Minting Anomalies in Greek Sicily: Stepped Flans, Edge Ridges, and Edge Splits

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Numismatists have long sought to gain a better understanding of ancient Greek minting techniques, a subject for which no ancient written sources have survived. Although the topic has been the subject of numerous papers, some of these have been based more on speculation than on evidence. Fortunately, several researchers have conducted useful experiments in re-creating ancient minting techniques, and some of these have been quite informative.[1]

Regardless, numismatists continue to be plagued by the spread of inaccurate information even though plausible explanations have been previously published. To increase our understanding of some commonly seen minting anomalies on Sicilian coins, it will be helpful to review past studies and to better illustrate their conclusions with clear examples based on my own basic experiments. I'll explore the causes of (a) the diametrically opposed edge ridges often seen on silver and bronze Sicilian coins, (b) the stepped-flan appearance of some Sicilian tetradrachms, and (c) large, V-shaped, edge splits.

Edge Ridges

Anyone familiar with Sicilian Greek coinage has seen the distinctive knobs on opposite edges of many of the coins such as those evident on the coins of Katana, Gela, and Syracuse below.

Figure 1. Edge knobs on a tetradrachm of Katana. Roma Numismatics Ltd., Auction XI, lot 90.

Figure 2. Edge knobs on a tetradrachm of Gela. Noonans, Auction 12, part of lot 294. Image © Noonans. Used by permission.

Figure 3. Syracuse, bronze hemidrachm with prominent edge knobs. Ira and Larry Goldberg, Auction 128, lot 908.

[1] Attempts to re-create ancient minting practices have been carried out and documented in Beer (1982), Faucher (2009), Hill (1922), Kleeb (1982), Kleeb (1984), Sellwood (1963), and Tobey and Tobey (1993).

These protruding edge knobs appear as angled ridges when viewed from a coin's edge.

Figure 4. Ridge on a tetradrachm of Gela seen from the edge. Author's collection.

Figure 5. Ridge on a tetradrachm of Himera seen from the edge. Künker, Auction 676, lot 4309.

These edge ridges have often been erroneously described as 'casting sprues.' Although they are related to the process of casting the coinage flans, these edge ridges are not the remains of a sprue. A casting sprue is a sunken channel in the mold that was used to cast the flans. Molten silver or bronze was poured into the mold and it flowed along the sprues to fill each hollow chamber within the mold.[2] Remains of such sprues are sometimes evident as seen on this bronze coin of Panormos and on this unstruck flan (which was likely intended for a Judean prutah[3]) and are quite different in appearance from the edge ridges on Sicilian coins.

Figure 6. Bronze coin of Panormos with prominent remains of a casting sprue. Kenneth W. Dorney Ancient Coins and Antiquities, www.vcoins.com listing, October 2022.

Figure 7. Unstruck flan, probably for a Judean prutah, showing untrimmed casting sprues at top and bottom, and casting channel running through the middle. Author's collection.

[2] For an illustration of a group of Roman-period flans still connected with their casting sprues, see Cores, Gozalbes, and Ripollès (2010).

[3] The flan for the Judean prutah was likely cast in a one-sided mold.

So, if the edge ridges on Sicilian coins are not casting sprues, what are they? This should be no mystery because the minting technique which caused these edge ridges was correctly described by George F. Hill in 1922. The edge ridges were the result of an unusual method of flan preparation:

> The most remarkable peculiarity is one which is especially characteristic of early Sicilian coins. On many of these there are to be seen ridge-shaped projections at two diametrically opposed points of the edge. It appears that the blank was cast in a spherical mould, made of two hemispherical halves. The metal flowed into the joint between the two halves, making a sort of equatorial ridge round the blank.[4]

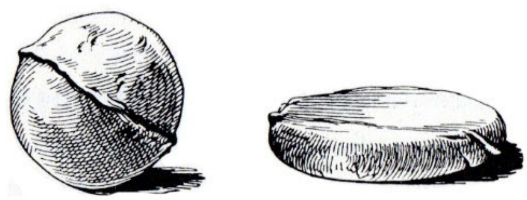


Figure 8. From Hill 1922 p. 8.

