Unfinished brass "shells" from the River Avon, Bath.

Fig. 1 An upturned set of three damaged bowls (18cm dia.) hammered together, as sometimes described in battery mill literature. These were recovered from the River Avon, down river of the Weston, Bath brass-mill site by Mr R Macy, formerly a river board man.

A section was cut near a broken edge and mounted and polished in the usual way. When viewed after polishing and before etching it showed a large number of smaller cracks and some signs of the 2% lead (small black spots) (Fig. 2). Etching in ferric chloride showed the expected worked and annealed structure with bent twins and some slip bands near the surface. The hardness is only 112 HVI which indicates that it is not in a highly worked state. The grain size is large which shows that it had been worked only slightly before the last anneal, or had been annealed at too high a temperature. The metal is very clean, showing no signs of the sort of slag one finds in brass pins. The iron content must be low and the fact that it is not magnetic show that it must be less than 1%. I would put it much lower than this. (Craddock gives 0.06%).

If the zinc content is 30% then it is not in a highly cold-worked state which would have a hardness of at least 145 HV after only 30% reduction. Therefore, it is clear that cracking was not caused by overworking. There remain three other possibilities: fire-cracking, stress-corrosion cracking, or cracking in the river due to oxide penetration along grain boundaries. This latter is often Called

"jacking" and is due to the stresses caused by the volume increase of the metal under corrosion (Cu to Cu_2O etc.). Fire-cracking occurs when coldworked brass is heated too rapidly annealing so that thermal stresses are imposed on those already present due to cold work; this is favoured by impurities such as lead.

In stress corrosion cracking the two most likely chemicals are ammonia from the stables and moist sulphur dioxide from the annealing furnaces. Before one can judge which is the most likely of the three possibilities one would like to know if there is any historical record which shows how common this sort of failure was. It would have occurred after cold working, before, or during annealing. Where were the shells left while they were waiting to be annealed?

I think that fire-cracking is the most likely explanation and will account best for the thick film down the crack shown in Fig. 2.

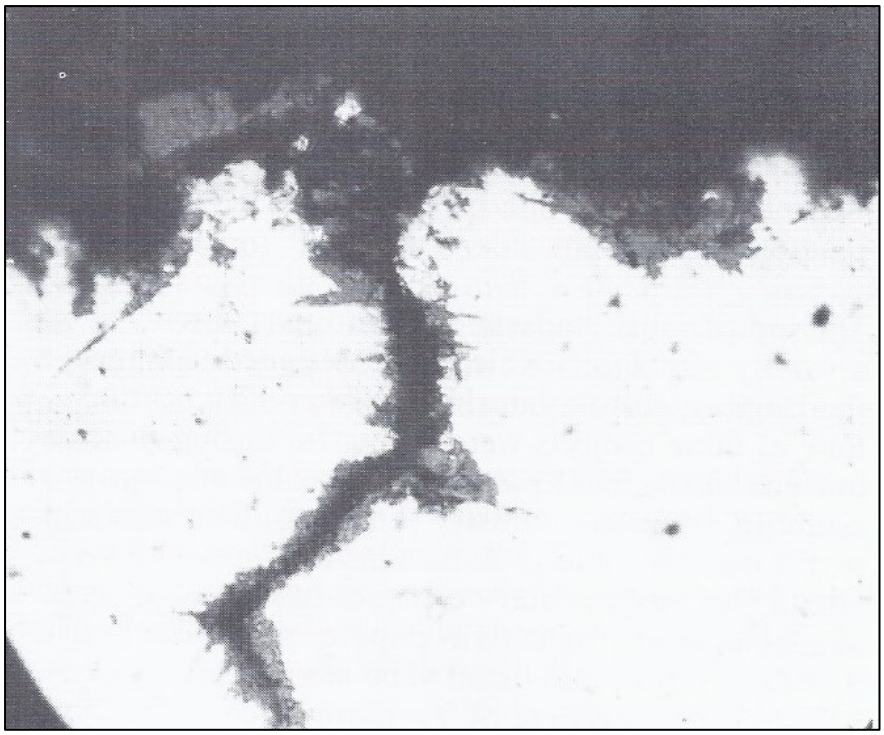

Fig. 2 Fire-crack in brass bowl (unetched) x 400.

R F Tylecote

1988

Reference

Bailey A R. The stress cracking of brass. Metallurgical Reviews, 1961, 6, 104-08.