Mount Gabriel and metal sourcing in the Bronze Age

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Introduction

The past 15 years have seen considerable interest devoted to the study of Bronze Age copper mining in both Britain and Ireland. Field survey and excavation over this period have led to the discovery of many important early mine centres, most notably Ross Island in Ireland, the Great Orme, Parys Mountain and Cwmystwth in Wales and most probably Alderly Edge in England (see Craddock 1994). The discovery of these early copper mines adds significantly to our knowledge of Bronze Age metallurgy and reveals how early miners were able to exploit a range of copper mineral occurrences in different geological settings. While many early mines were located on rich concentrated deposits of mineralisation, others exploited mineral occurrences which in terms of grade and tonnage would not qualify as 'ore' in modern times. This ability to adapt to different geological environments and mineral occurrences was an important factor in the successful development of copper metallurgy in these islands.

Mount Gabriel

This mountain in the Mizen peninsula of south-west Ireland was the first prehistoric copper mine to be identified in this part of Europe. Following an early radiocarbon result (Jackson 1968), the Bronze Age date of these workings was established by a programme of archaeological investigation between 1982-87. This work, combining detailed field survey and excavation with specialist contributions from geology and other disciplines, was subsequently published by the author as a monograph report (O'Brien 1994). In a review, Peter Crew (1994) questioned the status of this Bronze Age 'mining' and specifically asked whether we should view these workings as productive operations when they might in fact represent trials which failed to find suitable 'ore'. Given the prominence of Mount Gabriel in published literature on Bronze Age copper mining, it is necessary to briefly address this question and to consider the implications for how we view metal 'resources' in antiquity.

A feature of the mine workings on Mount Gabriel and at nine other locations in south-west Ireland is the low-grade, disseminated nature of the sedimentary copper-bed mineralisation with which they are associated. Our investigations on Mount Gabriel, assisted by the mineralogist Robert Ixer of Birmingham University, found it difficult to ascertain the exact concentration and mineralogy of ore extracted by the Bronze Age miners. This is a sampling problem relating to the residual nature of the ancient spoil record left behind from the extractive process and one which is not unique to Mount Gabriel. Despite these sampling difficulties, Ixer was able to characterise this copper occurrence fully in terms of its mineralogy and chemistry (O'Brien 1994, appendix 1). Snodin's (1972) study of this mineralisation in its broader regional setting provides further detail which can be added to the analyses on Mount Gabriel to provide a good indication of the copper 'ore' extracted by the miners.

In the Mount Gabriel publication, we argue that the miners were able to extract small quantities of secondary copper mineralisation (principally malachite) with minor sulphide by careful hand-cobbing using stone hammers and anvil slabs (p.175-7). The grade of copper mineral present at outcrop during the mining phase was typically 1-6%, a figure based not on a 'guess' as stated by Crew but on quantitative analyses from Mount Gabriel itself and from Snodin's regional study of this mineralisation type (summarised in O'Brien 1994, section 3.2; also p.173). Ore beneficiation on Mount Gabriel is marked by efficient removal of all visible mineralisation along clearly defined lithological controls. With an obvious empirical understanding of the geological environment, the overall picture is one of great economy of rock extraction and careful recovery of mineral disseminations. This explains the paucity of mineralisation evident both at mine outcrop today and in the spoil residues adjacent to these mine workings.

Crew disagrees with this interpretation stating that I ignored Ixer's 'acknowledgement' in his specialist report that the mining evidence here may represent '... exhaustive and extensive trials which failed to find suitable ore' (p.261-3). Crew concludes that this raises what he terms a 'fundamental uncertainty' about the status of these mines and invites comparisons with some of the less successful copper and gold enterprises of the 18th and 19th centuries.

In his treatment of the Mount Gabriel mineralisation, Robert Ixer did indeed raise the possibility of these mines

as failed trials, before immediately dismissing this possibility. Contrary to what Crew states, this idea was also considered in the main text (p.173) and rejected on the basis of the scale and character of the archaeological record on this mountain today and the long duration of mining. Radiocarbon results confirm that the mining activity on Mount Gabriel, beginning sometime around 1700 BC, spanned '... at least two centuries' (Brindley and Lanting in O'Brien 1994, 287), though it was probably not continuous over this time. The scale and commitment to mining in this period is impressive with 32 known workings spread across a mountain environment where extensive peat growth almost certainly masks many more mine sites. Total rock extraction from known workings is estimated at 3924 tonnes of hard sandstone rock (p.196), laboriously mined using a combination of fire-setting and stone hammers. The consumption of wood fuel for the former is estimated at between 3924-14533 tonnes depending on which experimental parameters one accepts (p.168), while the number of stone cobbles brought to the mountain from a distance of 4km away is conservatively estimated at around thirty thousand.

