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ON THE DARK STAINS OBSERVED IN SOME TONGAN BURIALS

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In recent years an increasing number of excavations of prehistoric and early historic burial sites have been carried out in Western Polynesia. While the first investigations of Tongan burial mounds occurred as early as 1921 (McKern 1929:104-105, 108-109, 113-114), systematic archaeological work occurred much later, starting with the excavations by Jack Golson in 1957 (Golson 1959; 1961). Both Jens Poulsen in 1963 (Poulsen 1964; 1967; 1987: 26) and especially Janet Davidson in 1964 (Davidson 1964; 1965;1969) excavated burial mounds on Tongatapu. Further work was carried out by Spennemann (1986a:68 ff.; 1989a; 1989b).

TONGAN BURIAL SITES

Tongan nomenclature distinguishes between three types of burial sites, *fa'itoka, mala'e* and *langi*. The nomenclature depends on the person interred in the structure. The common form of the *langi* and *mala'e* is that of a rectangular platform, faced with cut slabs of beachrock. In rare examples the facing is of blocks of coral limestone or even volcanic rock. Some unfaced structures are known which are also called *langi* (Gifford 1929: 125-126), by virtue of the interment of a member of the *Ha'a Tu'i Tonga*. Unfaced burial mounds are called *fa'itoka*.

Burial mounds are circular or sometimes oval-shaped heaps of soil with a gently sloping, convex cross-section. Their diagnostic feature is the coral sand with which the grave pits are commonly filled. The size of the mounds varies from small, 0.5 in height and 10m in diameter, to very large, over 3m in height and 30m in diameter. The excavated mounds consist of a series of 0.5-0.6m-thick soil layers, which represent a succession of burial phases. In the beginning a series of grave pits was dug at ground level. At a later stage a concentric borrow ditch with one or two access gaps was dug around the burial place and the soil heaped over the graves to form a mound. A new series of burial pits was dug in this, until, when it was full, the mound was heightened with material from a second ditch outside the existing one. While vertical enlargement of a

mound appears to be common, site TO-At-36 (Spennemann 1989b) provides an example where lateral enlargement occurred, possibly caused by the limited availability of soil.

Grave pits of adult individuals, where completely excavated, measured between 1.8 and 2.0m in length and 1.5 and 0.7m in width. The evidence of pits cut by trench walls is that they are commonly between 0.5 and 0.6m deep and rarely up to 0.8m. The lower part of the burial pits is filled with coral sand, while at the top the fill is often soil.

STAINS OBSERVED IN SEVERAL BURIALS

Careful excavation by Davidson (1969; at TO-At-1 & -2) and Spennemann (at TO-At-36) sometimes revealed a thin black streak running round the body. Davidson (1969:273) suggested that this black line was indicative of (now decomposed) black tapa cloth wrapping. In one of the graves excavated by her (n° 40) she encountered "fragments of what appear to be tapa cloth, now hardened to a form like paper mâché" (ibid. 271). While Davidson's find is a most extraordinary example of luck, enviable excavation skill and favourable preservation conditions, it needs to be pointed out that the amount of pigment in black tapa is not sufficient to cause such extensive stains. Spennemann in his PhD thesis (1989a:99) suggested that "the black colour, however, may as well originate from anaerobic decomposition of mats or tapa in general." No tangible material could be recovered in Spennemann's excavations and only very narrow, 1-3mm wide bands of discoloured sand grains were found.
Were the stains caused by black tapa, then the body would have to have been rolled in tapa many times over, not unlike a mummy. While this is certainly conceivable, some observations mitigate against such an interpretation. The thickness of the wrapper of the bundle and the airspaces trapped accidentally between the layers would have been much greater than the thickness of the well defined band encountered.

Further, "black tapa" (*ngatu 'uli*) is not solidly black, if the ethnographic record is any guide. The dye is made up of a mixture of red clay and the black soot of burned candle nuts *(Aleurites moluccana)* whereby the black soot predominates. Even though the dye is applied liberally, only a very thin vernier is left once the tapa is finished (Tamahori 1963).

That the body was wrapped in organic material before burial is indisputable, as there is other evidence which points towards the former presence of a body wrapper. The slumped sand observable in the profile of many burials (Davidson 1969; Spennemann 1986, 1989b; 1989c; 1989e) indicates that at the time of interment the body had been wrapped into something more solid than simply bark cloth, which trapped a quantity of air. While this slump could have been caused in the trunk area of a body by the decomposition of the large amount of organic matter in abdomen and chest, this would certainly

have not been possible at the tibiae—where the slump has also been observed. On the other hand, the concave bottom shape of the coral sand-filled pit and the absence of horizontal layering in the bottom part of the pits also indicate that no rigid object, such as casket, was interred. As the body and its wrapping decomposed, the sand settled between the bones and the soil above the sand layer slumped, creating a characteristic concave surface.

