Close plating: A Black Country silver plating process

Reg Morton and Michael Hallett

This paper is mainly the result of work done by Reg Morton and his colleagues and was given to Michael Hallett for completion upon his death. Michael had hoped to do more work on the process which was widely used in the Walsall area but unfortunately died before this could be done (Hon Ed).

In one process of close plating, the object to be plated, usually a copper-base alloy, was heated and tinned all over. While the tin was still molten pieces of sheet silver were wrapped around it and gently peened into place. A large part of the skill was the cutting of the sheet into pieces that would exactly fit against each other when wrapped around a curved and sometimes ornate object. The main advantage was that a much thicker silver plating could be applied than by electro-plating. The process was especially popular for carriage fittings and for coffin furniture. There was another process which we cannot recollect but which was carried out at a lower temperature than the one discussed here.

The process has been described in Lardner's Cabinet Cyclopaedia of 1833, an excerpt from which is given in the Appendix. The work investigated here was supplied by J Cotterell and Sons Ltd, of Littleton St, Walsall, Staffs. The firm is an old established manufactory of horse furniture and the samples were of 19th century manufacture. The process is no longer used by the company.

The base metal upon which the silver is deposited includes iron (both cast and wrought), and a range of nickel silvers. One ring made from a ferrous metal 4.8mm diameter and 4.76cm overall diameter was subjected to metallurgical examination. A section across the ring was also analysed by electron probe methods.

Two sections, one at right angles to the ring, and a bevelled region along the curvature of the ring were examined by microscopy. (Fig. 1a and 1b).

The only two elements in the iron sought by electron probe analysis were Mn and S. Manganese was mainly present in the form of MnS inclusions and to only a small amount in the iron itself. The inclusions ranged up to a size o 5 micron and were distributed in the iron to the extent of about 120 per square mm (see Fig. 2. The photomicrographs (Fig 1b and 1c) show their position and size at a magnification of x 200. The inclusions contained a maximum of 24% Mn and approximately 12% S. The Mn content away from the inclusions was only 0.35% — no sulphide being detected in this region.

The core was surrounded by a layer 0.13mm thick, on

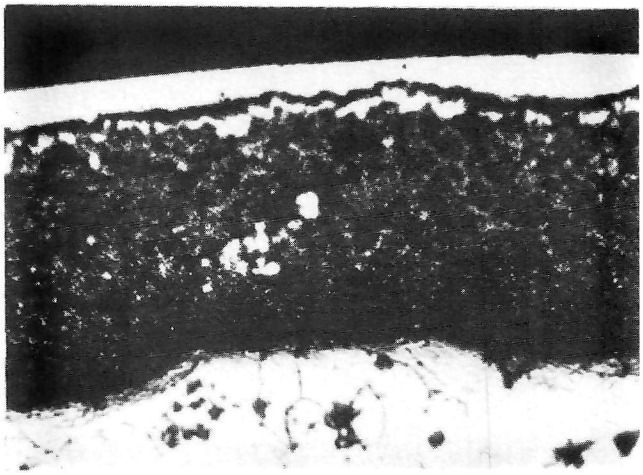


Fig. 1 (a) Silver plated layer (top) on lead-tin solder (dark) X 200

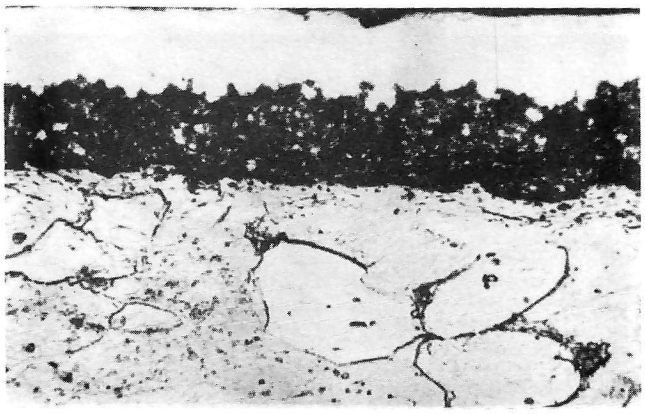


Fig. 1 (b) Silver plated layer on solder with ferrite iron core underneath. X 200