Hill pointed out that when striking the coin, 'the plane of the ridge was inclined, or even vertical, so that only two small projections remained after striking.' Why were these unusual ball-shaped flans produced, rather than the more common flat or globular flans? As Hill surmised, a globe of metal retains heat longer than a flatter disk, thus making it easier to achieve a well-struck coin.

To better understand this unusual method of flan preparation and striking, there was no need to cast silver spheres and strike them with bronze dies.[5] Rather, some modeling clay and two drinking glasses did the job nicely.[6] This allowed me to experiment with variations in flan preparation and striking to clearly see how the edge ridges were formed.

Following Hill's example, I formed the clay into the shape of a cast ball, including a ridge around the circumference of the ball to simulate the ridge left by molten metal which flowed into the seam of a two-piece casting mold. To make the results easier to see, I've exaggerated the seam between the two halves of the mold.

Figure 9. Clay simulation of a cast ball-shaped flan with seam.

[4] Hill (1922): 8.
[5] It is likely that most dies used to strike Greek coins were made of bronze, although steel dies were sometimes used. For a review of the evidence and a discussion of the advantages of bronze dies, see Sellwood (1963).
[6] Hill conducted his limited flan experiments using wax. See Hill (1922): 9.

I then 'struck' the flan, using the two glasses as obverse and reverse dies. If I aligned the flan with the seam running vertically (perpendicular to the surfaces of the dies) as Hill suggested, the clay is pressed flat, leaving projections at opposite edges of the coin—the remains of the casting seam.[7] The photos below clearly show the results.

Figure 10. Placement of the flan ball between the obverse and reverse 'dies,' with casting seam perpendicular to the die faces.

Figure 13. The resulting struck 'coin.'

Figures 11 and 12. After striking, the remains of the casting seam appear as a ridge on the coin's edge.

Stepped Flans

A tetradrachm from the Sicilian city of Gela in my collection (Figure 14) has an unusual feature which raised questions regarding how the coin was made. The coin was minted ca. 480-470 BC and is catalogued as Sear 785 (also Jenkins 104, SNG Copenhagen 251, Randazzo Hoard 19). The coin bears what appears to be a minting flaw. The obverse has a circular ridge beginning near the right rim, extending downward and to the left. The result is that the center and top portions of the coin are higher than the outer lower rim, leaving a sunken, stair-step, appearance around the rim of the coin from the 3:00 position to the 9:00 position. This effect has been described in catalogues as a 'stepped flan' or 'flan flaw.'

[7] Kleeb (1982): 47 stated that, in some cases, the spherical flan ball may have been hammered flat before the coin was struck.

Figure 14. Tetradrachm of Gela. Author's collection.

In addition to this coin from my collection, the following are other examples of 'stepped flans':

Figure 15. Gela tetradrachm, *c*. 480-470 BC, *Jenkins* 104: CNG, Freeman and Sear, and Numismatic Ars Classica, *Triton III* (30 November 1999), lot 171 (described as having an 'obverse flan flaw'). This coin was struck from the same obverse die as the Figure 14 coin, but the sunken area extends from the 7:00 position to the 11:00 position. The line demarcating the sunken area passes through the center of the chariot's wheel, but unlike Figure 14, it ends at the horse's rear feet, above the exergual line.

Figure 16. Gela tetradrachm, *c.* 480-470 BC, *Jenkins* 104. ANS 1925.172.21. This coin was struck from the same obverse die as Figures 14 and 15. It has a prominent sunken area between the 7:00 and 11:00 positions. The line demarcating the sunken area passes through the left side of the chariot's wheel and ends below the exergual line—different from both Figures 14 and 15. Photograph is courtesy of the American Numismatic Society.

Figure 17. Syracuse tetradrachm, *c.* 485-479 BC, Boehringer 144. Jean Elsen *Liste 216* (June-July 2001), no. 31. This coin shows a sunken area on the lower part of the obverse from 4:00 to 8:00.