There is further evidence which indicates that the wrapper consisted of thick mats: On numerous occasions in burial mound TO-At-36 it was observed that the body rested on the back, with a slight tilt towards the right-hand side (Spennemann 1989b). Such a tilt can only have occurred if one side of the burial parcel was thicker than the other. Thus it is very likely that the bodies were wrapped in mats (and bark cloth ?) in such a way that one or both ends were under the back.

The ethnographic literature describes a few burial observations, beginning with Mariner's account of the burial of Finau (Martin 1817:II 225) and ending with Queen Salote's funeral in 1967 (Kaeppler 1978). All these descriptions mainly cover the funerary rites for the highest ranking members of the Tongan Society (Baessler 1895; Koch 1955). Various historical reports mention burial goods that were placed in a *langi*, such as bark cloth, fine mats, beads and whale's teeth (Wilson 1799: 241 ff.; Martin 1817: II 225; see also Te Rangi Hiroa 1935; 1937). Commonly, however, the burial itself was shielded from prying eyes, and so first hand accounts are rare. Gifford (1929:202), quoting an eye-witness account of Beatrice Shirley Baker mentions that "the body of Tuita, which was to be interred was wrapped in fine mats and tapa" (bark cloth).

THE EXHUMATIONS ON MEJATTO ISLAND, KWAJALEIN ATOLL

In January 1993 the authors carried out a series of exhumations on Mejatto Island, Kwajalein Atoll, Republic of the Marshall Islands, which have a bearing on the issue at hand.

Purpose of the exhumations

Between 1946 and 1958 the United States of America detonated over 60 nuclear and thermonuclear devices in the northern Marshall Islands. In March 1954 a thermonuclear device yielding 15 million tons of TNT was detonated on Bikini Atoll as test *Bravo*. The radio-active cloud drifted eastward and contaminated numerous atolls, mainly Rongelap, Rongerik and Uterik. The fallout following *Bravo* led to a significant deposition of plutonium and other transuranics, mainly 239Pu, 240Pu and 241Am on the islands of Rongelap Atoll. Soil concentrations on Rongelap Island, Rongelap Atoll, are approx. a factor of 430 above the average of the northern hemisphere (Franke 1989).

For many years conflicting information was available about the extent of

transuranic uptake by the Rongelap community. Whereas dose estimates based on pathway modelling (uptake from estimated food intake etc.) indicated that plutonium and other transuranics were only minor contributors to the overall dose, data on plutonium in urine collected before 1988 showed elevated levels of plutonium. While these data are unreliable due to potential contamination of urine samples with soil and problems with the analytical procedure, recent analyses of Brookhaven National Laboratories of urine from former Rongelap residents indicate low levels of plutonium uptake. Since about 45% of the initial uptake of plutonium into the bloodstream is deposited in the skeleton, with a biological half-life of 100 years, the analysis of actual bone samples for their total transuranic content reduces uncertainties associated with other data sources (Franke 1992). To provide an independent verification of the estimates of plutonium intake via pathway modelling a series of six exhumations was carried out by the authors as part of a U.S. Congress funded study (Spennemann 1993a).

While the primary purpose of the exhumations as defined by the Rongelap Scientific Management Team was to recover sufficient bone tissue to conduct studies on the plutonium intake of individuals living on Rongelap Atoll after the *Bravo* thermonuclear test of 1954 (see Franke 1992 for details), they provided a unique opportunity to assess the decay rate of human bodies in the coral sand soils of the Marshall Islands (Spennemann 1993a).

FINDINGS

Some of the findings made during these exhumations are of relevance here, since, like the Tongan burials, the Marshallese burials were interred in coral sand. The bodies had been placed in locally-made wooden caskets made of plywood. Five of the six exhumations contained a layer of fine black silt inside the caskets. This silt deposit was particularly present on top of the shrouds or the mats covering the body. Only one burial, n° 5, did not have this. Unlike all the others, this interment also had a casket wrapped with plastic sheeting, thus effectively preventing the access for percolating rainwater. The state of preservation of the body in that burial was much better than that of any of the others.

The body of exhumation n° 2 (buried for almost 6 years) had been placed on a *jaki* mat (sleeping mat) woven from *Pandanus*, which was partially wrapped around the body, leaving only the head and the centre axis of the body free. The body was covered with a linen shroud, presumably a bed sheet, which was tucked under the mat ends. Mat and shroud were covered with a fine layer of black silt. The mat had turned dark brown and was very wet on touch. The weave pattern was well discernible. When the shroud was pulled up to expose the legs for the removal of the bone samples, the mat crumbled into small pieces. The deterioration of the mat seems to have been more pronounced at the foot end of the buried individual than at the head end.