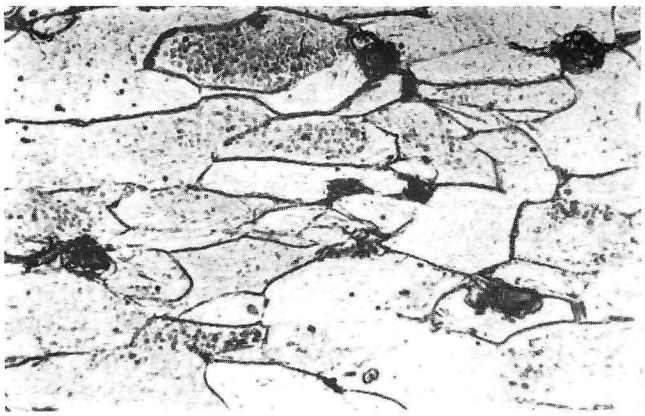
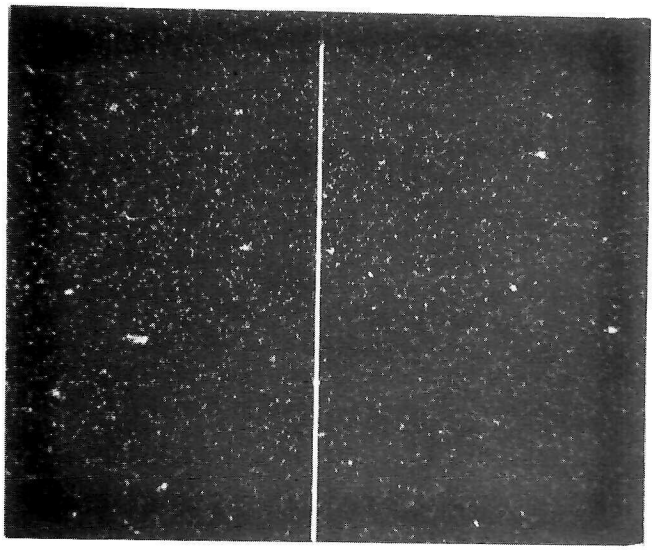
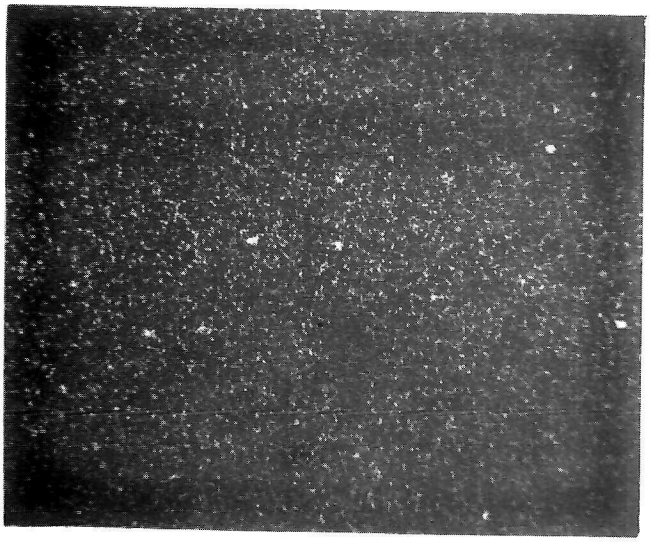


Fig. 1 (c) Ferritic iron core showing manganese sulphide inclusions. X 200

average, of a lead-tin alloy containing 55% Pb and 45% Sn by volume. This layer was very heterogeneous and showed a cored structure as indicated by the tin and lead X-ray images. (Fig 3 x350). Around this layer was a layer of Ag about 0.03mm thick. At the intersection of the two layers diffusion of tin has taken place to an average depth of 0.01mm into the silver, the zone containing a maximum of 25% Sn. The changes in composition of the elements, Fe, Sn, Pb and Ag are



