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Front cover: Scottish silver ryal of Mary and Henry, Regular issue (not to scale); from dies A19/55, weight 468.3 grains. (See article "The Silver Ryals coinage of Mary, Queen of Scots")

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Unusual 1945 Y. Australian Halfpenny: a numismatic Rosetta Stone?

Paul M. Holland

Abstract

The origin of round raised dots on coins in seemingly random locations has long presented a mystery. This article employs detailed numismatic observations and technical analysis on a very unusual 1945 Y. halfpenny to address this issue. The coin itself exhibits more than twenty raised ring-like features ranging from about 0.1-0.5 mm in diameter on its reverse. Electrochemical considerations suggest that these highly unusual features are due to interrupted corrosion (rust) at the periphery of small droplets at the surface of a coinage die. This interpretation is confirmed by simple experiments on a freshly machined steel surface that produce this same 'rust ring' morphology and, when left unchecked, can account for the observation of round raised dots on coins in seemingly random locations.

Keywords

[predecimal coinage] [die variety] [corrosion] [raised dot] [coinage dies] [bronze coins]

Article

It is the difficult and perplexing numismatic problems that are usually the most interesting. Among these is the origin of the raised dots occasionally observed on coins in seemingly random locations, and in a range of different sizes. While raised dots have been used as mintmarks on predecimal Australian bronze coins, their unexpected appearance in other locations on coins and how this came about has long presented a mystery. Several examples on Australian predecimal bronze pennies are shown in Figure 1, including raised dots near the O of ONE on the reverse of two different 1934 pennies, and the relatively large dot after the designer's initials KG on a 1945 penny.[1] Others, including raised dots on predecimal silver coins, are listed in John Dean's book[2].

1 Skinner, Dion H. *Renniks Australian Coin and Banknote Guide,* 6th ed., Renniks, Unley, South Australia, 1970 (see B50A, page 14).

2 Dean, John *Australian Coin Varieties Catalogue,* 1st ed., Hawthorn, Melbourne, 1964.

Figure 1. Raised dots on various Australian penny varieties (see text).

Such dots have also been observed in the British predecimal bronze coinage, with examples shown in Figure 2. On top are two different 1875 pennies with dot below the I of VICTORIA on the obverse, and "cannonball" to the right of the ship on the reverse. Below this is shown the 1897 penny with a round raised dot between the O and N of ONE on the reverse, which is especially well known to collectors. This dot was originally assumed by Freeman to be a die identification mark, and he gave it a separate listing[3,4]. However, in his 1985 book, he describes this as occurring "as a result of damage to the die – a specimen showing only a small crack in this region has been seen."[5] Michael Gouby has also discussed this variety suggesting "that a small piece of grit, metal filing, etc. got trapped on the die leaving a small indent when it fell out" resulting in the raised dot on the coin[6]. Nonetheless, this 1897 penny is still separately listed in many catalogues, and the presence of the dot on this coin can result in a more than 15-fold premium.[7,8]

Figure 2. Raised dots on various British penny varieties (see text).

3 Freeman, Michael J. *The Victorian Bronze Penny*, 2nd ed., The Author: Ayr, 1966, page 36.
4 Freeman, Michael J. *The Bronze Coinage of Great Britain,* Langman and Co., London, 1970, page 41.
5 Freeman, Michael J. *The Bronze Coinage of Great Britain,* 2nd ed., Barrie and Jenkins, London, 1985, page 51.
6 Gouby, Michael *The British Bronze Penny: Specialized Edition*, Michael Coins: London, 2009, page 92.
7 *Coins of England and the United Kingdom*, 51st ed. Spink: London, 2015, page 491.
8 "Price Guide to Pennies", *Coin News*, May 2015, Token Publishing, UK, page 68.