Figure 18. Katane, tetradrachm, *c.* 425-413 BC, *SNG Lloyd* 895. Birkler & Waddell Ltd., *Auction 2* (11 December 1980), lot 54. This coin shows a sunken area from 2:00 to 8:00.

Figure 19. Syracuse tetradrachm, *c.* 405-395 BC. Künker, Auction 365 (3 April 2022), lot 5059. The reverse shows a prominently sunken outer rim from the 8:00 position clockwise to the 4:00 position.

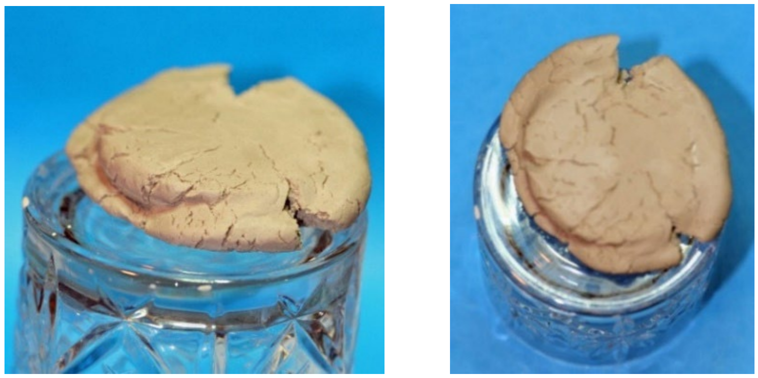
Figure 20. Panormos tetradrachm, *c.* 390-380 BC. Künker Auction 376 (18 October 2022), lot 4341. This photo, taken from Künker's excellent video in which the coin is rotated in hand, clearly shows a deeply sunken area around the rim from 5:00 to 12:00.

While 'stepped flan' does describe the appearance, it does not offer any clues as to the cause of the sunken areas around the rims of the coins. Figures 14-16 show the sunken areas positioned differently on coins struck from the same die, thus demonstrating that the effect was not due to a worn or broken die. So, was it the result of an error in striking? Or was the unusual appearance due to an anomaly of the flan prior to striking?

A little more experimentation may provide the answer to the 'stepped flan' phenomenon. For this strike, the clay flan ball was placed between the dies with the casting seam *not* perpendicular to the die faces.

Figure 21. Cast flan ball placed on bottom die with the casting seam not perpendicular to the die face.

After striking, we can see the result—the coin exhibits the stepped-flan effect, with an area around the rim of the coin sunken in relation to the rest of the coin's surface.



Figures 22 and 23. Resulting coin after striking.

The sunken area near the rim is the remains of the casting seam. The higher area in the center of the coin is the remainder of the spherical flan which has not been compressed enough from the strike to make it level with the outer edge. Clearly, this cannot be considered a flan flaw. Rather, it is a coin striking anomaly.

Another variation in striking could also account for the stepped-flan, and this variation was briefly described by Sellwood in 1963: 'Another peculiarity of the Sicilian series...is a sort of shield-like edge to part of the design where the whole type is not struck. This is, in fact, due to a certain degree of off-set of two parts of the completely enclosed mould used to cast the blank.'[8] More experimentation with the clay helped to clarify Sellwood's statement.

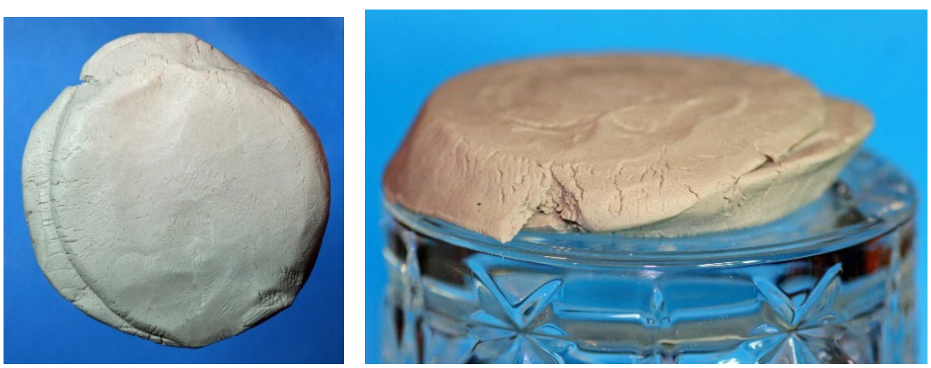
As noted above, to make spherical flans, molten metal is poured into a two-piece mold. If the two halves of the mold are not perfectly aligned (the two hemispheric casting chambers were off-center in relation to each other), the resulting flans will look something like this:

Figure 24. Flan resulting from mis-aligned halves of the casting mold.