In addition to the scale of mining, we must also consider the character of the archaeological record left behind by the miners. In the Mount Gabriel publication, it is acknowledged that some of these workings may indeed be classed as 'trials', where individual mining efforts met with varying degrees of 'success' (p.60-1). This reflects the limited strike and depth continuity of the mineralisation, however even very shallow drivings may have provided some quantity of copper mineral. Some were sufficiently productive to warrant mining to depths of 10-15 metres over a period lasting from six months to one year, or probably longer in the case of mines 9 and 10. Such a time and energy commitment would have been beyond the resources of the small population group(s) involved in this mining had not they made some significant return in finished metal. What we see in the Mount Gabriel-type mining is a dedicated search for small amounts of copper mineral which could be retrieved from copper-bed exposures, leading in time to a proliferation of surface workings across a landscape instead of one major mine locus.

At each location we can point to the highly comminuted nature of the mineralised rock residues as further evidence that the miners did succeed in this search. Away from the main spoil deposits, the discovery of spreads of finely crushed, mineralised rock associated with stone hammers and the use of anvils slabs as hand-cobbing surfaces is totally consistent with the extraction of copper minerals. These activity areas would not have been necessary if the mine extract was totally barren, something which would have been readily apparent to the miners as they sorted fire-set rock fragments outside the mine entrances where the main spoil dumps occur. The absence of smelting evidence is not relevant to this discussion as slags, furnaces and other such indicators of metallurgical processes have not been discovered in other Bronze Age copper mines in Britain and Ireland, with the notable exception of Ross Island.

Further evidence of the productivity of the Mount Gabriel mines is provided by the manner in which workings are distributed across these mountain slopes. This is suggestive of a clear prospecting sequence and a 'pitting' approach to the extraction of surface mineralisation along the strike outcrop of the host sandstone beds. The marked clustering of mine workings at different stratigraphic levels on the mountain also supports the notion of a slow, but steady return of copper minerals. Why would miners begin working within metres of 10m deep drivings which had previously failed to produce any copper mineralisation after many months or more of effort?

In summary, are we expected to believe that miners continued to work on Mount Gabriel over two centuries or possibly more, extracting probably in excess of 4000 tonnes of hard rock from an estimated 32-50 separate workings, using several thousand tonnes of wood and tens of thousands of stone hammers - and all for nothing? These same miners or their kin groups then repeated this exercise in the same period at nine other locations where Mount Gabriel-type mines have been found in peninsular County Cork (ibid, fig 3), thus continuing the fruitless search for metal. Disallowing some bizarre ritual practice, this scenario is scarcely credible in a region which first saw copper mining successfully developed half a millennium earlier, as witnessed by the recent Ross Island discoveries (O'Brien 1995).

On the scale of mining, it must also be pointed out that the original number of Mount Gabriel-type workings in this area probably far exceeds the ten sites known today. This copper-bed mineralisation is concentrated along the rocky shoreline of the Mizen peninsula (O'Brien 1994, fig 16) where erosion and sea-level change have probably removed numerous Bronze Age workings. In addition, I have no doubt that many sites remain to be discovered in the hilly inland terrain of these peninsulas where blanket bog growth has a significant masking effect on their exposure. Add to this the destruction caused to primitive copper workings by the 19th-century mining industry and it is possible to see these copperbed workings *collectively* as a significant mining initiative in Bronze Age times.

Crew's interpretation of the Mount Gabriel record bears comparison to the suggestion some years ago that these mines were failed ventures of mid-19th century date worked by '... impoverished Irish peasants under the indirect control of overendowed Victorians of leisure'