The body of exhumation n° 3 (buried for almost 5 years) was covered with a mat folded length wise woven from *Pandanus* leaves (*jaki*). This mat partially covered the body as well and overlapped with the shroud. When the casket was opened, the mat was still intact, but crumbled to small unrecognisable pieces when the shroud was lifted and moved up to expose the lower legs. It had completely deteriorated and turned into a silty substance, which still maintained the weave pattern. The bottom of the casket had been covered with another mat, which had become completely deteriorated. In addition, a great amount of mold could be observed between the cloth of the trouser legs and the *Pandanus* mat.

TOWARDS UNDERSTANDING THE STAINS

In the literature it had previously been argued that these stains were caused by anaerobic decomposition of the mats or that they may represent the residual black pigment of tapa. Based on the observations on occasion of the Mejatto exhumations another origin can be presented, namely the trapping of fine humic silt which is transported through the soil column by percolating rainwater.

Since soils are generally speaking permeable, percolating rainwater creates a gradual particle sorting with the soil. Fine-grained silt is often carried through various layers. There, where stratigraphic boundaries are present, such as a compacted layer underlying a less dense layer, the progress of the percolating water is temporarily halted. During this residence time minerals and other components carried by the water are often deposited. The formation of iron stains at the bottom of storage pits in iron-oxide rich soils is one good example, the contamination of archaeological radio-carbon samples with nuclear testing derived carbon another.

We believe that this principle also applies in the case of the Tongan burials. Rainwater percolating through the soil column carries with it humic and silt particles. Upon encountering the mat-wrapped body parcel, the percolation of the rainwater was temporarily halted, leading to some discharge of humic material/silt. Further, at the sides of the parcel, the mat acted as a conveyor, redirecting the percolating water along its surface, possible leading to increased discharge of silt particles.

In view of the narrowness of the stains observed, often only 1-3mm in width, and in view of the small contamination with topsoil often present in the coral gravel filled pits, it is not surprising that these discolourations were never found on top of the interments: the layer of the stains is simply too thin to be found during the course of normal trowel and/or brush excavations.

Such stains were only noted in TO-At-1 and -2, excavated by J.Davidson,

and TO-At-36 excavated by Spennemann. These mounds, as well as the Mejatto exhumations, were covered with a thick layer of topsoil which contained many fine silty particles. The other Tongan burials sites excavated by Spennemann did not show any such stains. With the exception of site TO-Fa-4 the other excavated burial sites differ significantly from those showing stains in several aspects: the inhumations at TO-At-96 are interred in soil without the addition of coral sand (Spennemann 1989f); inhumation TO-Nu-50 is interred in what is believed to be a former earth oven (Spennemann 1989g); and burial sites TO-Pi-4 and TO-Pi-15, located on the sand cay Pangaimotu, are composed of coral sand throughout (Spennemann 1989d; 1989e). Further, burial mounds TO-Pi-4 and TO-Pi-15, on the other hand, lacked fine silty material in their thin topsoil horizons. Only site TO-Fa-4 is similar in that it consists of a layered soil mound with burial pits infilled with coral sand (Spennemann 1989c). At the latter site, however, only the profile of the partially quarried mound was recorded and no area excavations were undertaken, which could have shown up details such as stains.

IMPLICATIONS

As was observed by Davidson and Spennemann, some burials have a dark stain, some do not. There appears to be no archaeologically visible distinction in status between those burials which do and those which do not—which, following Davidson's interpretation as the remains of black-coloured tapa, may of course be the distinction in itself (but see above). However, Spennemann encountered several burials where the pit fill appears to be slumped, thus indicating the presence of a body wrapper—yet black stains are absent. If the interpretation of the stains in Tongan burials as deposition of silt and humic material is correct, then the presence or absence of such stains in some burials may have other implications. On the whole, mats do not survive long. In view of the evidence from Mejatto, a period of less than 10 years until complete disintegration is likely. It also needs to be taken into account that the decomposition process is slower for bodies or clothing buried in coffins than for bodies/clothing buried without a coffin (Motter 1898; Rodriguez & Bass 1985; Mann *et al.* 1990). Thus the absence of such stains in some graves, while others in the same mound show such stains, may indicate the time interval after which the subsequent layer of soil was thrown on top of a grave to heighten the mound.

FUTURE WORK

Based on the above discussion, then, future excavations of Tongan burial mounds should attempt to collect amounts of this black discoloured sand sufficient for chemical analysis. If the stains are derived from black pigment of decomposed black tapa, then the sand must be extraordinarily rich in carbon. Given the currently greatly increased techniques for 14-C dating, this material

might then even be suitable for dating the burial. On the other hand, if the analysis shows that the material is low on carbon and rich in humic acids, then we may assume a genesis as outlined in this paper.

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