http://dx.doi.org/10.1595/147106712X655230 •*Platinum Metals Rev.*, 2012, **56**, (4), 284–286•

FINAL ANALYSIS

Challenges and Opportunities in Palladium: The Claret Jug Experience at the Santa Fe Symposium

In 2009, jeweller Martyn Pugh was commissioned to craft a claret jug from pure palladium, thought to be the largest decorative object ever made from this metal – in fact there are two jugs, one in metal and one with a glass section (**Figure 1**) (1). This commission, one of a set intended to be hand crafted in four different precious metals, was a unique challenge that gave rise to a number of considerations, not least of which was the requirement to exactly match the previous pairs of jugs, one in silver and glass and the other in hard 24 carat gold (2). In addition the chance to work in palladium at such a scale (the finished height of the jugs would be 360 mm) presented challenges, and opportunities, of its own. Chris Corti was at the Santa Fe Symposium where the work was unveiled, also reviewed in this issue of *Platinum Metals Review* (3), and here he discusses Pugh's fascinating work on the pure palladium jug in more detail.

Fig. 1. The finished pair of palladium jugs made by Martyn Pugh

Established Techniques

The first point was to establish what techniques used for the gold jug could be transferred to palladium. The craftsman, expert in metal spinning and who had made the body of the gold jug, was approached; he had concerns that the malleability of palladium was insufficient to spin the body from a flat disc. Pugh turned to Johnson Matthey, whose Noble Metals business had experience of manufacturing large items for industrial and scientific applications. The jug body was a more complex, larger shape than they were used to producing. However, they accepted the challenge. The Johnson Matthey metal spinner was confident he could produce the shape required. To undertake the spinning, Johnson Matthey utilised existing formers, mostly in brass, but also had to make some new ones which were made in steel for the stopper, spout and foot sections of the jug (**Figure 2**). The Johnson Matthey spinner undertook trial spinnings in 99.9% pure palladium using several shapes of former to hone his skills and Pugh's drawings were translated into computer aided design (CAD) files. The body was spun in three sections – neck, shoulder and lower section – from cone shaped blanks (rather than flat discs) which were hand forged to lock the cones onto the former for spinning. After the odd mishap, all three sections were successfully spun and then tungsten inert gas (TIG) welded together.

A Fruitful Collaboration

From that point, Pugh was able to proceed with completion of the jug. This involved dressing the

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Fig. 2. Formers for spinning parts of the palladium jug, in brass and steel

seams from TIG welding, shaping the spout and soldering the various components together with a range of solders. The edges of the spinnings were left slightly raised to facilitate TIG welding. A lot of palladium filler was used in the weld to prevent any porosity. This provided functionally good welds but they were unattractive; the inside of the jug body was dressed using a custom-made stake – a 25 mm rod with a polished upturned end. The external seams were dressed with a planishing hammer.

Pugh devised a jug-specific table of soldering joints which detailed each fabrication stage and analysed the solders required. Each operation was grouped according to the proximity of heat-affected zones. The various sections required three to five soldering operations each. The solders used, with their melting temperatures, were: Platinum Easy (1060ºC), Palladium Hard (950ºC), Palladium Medium (940ºC), Pallabraze™ 810 (810ºC) and 18 carat White Gold Easy (740ºC). These provided the range of melting temperatures needed and the analysis ensured that all soldering operations were accomplished without accidental omission of a joint. Solders were generally used as 'stick' solders, i.e. several wires twisted together, fused and forged or thin strips cut from sheet and fused together. The colour of the solder was also important where the soldered seam was visible. Laser tack welding was used in places where buckling or thermal movement was a risk and this was done at Birmingham City University by Ann-Marie Carey. Two fluxes were used to solder: Johnson Matthey Tenacity™ No. 125 Flux Powder and Johnson Matthey Tenacity™ No. 4A Flux Powder for the higher and lower temperatures, respectively.

The hollow handle was made from a tapered palladium sheet carefully bent over a former and this was not as simple a job as it appeared. An initial U-shape was made by hand-bending a tapered sheet over a steel former and then drawing it through a custom-made block. An issue here was that the palladium caught (galled) on the tool and as it snagged unevenly, this caused the material to rotate in the block and jam up. With a pause for breath, the tool was dismantled and the twisted and scratched palladium removed. Redrawing the piece through the block using graphite-containing oil lubrication enabled a satisfactory piece to be produced. This was then soldered to the back panel of the handle, using binding wire at both ends. The hollow D-shaped handle was filled with pitch before bending to shape in a wooden former; the pitch was then removed. The visible solder seam after assembling to the jug was engraved and filled with palladium by laser welding to disguise the original unsightly soldered seam.

The jug body was required to have a subtle matte textured finish. Some pre-finishing was carried out using a flick wheel to obtain a consistent texture; the texture was applied in stages. The internal surface of the spout was polished to a high degree using a series of grits and polishing media, ending with Brasso®, thus creating a contrast between exterior and interior.

Final Results

A problem emerged at a late stage when it was found that the palladium jug was not quite the same height as the gold jug. There was a difference of 3.2 mm! This was found to be due to inaccuracies in the gold jug's dimensions and Pugh had to solder some 3 mm palladium wire at the bottom of the palladium body to rectify the problem, so that the spouts of the two jugs were level when placed together. The culmination of this effort was a matching jug in palladium, shown in **Figure 1**.

This was a fruitful collaboration between Martyn Pugh and Johnson Matthey, and the technical expertise of both was necessary to achieve success.

Acknowledgements

Ann-Marie Carey (Birmingham Institute of Art and Design, Birmingham City University, UK) and Martyn Pugh (Martyn Pugh, Goldsmith and Silversmith, UK) are acknowledged for their assistance in preparing this item.

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References

1 A.-M. Carey and M. Pugh, 'Art and Scientific Manufacture: A Collaboration', in "The Santa Fe Symposium on Jewelry Manufacturing Technology 2012", ed. E. Bell, Proceedings of the 26th Santa Fe Symposium, Albuquerque, New Mexico, USA, 20th–23rd May, 2012, Met-Chem Research, 2012, Albuquerque, New Mexico, USA, 2012, pp. 69–101

2 A.-M. Carey, 'The Changing Demands on the Creative Process as a Consequence of New Technologies', in "The Santa Fe Symposium on Jewelry Manufacturing Technology 2010", ed. E. Bell, Proceedings of the 24th Santa Fe Symposium, Albuquerque, New Mexico, USA, 16th–19th May, 2010, Met-Chem Research Inc, Albuquerque, New Mexico, USA, 2010, pp. 101–118

3 C. Corti, *Platinum Metals Rev.*, 2012, **56**, (4), 242

The Author

Christopher Corti holds a PhD in Metallurgy from the University of Surrey (UK) and has recently retired from the World Gold Council after thirteen years, the last five as a consultant. During this period, he served as Editor of Gold Technology magazine, Gold Bulletin journal and the Goldsmith's Company Technical Bulletin. He continues to consult in the field of jewellery technology and as a recipient of the Santa Fe Symposium® Research, Technology and Ambassador Awards, he is a frequent presenter at the Santa Fe Symposium. From 1978–1988 he was a Research Manager at the Johnson Matthey Technology Centre, Sonning Common, UK, and from 1988–1992 he was Technical Director at Johnson Matthey's Colour and Print Division.

Martyn Pugh, Goldsmith and Silversmith

More of Martyn Pugh's designs and work in different precious metals, including gold, silver, platinum and palladium, can be seen on his website at: www.martynpugh.co.uk

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