As a student of predecimal bronze coinage varieties, the origin of such dots and the possible mechanism leading to their formation has long been of interest. During a July 2000 visit to Australia, I was fortunate in being able to obtain an EF example of an unusual 1945 Y. Australian halfpenny from M. R. 'Bob' Roberts that seems to offer important insight into this problem, along with another nVF identical confirming coin with the same features. These coins show numerous small raised circular rings and dots in the vicinity of AUSTRALIA on the reverse, especially at the TR of AUSTRALIA, as shown in Figure 3. In his March 1997 issue of NUMI$NEWS, Roberts describes these as having an O or C letter positioned between the T and R, and that he found this to occur on about one in every 70 of the 1945 Y. halfpennies examined.[9] Similar ring-like features and raised dots also occur at the neck and face of the kangaroo, and elsewhere on the coin. After Sydney, my next stop was the Perth Mint where these unusual halfpennies were originally struck. After showing them to the mint's technical department, we examined them under a microscope and took photographs, but no answers were forthcoming. Since my primary focus at the time was on Perth Mint predecimal proofs,[10] the puzzling problem presented by these coins was then set aside.

Figure 3. Raised ring-like features and dots on unusual 1945 Y. halfpenny (see text).

During the intervening years I occasionally thought about this problem, but it was only recently that a plausible mechanism for the formation of these ring-like features occurred to me. Under detailed microscopic examination more than 20 of these ring-like features ranging from about 0.1-0.5 mm in size can be seen. These raised rings exhibit rough surfaces suggesting corrosion, as shown in the closeup of the distinctive 0.4 mm ring directly below TR at the lower right of Figure 3. On the face of a steel die, such corrosion can only be rust. The unusual circular form of these features and the fact

9 *NUMI$NEWS*, March 1997, M. R. Roberts, Sydney, page 13.

10 Holland, Paul M. "Perth Mint Proof Coins 1955-1963", *Journal of the Numismatic Association of Australia*, vol. 16, 2005, pp 3-48.

that they are seen in many different sizes, strongly suggests that they resulted from rust forming at the periphery of tiny water droplets, where both atmospheric oxygen and water would be present at the surface of the die, thus providing ideal conditions for rust formation.

It is well known from surface science that on hydrophobic surfaces water spontaneously beads up into droplets in order to minimize their surface area. Under the right conditions on a steel die thinly or incompletely coated with oil or grease, I postulate that these droplets on the surface could directly lead to a circular ring of rust. Once established, such circular rings would likely establish a locus for additional corrosion, eventually leading to filled-in round beads of rust at the surface of the die. Due to the very low tensile strength of rust compared to hardened die steel, when used in a coining press this rust would be rapidly pulverized and lost leaving a round pit. This process could potentially account for the observation of round raised dots in seemingly random locations on coins struck from these dies.

Considering the specific case of the 1945 Y. halfpenny shown in Figure 3, such a corrosion event might lead to incuse circular rings etched into the surface of the die, and therefore directly result in the observed raised rings on the struck coins. Such ring structures are highly unusual features, and these are the only ones I have seen in more than thirty years of collecting and studying predecimal bronze. In my opinion, these circular rings document a corrosion process that began at the periphery of tiny water droplets that sometime afterwards was *suddenly stopped*, capturing and preserving these transient features.

The relatively uniform width of these "rust bands" in spite of the significant size differences seen in these circular rings supports this conjecture. Some of the smallest ones, in fact, appear to have rusted well into the interior, nearly merging into a circular bead rather than a ring, and numerous other tiny raised dots can be seen. Also of interest is the much thicker band of the raised "donut-like" feature observed on the upright of the R of AUSTRALIA (upper right image in Figure 3). On the die itself, this would have been located in a deeply incuse area, suggesting that while the corrosion process at the die face may have been *stopped* by wiping it clean, corrosion likely continued somewhat longer in this protected incuse area.

