Silver plating technology of the late 3rd century Roman coinage
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ABSTRACT: The discovery in 1998 of a late third century AD coin hoard at Rogiet (Monmouthshire) provided the opportunity for a technical study of the plating of the later Roman silver coinage which carried a very thin silver wash over a copper core. Optical metallography and scanning electron microscopy were carried out on taper sections on eight coins. Their plating was rarely thicker than 1-2 μm and often too thin to be visible in cross section. There was no eutectic layer or diffusion zone at the interface between plating and core. The plating penetrated into cracks and crevices of the copper. It was not connected to the small amounts of silver phase within the copper core. From a comparison of these results with replication specimens it was concluded that the plating was applied in the form of a silvering paste, possibly based on silver chloride. Hot-dipping into molten silver chloride proved to be impractical in the replication experiments and was ruled out. No mercury was detected on any of the coins with EDX analysis in the electron microscope.

Introduction
Manufacturing techniques of plated Roman silver coins have been the subject of technical studies since the 1930s (Darmstaedter 1929, Campbell 1933). More recently a number of authors discussed Roman coin plating techniques on the basis of metallographic and scanning electron microscopic evidence (Cope 1972, Kalsch and Zwicker 1986, La Niece 1993a, Zwicker et al. 1993, Anheuser and Northover 1994, Anheuser 1998). Most of these papers focused on republican and early imperial denarii, periods in which the genuine coinage maintained a consistently high silver standard. Plated imitations were normally coated with thick silver foil strong enough to withstand considerable wear and convincingly emulate the look of solid silver. In the later Roman empire the silver standard of the Roman coinage declined sharply and during the mid 3rd century AD reached a point when even official issues were merely copper coins which carried a token silver coating so thin that it would have worn off rapidly in exposed areas of the surface and could certainly not long have been mistaken for genuine solid silver. These 3rd-century radiates were mass produced in very large numbers (millions). Their plating technique was first discussed in detail by Cope (1972, 275) who postulated a silver surface enrichment technique related to the cupellation process which required lead as an additional constituent, or alternatively hot-dipping into molten silver chloride, although he did not present any metallurgical evidence for the use of either option. Whilst our knowledge of Roman republican and early imperial coin plating techniques is detailed and appears well founded, the later Roman issues have so far been neglected. Unlike the investigation of the earlier Roman plated coins, no technical studies using modern analytical equipment have been carried out even 30 years after Cope’s work, and it is the aim of this study to contribute to filling this gap.

The discovery in September 1998 of a large coin hoard in the village of Rogiet (near Caldicot, Monmouthshire) (Besly 2001) offered an opportunity for a technical study of the plating technique of the later Roman silver coinage. This unique hoard, now kept in the National Museum and Gallery of Wales, Cardiff, consisted of more than 3,750 Roman coins of the late 3rd century, covering a period of 40 years and the issues of 22 emperors from a number of different mints. It was ideally suited to provide the necessary material for investigation.