Manganese

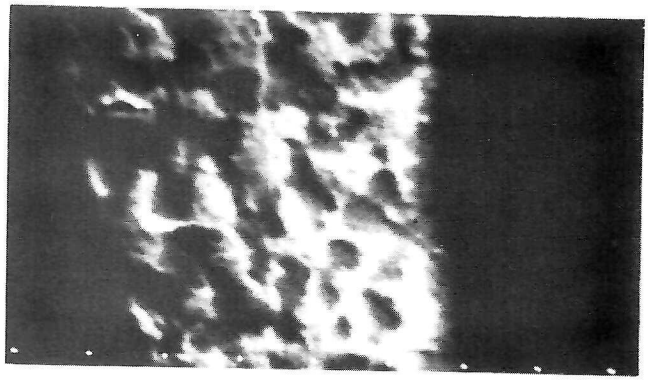


Sulphur

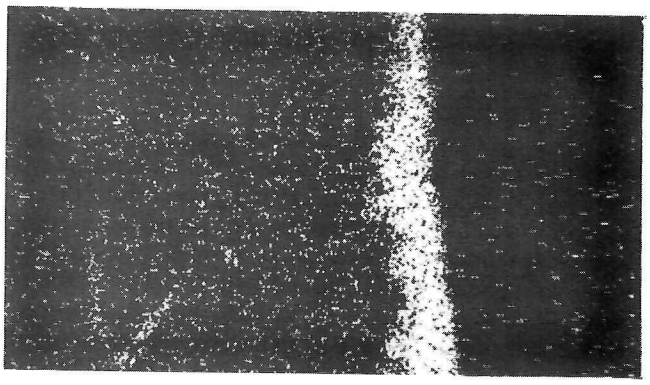
Fig. 2. X-ray pictures of iron core for manganese and sulphur. X 200

shown in the diagram. (Fig 4). These are not corrected values although a general picture may be seen from the super-imposed traces. From these can be seen the extent of the Sn/Pb heterogeneity, with a small amount of tin being in solution in the silver but not vice-versa.

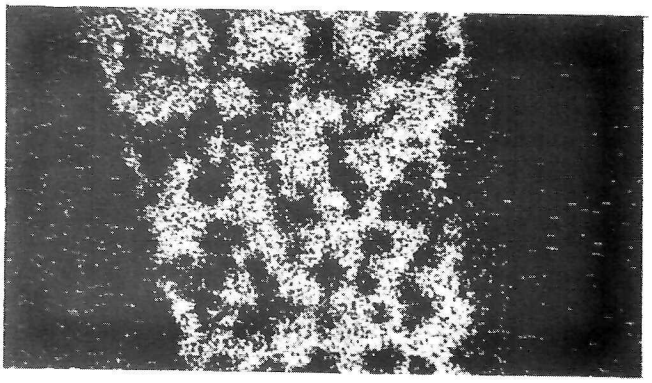
The producers of this type of ware could afford to use labour which was cheap to save expensive silver which was only 0.03mm thick. The Pb-Sn layer acted like a



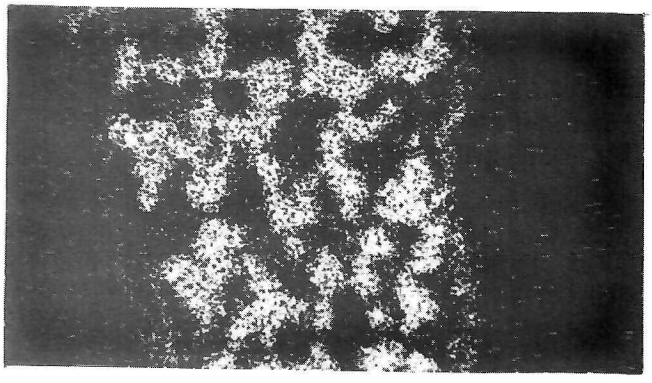
Electron image



Silver x-rays



Lead x-rays



Tin x-rays

Fig. 3. Pictures of coating on iron rod. X 350

cushion and a filler between the very thin silver layer and the iron core. [Morton refers to the iron as being "malleable cast iron". From the structure shown in Fig 1, this seems very unlikely. The metal would seem more like a modern low-carbon free-cutting mild steel with the intentional addition of MnS. (Ed)].