To further investigate this phenomenon, a few simple experiments were performed. This involved placing tiny droplets of water onto a freshly machined steel surface after rubbing the surface to impart a thin layer of oil. The water is placed onto the surface using a miniature probe, and observations show that this immediately forms into tiny beads. The test assembly is inserted into a small chamber to ensure a high humidity environment, and the results examined using a digital microscope. Rusting at the periphery of these droplets is observed in all cases, with the best results obtained when a

small amount of salt was added to the water. An example is presented in Figure 4, where a 0.7 mm rust ring can be seen that closely resembles the ring-like structures observed on the reverse of my 1945 Y. halfpenny. The morphology of this ring-like structure can be explained by the electrochemistry of a small droplet containing salt on a steel surface where a rust band forms between an inner anodic region and an outer cathodic region at the periphery of the droplet, where there is better access to atmospheric oxygen[11].

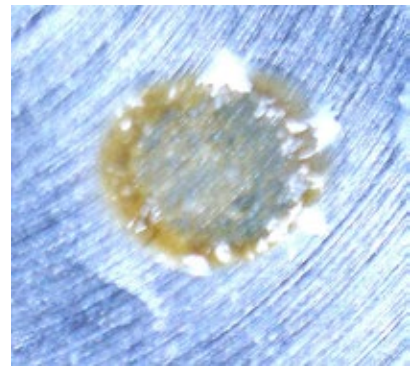

Figure 4. Rust ring generated at the periphery of a water droplet on a freshly machined steel surface (see text).

Taken together, these observations suggest a possible scenario for the accidental creation of this unusual variety. In 1945, all coinage dies for the Perth Mint were produced at the Melbourne Mint, and the Royal Mint Report shows that 72 of these reverse halfpenny dies were prepared.[12] This gives a very close match to the one in 70 occurrence rate for this variety among 1945 Y. halfpennies reported by Roberts,[9] and thus provides indirect evidence that the formation of the observed ring-like structures on this reverse die was complete before it was used to strike coins. This is further supported by the observation that the features on both of my examples of this coin appear to be identical.

Under the wartime conditions that prevailed at both mints in 1944-1945, quality control procedures were probably affected. Also, coinage die production would have reached its annual peak at the end of 1944/beginning of 1945, the hottest time of year in Melbourne. What is the probable source of the salt? One might imagine that there was no shortage of human perspiration (which contains salt) in the mint workshop at a time when there was no air conditioning. In any event, this 1945 Y. halfpenny die must have been improperly handled or stored, perhaps before shipment to Perth. At some point the resulting small amounts of surface rust on the die were likely discovered and cleaned off, suddenly stopping any further corrosion at the surface but allowing it to continue in some deeply incuse areas such as on the upright of the R of AUSTRALIA.

Regarding round raised dots on coins in seemingly random locations, studies of corrosion pitting on the surface of steel show that circular rust pits are typically produced, which

11 Evans, Ulick R. *The Corrosion and Oxidation of Metals: Scientific Principles and Practical Applications*, Edward Arnold Ltd., London, 1960, pp 118-119 and 711.

in cross-section exhibit a 'saucer shaped' or rounded appearance below the surface[12]. This closely matches the raised dots seen on coins, which typically show a smoothly rounded appearance that makes them appear to have been deliberate. In fact, had a punch with a rounded end been used to deliberately impress them into the surface of a coinage die, a raised rim of displaced metal would have also been produced. On struck coins this would result in a small depression surrounding the dot, as is frequently seen on 1919-1920 bronze pennies. To eliminate this feature due to displaced metal whenever deliberate dots are added by the mint, the surface of the die itself must be repolished.

In numismatics, as in life, among the most interesting questions is how? Arguably, study of this unusual 1945 Y. halfpenny variety has provided us with a kind of numismatic Rosetta Stone that allows interpretation of the unusual ring-like features it presents. The resulting numismatic insight reveals a very plausible formation mechanism that seems to explain the origin of the mysterious round raised dots observed on predecimal bronze coins in seemingly random locations.

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Author

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12 *Annual Report of the Deputy Master and Comptroller of the Royal Mint 1945,* London, page 44.