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CHEMICAL ANALYSIS OF A TRY-WORKS ASH

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The 1991 excavation of Wellers Rock try-works on the Otago Peninsula revealed a thick layer of consolidated black ash, with a clinker-like consistency (Campbell 1992:139). A common fuel for shipboard try-works was the chips of scrap blubber once they had had the oil boiled out of them. It was thought that the unusual consistency of the Wellers Rock ash could result from a similar practice, with unburnt lipids binding the ash. A "consistency of asphalt" was also noted for soils and ash at a sixteenth century Basque whaling station in Red Bay, Labrador (Logan and Tuck 1990:68). Such clinkery ashes may be diagnostic of try-works, and so it was decided to try and establish their cetacean origin through chemical analysis.

A sooty residue from try-works at Bathers Bay in Freemantle, Western Australia, had been analysed by gas-liquid chromatography in 1984. The results were encouraging but inconclusive. A probable cetacean origin was indicated, but the extracted sample was small and degraded (McIlroy 1986:48). Similarly a shipwreck at Red Bay was thought to be of the *San Juan* which sank, laden with casks of oil, in 1565 (Morgan et al. 1992:129). Fatty materials immersed in water for long periods convert slowly to a waxy substance called apidocere, and analysis of the black ooze from the bottom of the wreck, by thin layer and gas liquid chromatography, showed it to be consistent with apidocere formation for right whale blubber, but did not exclude other marine sources. This work had not been published, however, when the Wellers Rock material was analysed.

The black greasy soil from the oven at the Fyffe moa hunter site was also analysed by gas liquid chromatography for traces of possible moa fat residues (Campbell and Munro 1983:208). Since there are points of comparison in the results with a sample of fur seal blubber, and no work was done on comparative moa samples (the authors state that a small sample from a mummified specimen would be adequate) These results are also inconclusive.

MATERIALS AND METHOD

Since the fatty acid composition of right whale blubber is not known, two comparative samples were taken from whale bone, which were soaked in chloroform/methanol to remove any fats still in them. One sample was right whale (*Balaena australis*) and one was humpback (*Megaptera novaeangliae*). Both samples were roughly as old as the Wellers Rock site. The fatty acid composition of the Northern right whale (*Balaena glacialis*) is known and could also be used for comparison. The humpback is more closely related to rorquals like the blue whale than to the right whale (whale taxonomy is taken from Ellis 1981:4). A number of the try-works soil samples were analysed, including a

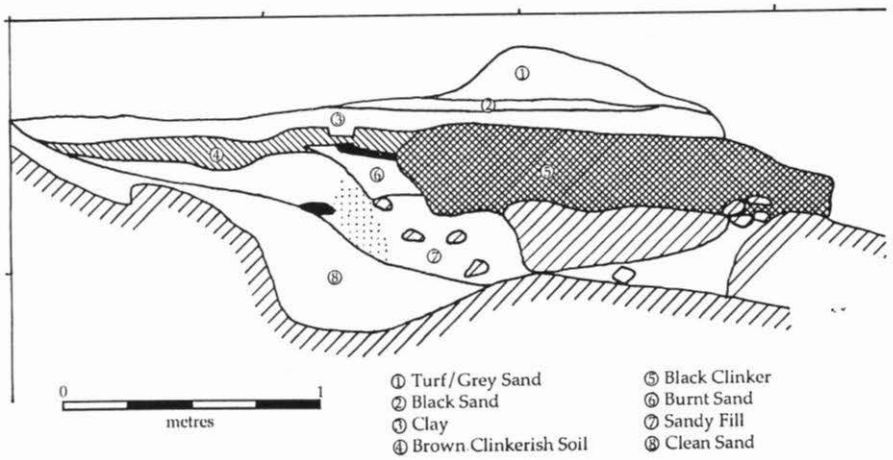

Figure 1. The stratigraphy of the Wellers Rock try-works. The ash sample was taken from layer 5.

presumably sterile sand sample and an ash sample from about lOcm below the surface of the layer (Figure 1.). Initial x-ray fluorescence analysis demonstrated the presence of zinc, manganese and copper in the ash sample, consistent with a marine mammal origin.

For the analysis of the organic content fatty acids were extracted from both the ash and bone samples with both hexane and toluene. The extracts were then analysed using both gas chromatography and mass spectroscopy. Gas chromatography separates the fatty acids according to their retention time in a capillary column, mass spectroscopy by their mass spectra as they leave the column. The resulting data were compared with library samples for identification. The results are shown in Table 1. No results were obtained from the right whale bone sample.

CONCLUSIONS

Fatty acids have persisted for over 100 years in the ground at Wellers Rock without oxidation, retaining their double bond structures. These fatty acid components compare favourably with samples of known cetacean origin, and themselves certainly originate from the right whales tryed-out at the site. However this assertion can only be made on archaeological rather than chemical grounds. Like the studies cited in the introduction, this analysis gives a reasonable indication, but is not conclusive.

Table 1: Results of the analysis. *after Smith n.d.:15*

Balaeana gracilis*	Megaptera novaeangliae	Tryworks ash (hexane)	Tryworks ash (toluene)
14:0	14:0	14:0?	
16:0	16:0	16:0	16:0
16:1	16:1?		
	18:0?	18:0	18:0
18:1	18:1	18:1?	
		20:0	20:0
20: 1		20:1	20:1?
20:5			
		22:0	
		22:1	
22:6			
		24:0	
		24: 1	

*Ackman et al. 1965.
? Tentative identification
The convention is- chain length : number of double bonds

The sample extracted with hexane resulted in a much broader range of fatty acids than the toluene extracts. An even better result could be obtained by extracting in chloroform and methanol in a 2:1 volume ratio, the Bligh and Dyer method. This method, applied to a wider range of archaeological and comparative samples, would result in a much better diagnostic tool, though whether this is practical or not is a different matter. The breakdown of fatty acids, both in soil and through time, is not well understood, besides which the difficulty inherent in obtaining a sufficient blubber sample from a right whale are obvious. Nonetheless the experiment is instructive, in that it demonstrates the possibility of useful future analysis of tryworks ashes or other archaeological ashes and soils.

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