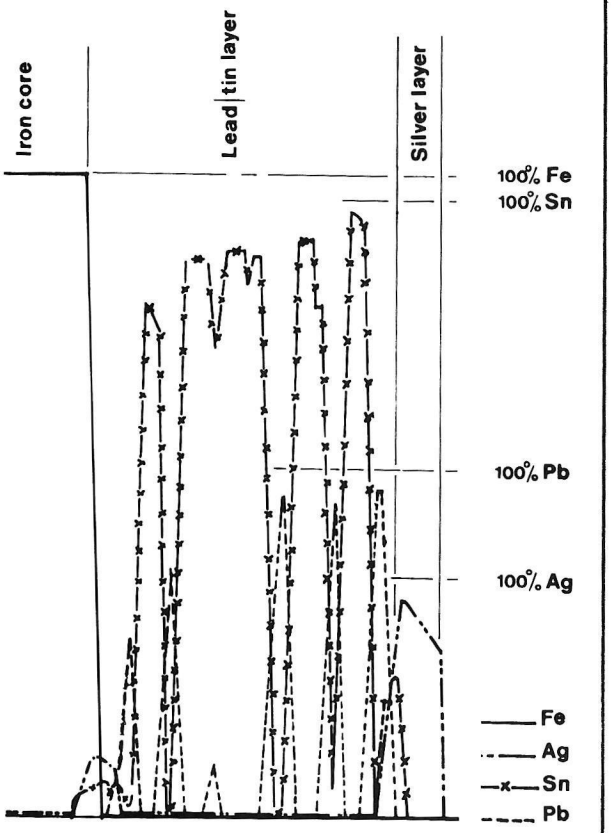


Fig. 4. Trace across from iron core through layers of tin, lead and silver

Acknowledgements

The electron probe analysis was done in the Metallurgy Dept of the University of Aston to whom we are grateful.

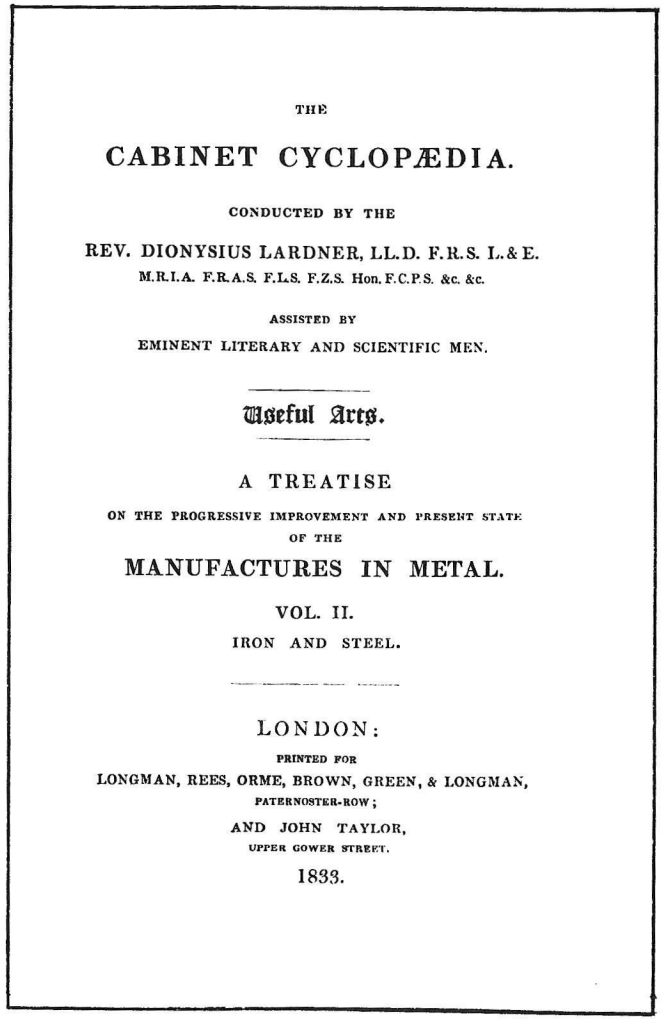
Appendix

SADDLER'S IRONMONGERY
From The Cabinet Cyclopaedia, conducted by the Rev. Dionysius Lardner, LLD, FRS, L & E, MRIA, FRAS,

Page 313:

The manufacture of all the metallic parts of horse furniture was carried on at an early period in London, by artisans, incorporated under the denomination of loriners and spurriers. In more modern times, however, saddlers' ironmongery of every sort has formed a large part of the staple trades of Birmingham, Walsall, Wolverhampton, Wednesday and places adjacent; where, for cheapness in the common, and perfection in the best articles, the workmen are at present unrivalled.