[8] Sellwood (1963): 228.

Now, if the defective flan is placed between the dies with the casting ridge parallel to the die surfaces, the resulting strike would show a prominent 'stepped' effect on both the obverse and reverse of the coin.

Figure 25. Flan with casting misalignment placed between dies with seam parallel to the die faces.



Figures 26 and 27. Two different resulting coins. The stepped effect appears on both the obverses and reverses of the coins.

It is interesting to note that my Gela coin and three other published examples of the stepped flan (see above) are of the variety *Jenkins* 104.[9] We can see examples from these dies which exhibit different dies states, showing the progression of the die cracks on the reverse. It seems that either a batch of off-center flans were utilized (confirming the 'misaligned mold' theory), or the flans were frequently mis-aligned on the die faces during striking when the *Jenkins* 104 die pair was in use. Other examples from these dies (*e.g.*, *SNG Copenhagen—Sicily, Gela* 251) were struck with properly prepared flans or were struck properly aligned in relation to the die faces.

[9] Jenkins (1970).

Edge Splits

Now let's see if our clay trials can lend insight into the phenomenon of large edge splits. Minor edge cracks are common on many ancient coins and are caused when the striking pressure is simply too much for the flan to absorb. Minting experiments have shown that such cracks are more likely to form if the flan is too hot when struck (such cracks are sometimes erroneously attributed to striking a cold flan).[10] Cracks 'are the result of striking at a temperature near the melting point, when there is a weak bond between the partially crystallized atoms.'[11]

However, you'll occasionally see very large, V-shaped, splits such as on these tetradrachms of Syracuse and Katana:

Figure 28. Tetradrachm of Syracuse. Ira and Larry Goldberg, Auction 80, lot 3077.

Figure 29. Tetradrachm of Katana. Nomos AG, obolos Webauction 25, lot 16.

Could a variation in flan preparation or striking be the cause of some of these splits? Another experiment with clay may suggest an answer.

If the mis-aligned flan of Figure 24 is placed on the dies with the seam perpendicular to the die faces (as in Figure 30), the striking pressure will cause large V-shaped indentations at the coin's edges (Figure 31). Uneven pressure could account for a large indentation on one end of a coin, with a normal edge knob on the opposing end (as in Figure 28), or a large indentation on one end of a coin, with a smaller crack on the opposing end (as in Figure 29).

Although clay may not react exactly as silver or bronze will when cast and then struck under high pressure, these experiments likely provide useful insights into some of the flan characteristics frequently seen on Sicilian coins. The illustrated examples should help explain the concepts described by earlier researchers whose insightful theories and conclusions have too often been overlooked.

[10] Hill (1922): 37 stated, 'The split edges characteristic of many Sicilian coins, among others, could only have been produced if the metal was cold.' However, actual experiments in minting have shown the opposite to be true. Kleeb 1984 page 33 stated, 'We had learned early in our investigation that the edge cracks so common on ancient coins from certain mints were the result of striking when the metal in the coin was too hot rather than too cool as many books say. This we learned was a fact known by most persons with a reasonable knowledge of metallurgy, yet unfortunately not known by some of the foremost numismatists.' Kleeb also pointed out that flans which contain a higher percentage of non-silver alloy are more likely to crack. Therefore, edge cracks can be caused by low flan temperature, reduced silver purity, or some combination of these variables.

[11] Kleeb (1982): 44.


Figures 30 and 31. Coin shows large V-shaped gaps after striking a misaligned cast flan.

Acknowledgements

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