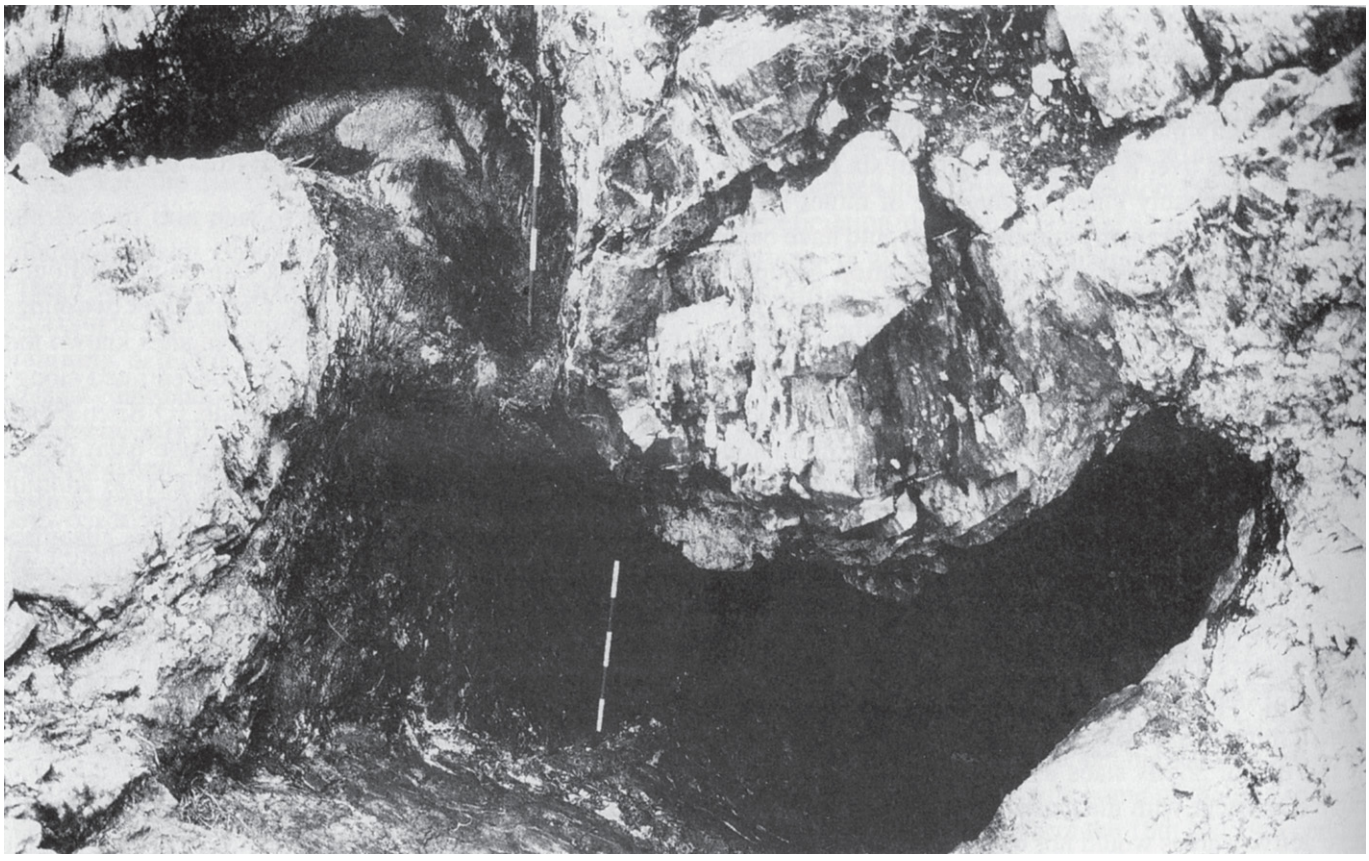
(Briggs 1983, 71). Also relevant here are the inflated production estimates produced by Jackson (1980), at a time when this mountain was the only early mine known in these islands and thus charged with meeting almost all Bronze Age copper needs! With recent research, it is now possible to revise the production figures for Mount Gabriel and emphasise the role these copper-bed sources played in meeting local and regional metal needs. The revised estimates for Mount Gabriel are in keeping with the low grade occurrence of this copper mineralisation. Depending on the parameters taken, a number of which are highly speculative, total metal output from this mountain over a 200 year period is estimated at between 1.47 and 29.43 tonnes, with my own preference definitely towards the lower end of this scale (ibid, table 12).

In this light, annual 'production' on Mount Gabriel should be viewed in kilograms and not tonnes, possibly enough copper to produce in the order of 40-50 bronze axe heads a year (p.197). This scale of production is enough to meet local and some regional utilitarian needs, as well as produce a limited number of prestige objects, specifically decorated axe heads of the Toormore type. The latter may have achieved a wider inter-regional circulation through different exchange mechanisms, not necessarily as part of an organised metal 'trade', though the need to procure tin from Cornwall and other sources makes long-distance metal supply unavoidable here.

Conclusions

This discussion raises some pertinent points concerning our perception of what constituted 'ore' and 'resource' in prehistory. Clearly some have difficulty accepting the Mount Gabriel-type mining as 'successful' and would invite comparisons with failed ventures of the Industrial Revolution. This thinking is symptomatic of a particular approach to early metallurgy, one which is heavily influenced by modern industrial perspectives and notions of 'profit' and 'loss', none of which are appropriate to the study of Bronze Age mining and metallurgy. In reacting against excessive claims for Bronze Age copper mines and their role in inter-regional exchange, we must be careful not to deny their important local contribution to societies at different stages of development, whose 'need' for metal must be interpreted in social as well as utilitarian terms.

The Mount Gabriel-type mines represent a particular approach to sourcing metal in the Bronze Age. The majority of known Bronze Age mines in Britain and



Bronze Age copper mining on Mount Gabriel, Co. Cork: an 11m deep working on sedimentary mineralisation radiocarbon dated to 1700-1600BC.

Ireland are to be found on site-specific deposits of concentrated mineralisation, centres like Ross Island or the Great Orme where miners made a considerable time-energy commitment over long periods. In the Mount Gabriel-type mining, we are presented with a different approach where metal needs can be met by short-term commitments to mining across an entire landscape. The reasons why this dispersed landscape approach was adopted remain the subject of continuing research, but must be rooted in the social context of this mining, the perceived 'need' for metal and the ability to mobilise resources to obtain it.

In Chapter 8 of the Mount Gabriel publication, I explore the wider context of this copper mining by examining the contemporary megalithic monuments and the insight they offer into the organisation of these early metal-using population groups. Our discovery of a bronze axe and fragments of raw copper outside the entrance to a megalithic tomb close to and contemporary with the commencement of mining on Mount Gabriel is outlined. This votive deposit and others like it emphasise the value which these people placed on copper at this particular stage of the Bronze Age. Put simply, for the Mount Gabriel miners copper had the same value we place on gold today and so their efforts should not be interpreted in terms more appropriate to modern capitalist economy.

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