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STONES, STORIES AND SCIENCE

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The following was presented as the Keynote Address at 'Archaeological Science Under a Microscope: A symposium in honour of Tom Loy', held in Emmanuel College, The University of Queensland, on 19 August 2006.

Tom Loy died suddenly in October 2005. He left behind unfinished books and ongoing research projects mostly related to prehistoric residue analyses in collaboration with students working at the University of Queensland. A year or so down the track, several of these projects have come to fruition (as theses and numerous publications), and new directions have emerged. It is therefore appropriate and timely that the organising committee (Gail Robertson, Alison Crowther, Luke Kirkwood, Michael Haslam and Sue Nugent) pulled together this symposium, primarily to honour Tom, but also to reflect on the discipline he left behind, to ask about its latest developments and to examine where it's headed. That is the task of this symposium. My purpose here is not to put Tom's life under a microscope, but to briefly reflect on three strands of knowledge he pioneered: stone tool function, the stories and reconstructions based on them, and archaeological science.

I first met Tom in Victoria, BC, Canada, in 1983. He was seated at his large, old Reichert microscope, which reminded me of a modern telescope, like at Mt Stromlo. At the time, I was beginning a PhD thesis, at La Trobe University, to work on integrating use-wear and residue research. He was showing me the worn edges of stone tools with blood and hair residues, as clear as you can imagine, and all of which had just been published in the journal *Science*. Tom spent early years in the desert among the Navajo, and was trained in geology and consequently knew about lithology, as well as stone artefact technology. Although the artefacts he was showing me came from an arctic environment, he still enthused excitement because the organic tissues had survived so long – over thousands of years; because the details were so good – down to a splash of blood; and because hard evidence (from geology, biochemistry and biology) enabled precise conclusions – bison hairs, red blood corpuscles and a radiocarbon age. He was wildly enthusiastic about the potential of using plant and animal traces to work out ever more precisely how stone tools were used.

He spent most of his academic life developing residue analysis not just to find out about stone tool function but to find out what people did; and he did this in forensic detail. I think his primary concern was with people; at least what tools can tell us about people in the past. And stone artefacts were a major focus, although, as we all know, he studied residues wherever he could find them; on pottery, glass, bone, shell, skin, textiles, on ancient and modern materials. He promoted a kind of Stone Artefact Bank – stone artefacts collectively as a reserve of new information about resource use, blood lines, disease history, botanical landscapes and evolution.

In contrast with the mundane practice of tool-use, Tom was also deeply interested in Buddhist philosophy. Annie Dillard, who has written novels about human connections with nature, wrote a short story about a certain Larry, who was 'Teaching a Stone to Talk' – which is the title of the story. (Dillard said some profound things. One of my favorites is: Eskimo/Inuit: 'If I did not know about God, and I sin, would I go to hell?' Priest: 'No, not if you did not know.' Eskimo: 'Then why did you tell me?' She also quips that 'Nature's silence is her one remark and every flake of the world is a chip off that old mute and immutable block'.) Anyway, 'teaching a stone to talk' is a kind of ceremony or ritual for Larry, who is into meditation. So was Tom. But I think Tom was less interested in making a stone speak (although he would have liked the idea) than he was in the logic of science. He certainly liked making things, as well as talking – and he was a great raconteur. But he was not merely into 'squeezing blood from stones' (prophetically the title of an important paper by Glyn Isaac in 1977); seeing just how much we can get from a rock or a residue; seeking knowledge for its own sake. I think his search for knowledge entailed much more. As Isaac (1977:11) said in his paper, '(w)e need to concentrate our efforts on situations where the stones are only a part of a diverse record of mutually related traces of human behaviour and adaptation'.

Certainly a primary concern of Tom, as an archaeologist working with stones and bones, was what people made; what people actually did, on the ground, in the ground; hence his experiments with artifacts to test ideas about how people collected and gathered food. His experiments with bone artefacts to replicate Australopithecine extraction of *Hypoxis* African potato roots illustrate this endeavor. And somewhat in common with the late Rhys Jones (a former colleague of his at the Australian National University), I think Tom tried to get into the mind of prehistoric people. If he could get details of tool use right, he just might be able to test hypotheses about technological change, subsistence, exchange, ceremonies and perhaps even perceptions of landscape and society; how people saw the world.

As Jay Hall (then Head of Archaeology at the University of Queensland) has suggested previously, few studies by Tom fall short by a story. Most of his studies provide a detailed account of what might have happened; what people probably did; some account of human action and thinking. One of the best examples is the story of the man known as the Glacier Mummy, Tyrolean Iceman, or most commonly now, Ötzi. Tom introduced me to the archaeology of Ötzi, who was found in September 19, 1991 in the Ötztal Alps (just on the Italian side of the Austrian–Italian border as it finally turned out). Tom was among the first scientists contacted – in part because of his expertise and the fabulous preservation of organic tissue. Everything about Ötzi was intact, including his genitals. His woven grass cloak, shoes and bearskin hat indicated he might have been a shepherd, caught out in bad weather while moving his flock. However, artefacts found near his body – a bow, a quiver of arrows, a copper axe, a fire-making kit, a backpack and a flint dagger – suggested he may have been a hunter or even a warrior. Tom packed a microscope (a personal one belonging to Rowan Webb, now at the University of New England) and was flown to Austria. During my visits to the ANU, he had discussed how to record the usewear on the artefacts, and we decided to record use-wear and residues on the tool edges by taking acetate peels – which he brought back for me to examine, confirming a diagnostic polish from cutting highly siliceous plants. As his students know, Tom was a bit of a loner, but was remarkably generous in sharing his knowledge and involving others in his high profile research.