Curb chains and branches, as well as the various



THE

CABINET CYCLOPÆDIA.

CONDUCTED BY THE

REV. DIONYSIUS LARDNER, LL.D. F.R.S. L. & E.
M.R.I.A. F.R.A.S. F.L.S. F.Z.S. Hon. F.C.P.S. &c. &c.

ASSISTED BY

EMINENT LITERARY AND SCIENTIFIC MEN.

Useful Arts.

A TREATISE

ON THE PROGRESSIVE IMPROVEMENT AND PRESENT STATE OF THE

MANUFACTURES IN METAL.

VOL. II.

IRON AND STEEL.

LONDON:

PRINTED FOR

LONGMAN, REES, ORME, BROWN, GREEN, & LONGMAN,
PATERNOSTER-ROW;

AND JOHN TAYLOR,
UPPER GOWER STREET.

1833.

metallic articles belonging to coach and other harness, are made of iron or steel, japanned, tinned, burnished or plated with brass or silver, and in some cases still more expensively ornamented at the option of the makers and purchasers. The ordinary bright articles of this class ought to be forged out of good iron, and afterwards case-hardened. When the material has been first rudely fashioned on the anvil by the hammer, it is then brought into its final shape by filing. Vast quantities are cast in sand moulds, with that kind of run steel which is so largely used in the production of common table-knives and forks. As articles cast from the best sorts of native iron admit of being annealed so as to unite a considerable degree of elasticity and tenacity of body with a good polish, many pieces of the metal work used by the harness maker may without danger be so manufactured. But as in dealing with a spirited horse, either in harness or when mounted, the lives of individuals so frequently become dependent on the stability of the metallic parts of the reins or other trappings, it is certainly a matter of serious

consideration, not only to know that good materials but good workmanship characterise such articles.

In the present day, not only spurs, bridle bits, and horse furniture in general, as before stated, but likewise a great number of other articles, are plated with silver upon steel, thus adding to the strength of the solid material the beauty of the precious metal with which it is covered. In the best workmanship, the article, after being filed clean and smooth, is wrapped all over with a fillet of sheet silver, which is fastened with small wire: after which, borax ground with water is laid upon the surface and sprinkled with silver solder; it is then heated red hot, so as to braze the silver to the iron. The surface is then filed smooth, burnished, and otherwise got up as silver. More commonly, however, the metallic parts of harness, and a vast variety of other wares, are covered with silver by soft soldering. The process of plating articles of this description is as follows:- The piece is, in the first place, filed all over the surface, so as to be perfectly clean and bright; it is then tinned in the usual manner, by dipping in a vessel of melted tin, and wiped over with hurds, so that no more than a very slight coating may remain. A foil of silver, beaten very thin, is then cut off the size of the article, and folded upon it as perfectly and closely as possible. In the flat parts it is beaten close with a small hammer, covered with cloth; while, upon the mouldings and in hollows, the foil is rubbed down with a sort of wooden burnisher. When the silver film has been properly closed upon the steel, in every part, so as to adhere, as it will do from contact, a heated doctor, or soldering bit, very similar to that used by the tin-plate workers, is passed over every part of the surface, by which operation the tin and silver are united, and the pellicle of precious metal adheres to the body of the article with considerable tenacity.

To make the attachment still more perfect, the surface is now sprinkled over with powdered rosin, and heated over a charcoal or clear coke fire, gently urged by the bellows, the article being frequently withdrawn and dipped into powdered rosin, in order to flux the tin. A piece of rod solder is next applied freely upon the surface; so that, by repeatedly re-heating, the greatest certainty of its being secured is attained. When the latter object is believed to have been gained, the article is withdrawn from the heat and carefully wiped over with the hurds and oil, in order to remove as much as possible the tin and solder from the surface, which is still more completely effected by buffing the surface with fine sand.

When the shape of the article permits, it is then furbished all over with a dead smooth file, and afterwards rubbed with a Charley forest-stone of a peculiar grain. It is next got up by the application of a stick covered with soft leather and dressed with burnt rotten stone and oil, and, finally, finished, or "coloured", on a buff of buck-skin with fine dry sifted rotten-stone.