NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER

LETTER TO THE EDITOR

Conchiolin Dating - the needle in the haystack

Dear Sir,

I was delighted to see in the June Newsletter that conchiolin dating has attracted some more attention from New Zealand archaeologists. This potentially valuable technique has led a fascinating history of use and mis-use over the years, and is taking on a definite 'herbal remedy' character. Readers of the Newsletter will remember that back in 1963, Dr Buist stayed up late one night laboriously grinding up four cockle shells which were then dissolved in cider vinegar. Before morning-rounds next day, he discovered that the modern shells had vanished without trace, while cockles from a moa hunter midden had a small murky residue which could well have been dirt! The reason for this curious result only became clear ten years later when Atholl Anderson investigated the problem further. It seems that while some species of shells have up to 7% of this elusive muco-protein, cockles have practically none (certainly less than 0.02%). Anderson's technique of analysis was rather different to that originally developed in 1960 by Schoute-Vanneck. The new method gave very accurate results, but involved tiresome re-weighings for most of the day and night while equilibrium of the hygroscopic residue sets in. Little wonder that so few archaeologists have applied the method since (digging by day and sleeping by night?).

The latest in this round of improvements was suggested by Brian Wilson who decided to abandon altogether the idea of measuring the conchiolin by measuring the conchiolin. He noted, quite correctly, that this is very difficult. Instead, he conceived the inspired idea of measuring the conchiolin by measuring something else - the calcium content! This is all very well, but it is a bit like looking for needles in a haystack without being able to take the haystack to pieces (see Figure 1). It is difficult enough to find out if there is more than one needle there by the Anderson method; it is well nigh impossible by the Wilson alternative. Compared with gravimetric determination, atomic absorption spectroscopy may well appear to be a Rolls Royce, but I suspect that it is really a Volkswagon in disguise in this case.

To be useful in relative dating, the conchiolin must be able to be estimated to within about 0.1%; that is, with an experimental error of at least $\pm$ 10%, and preferably $\pm$ 1%. This is not a very tall order in practice (Anderson achieved $\pm$ 0.4%), so long as you are observing the minor component. However, if you are observing the major component, this 10% error leads to an unacceptable scale of error in the subtracted minor part. To illustrate the point, let us imagine that the actual calcium carbonate and conchiolin values in a shell are 99% and 1% respectively.

FIGURE 1. Estimating how many needles there are in each haystack is very difficult because there is so much hay compared with the needles. A scientific experiment is a bit like observing the haystack through the wrong end of a telescope - the best one can hope to achieve is 1% accuracy, but one usually obtains about 10% (drawing by Linden Cowell).

If we design an experiment to measure the conchiolin (equivalent to burning down the haystacks in Figure 2), we should be able to get a result within 10% of the correct figure; that is, between 0.9% and 1.1%. On the other hand, if we design the experiment to measure the calcium carbonate, and then estimate the conchiolin by subtraction, we could only expect to get a result within 10% of the calcium carbonate (90.9% to 108.9%), or $\pm$ 900% of the conchiolin value; that is, between -8.9% and +9.1%. Clearly, this is ridiculous.

There are several other hazards involved in the indirect approach. For one thing, the assumption that shells only contain calcium carbonate and conchiolin is questionable. Shells also contain varying

FIGURE 2. Anderson suggested burning the haystacks down! This makes it much easier to estimate how many needles there are in each. Even with the blurring image of the scientific experiment (the telescope), the difference is quite clear (drawing by Linden Cowell).

amounts of Mg and Sr compounds; and in the case of Amphibola crenata at least, quantities of mud and other inorganic components in the actual shell matrix. However, before this possibility is taken up in earnest, it should be pointed out that atomic absorption analysis of calcium in shells is no better an estimate of how much mud is in the shell that it is an estimate of the conchiolin!

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