Ötzi is one of the greatest archaeological discoveries of the 20th century in part because his preservation is about as good as it gets. Archaeological, forensic, genetic and other molecular techniques are being pushed to the limit. But well-preserved mummies are found in the Peruvian Andes, the Egyptian pyramids, the bogs in the UK and Europe.

What makes Ötzi special? His antiquity is part of it; he was buried for longer than the others. And the fact that his belongings were not arranged artificially (as in a ritualised burial) provides us with a unique glimpse into everyday Neolithic life. Or does it? The mystery surrounding his death adds an extra dimension.

New evidence was previewed on video in 2003, and was fresh out of Tom's lab where he had analysed DNA preserved in blood films found on Ötzi's leather tunic, knife blade and one of the two arrows. Tom isolated the DNA fingerprints of four human individuals, and one of the individuals indicated was probably responsible for Ötzi's death. Another of the DNA profiles probably belonged to Ötzi. An unhealed stab wound in his right hand suggested he may have put up a fight, and study of blood pooling indicates he was moved before he died. Was he attacked by a gang? He was shot in the back with an arrow, but the shaft had been removed, so someone might have helped him. Who was with him? Why were valuable items of equipment like a copper axe not taken but left with him? Tom systematically traced the possibilities, like a crime scene investigator with new insights into motives and the likely sequence of events leading to Ötzi's death.

We need stories like these, not just because they appeal to the public but also because they help set up new hypotheses. The stories feed back to hard science; the scientific hypotheses that lead us to more detail; filling in the gaps about the life and times of Ötzi. This is important. We should get the facts right. And many of the papers at this conference show us the expanding array of current and new scientific approaches. I should also mention in this context that Tom Loy undertook the initial scans of the Kuk Swamp stone artefacts that revealed the first early evidence of starchy plant exploitation in the Papua New Guinea Highlands. I know this because I examined them with him at the ANU. We found remarkable preservation of starch, and it is these initial findings that led to further work at the Australian Museum and the University of Sydney confirming evidence for processing *Colocasia* taro and *Disocorea* yams in the Highlands of New Guinea 10,000 years ago.

Finally, apart to some extent from the stones, stories and the hard science, I want to mention some aspects of theory, and the role of Tom's lab. I would like to reinforce a new direction of stone artefact studies in Australia. Part of this new direction is drawing together a relatively new range of specialist studies like refitting or conjoining, reduction sequences, microwear and technological indicators of risk, a range of research in which the University of Queensland continues to play a key role, building on Tom's foundations.

Of course stone artefacts don't speak for themselves, but we are learning snippets of the conversation in large part because of the context. Stone artefacts as agents no doubt have an impact on human behaviour. Beautiful Kimberley points were extensively traded among Aboriginal groups in northwestern Australia and were emblems of social identity, craftsmanship and prestige. I am not sure that you would call the huge blocks that make up Stonehenge 'stone artefacts' in the normal sense of the term, but certainly the massive stone quarries and huge stone lithic scatters that mark the Australian landscape, are made of stone artefacts, and they must have signalled information of various kinds to Aboriginal people, including highly visible indicators of potential stone sources and locations of settlement. But these are like the beginning and end points in long lives of stone tools – long before the archaeologist picks them up. In between, are complex life histories that we are only beginning to understand. Several studies now, notably by Peter Hiscock (formerly UQ, now ANU) and Chris Clarkson (UQ) in Australia and Robin Torrence (Australian Museum) in Papua New Guinea, show how subtle changes in technological behavior, how and where stone artefacts are made, may be linked with other aspects of subsistence, resource use, settlement history and responses to risk. At different times, in

some places, unretouched flakes are used for tasks in preference to standardised backed microliths that are used in other contexts. The need for tools at certain times and places means that particular materials and tool forms were preferred. At least this is an argument built on theoretical models of behaviour and detailed studies of flakes and cores.

After so many advances in our understanding of lithic technology, use-wear, residues and molecular biology, we are in a position to move well beyond compiling what George Odell called the laundry list of stone tool functions, by which he meant that usewear analysts 'analyse' the artefacts essentially by providing a list of what they were used for. We know that artefact forms were used for many tasks; for example, so-called 'points' are not always used as spear tips, they might be wood scrapers; so we have to look at what each artefact was used for in each assemblage to get an idea of what tasks were undertaken. Even so, there are some problematic assumptions in this approach. For example, it is usually implicit in this approach that all the artefacts were used at about the same time, yet we know this is not always true. The sequence of use is also important, as cores and flakes are frequently further sharpened and reduced. If we take away, or decouple, finished artefact form and function, can they be re-coupled in terms of reduction sequences? How do we link manufacturing and reduction stages with function? Can we ever only find out about tool function at the point of discard?

I suggest we need to rethink how artefact assemblages are sampled for functional studies. It would be extremely useful to sample assemblages with indicators of technological change to test whether they correlate with shifts in resource use or task composition. Does a technological shift in response to risk (say more backed microliths) correspond to different maintenance tasks? Of special significance will be usewear and residues on small flakes that have been broken from tool edges or the tiny retouch fragments from edge sharpening, rather than the discarded implement itself. It is on the platforms and dorsal surfaces of these sharpening flakes, only several millimetres in size, that we might expect to see records of tool use during earlier stages of reduction. Will sequences of use in tool life histories be the same at different times and places? What would we predict for different hominin species like Neanderthals and hobbits (*Homo floresiensis*)? This of course moves into theories of what constitutes modern human behaviour and warrants theories about particular kinds of activities, task performance and diagnostic archaeological indicators of past behaviours.

This is only one small aspect of archaeological science and theory to be explored in these papers, and I would like to finish by acknowledging how well Tom's lab, his students and colleagues are positioned to make advances in understanding stones, relating the stories, and further developing the science and the theory.

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