron oxides form about half the remainder of the grain population. Also present in minor amounts, however, are foliated metavolcanic rock fragments of the type dominant in the Yap metavolcanic temper. Their presence is clearly indicative of importation from Yap, and allows identification of the exotic temper as a variant of the Yap calcareous temper. It is worth emphasising that tempers composed mainly of metavolcanic rock fragments resembling the bedrock of Yap are unknown elsewhere from the Pacific islands (Dickinson and Shutler 1979).

In the other four sherds from Lamotrek, the only temper is grog. Based on the prevalence of grog temper in sherd collections from Palau, previous work suggested Palau as the most probable source of these sherds (Dickinson 1984). Subsequent work has indicated, however, that grog temper is common elsewhere in the Carolines as well. Moreover, re-examination indicates that the clay pastes of the grog-tempered Lamotrek sherds contain significant proportions of small quartz, feldspar, and microcrystalline felsite grains. These constituents are characteristic of Yap grog temper at the Pemrang site, but not of Palau grog temper. Accordingly, the grog-tempered sherds at Lamotrek were probably also imported from Yap, and not from Palau.

Ulithi

Ten prehistoric potsherds were examined which were kindly provided to Dickinson for study by Christophe Descantes. All the potsherds examined were classified into three of the four Yapese temper types: Yap metavolcanic temper (n=3), Yap calcareous temper (n=6), and Yap grog temper (n=1) (Dickinson and Shutler 2000). This result clearly indicates that pottery was also imported from Yap. Considering the important role that Ulithi had in the *sawei* system, this result was not unexpected.

Temper group	Number of sherds	Category in Dickinson 1982
A. Yap metavolcanic temper	3	A+D
B. Yap calcareous temper	3	B
C. Yap quartzofeldspathic temper	1	I
D. Yap grog temper	1	H
E. Palau grog temper	3	F

TABLE 4. Identified temper groups of Ngulu potsherds.

Ngulu

Ngulu is a small atoll situated between Yap and Palau. A number of potsherds were excavated in 1981 (Intoh 1984, 1992). A total of 11 sherds were examined by Dickinson and it was shown that most were imported from Yap, but some may have come from Palau (Dickinson 1982). Table 4 shows the identified potsherds grouped by temper types. The left column indicates the temper types used in this paper and the right column shows the corresponding temper types used in Dickinson's 1982 work. The potsherds classified as Yap quartzofeldspathic temper were previously identified as non-Yapese and the Philippines were suggested as one of the original locations. However, as has been demonstrated in this study, Yap does have quartzofeldspathic rocks. So, the somewhat ambiguous connection between Ngulu and the Philippines was rejected.

The principal sherd ties from Ngulu to Yap seem conclusive, and the subordinate tie of grog-tempered sherds to Palau is also strong, but not entirely definitive (see previous discussion of grog-tempered sherds from Yap and Palau at Fais).

CONCLUSION

A total of about 800 potsherds excavated from Fais Island in the central Caroline Islands were analysed. Four physical types were used for classification, Laminated, Plain, Calcareous Sand Tempered (CST) and Coarse. The results from both the physical and petrological examinations strongly indicate that most of these sherds were Yapese in origin. The distribution pattern of pottery types in the stratified layers on Fais showed the same order with that observed on Yap. This strongly indicates that Fais people had close cultural contacts with Yap throughout its habitation history. The earliest cultural horizon on Fais was dated to about 1800 years ago.

There was, on the other hand, a small amount of hard pottery, with distinct tempering material, classified as the Coarse pottery group. This pottery was determined to be

Palauan based on petrological examination. The presence of Coarse pottery in the cultural sequence is regular but it accounts only for a small percentage of the total pottery. Continuous but not frequent contact with Palau is indicated.

There was no sign that pottery was transported from other pottery-bearing islands in Micronesia, such as the Marianas, Chuuk, Pohnpei, and Kosrae. This result presents a contradiction between linguistic and archaeological studies. The language Fais Islanders speak is Nuclear Micronesian and has very different origins from Yapese.

Two suggested hypotheses were presented to account for this apparent anomaly, but neither provided conclusive answers. The first outlined the possibility that Fais was originally settled by a group of Yapese who kept cultural contacts with the mother island, Yap. The nature of the settlement may not have been permanent. As the population may have been small, language replacement may have occurred relatively easily when Nuclear Micronesian came to Fais. The problem associated with this scenario is that there is no clear evidence of language replacement or obvious cultural change in the archaeological record.

The second hypothesis suggested that Fais was settled by a group of Nuclear Micronesian speakers, a scenario that linguistic studies indicate. As soon as they colonised Fais, they expanded further to Yap almost immediately. Contacts between the islands were kept up constantly despite their language differences. The inter-island network, the *sawei*, could well have developed from some form of continued cultural contact.

Both scenarios have a number of weaknesses which require further research in the future. However, in either case, it is clearly shown in this study that steady inter-island contact was continued across the language differences. It is also suggested that such long term inter-island connections may well have been the original form which developed into the *sawei* network system.

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