Among the stamps analysed, the dull ultramarine on ordinary paper is an oddity. It not only presents a pronounced reddish cast to the eye (Fig. 1); its spectrum has an extra peak not found in the other stamps, at about 590 nm (Fig. 3). The peak corresponds closely to that in the spectrum of a small heads Selangor 10c. that LYC analysed for another study (Fig. 3). As a magenta ink very similar to the Selangor 10c. was used for some of the BMA 10c., we suspect that the ink used for the 15c. could have been inadvertently tainted by residue from an earlier batch of magenta ink mixed in the same vessel. There is no obvious reason why this should have been intentional.

Although this study does not match shades to "printings" or solve the catalogue conundrum, it gives a glimpse into the fascinating chemistry behind a messy post-war printing frenzy.

Acknowledgements

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References

1. Cameron, W. G. 1950. BMA MALAYA. *Gibbons Stamp Monthly* 23:54–56.
2. Holley, D. R. M. 1994. "BMA MALAYA" issues: a response to requests for information. TMP 35/3.

PERFORATION QUALITY AND SMALL-HOLE CHARACTERISTICS IN THE MALAYA SMALL HEADS ISSUE

by Robert V. Mustacich and Lin Yangchen

The Malaya small heads issues of 1949 to the 1950s not only have the highest gauge perforation in the world, of 17.6 x 18.2 [7], but also has perforation with extremely small holes. Observation of poorly aligned perforations in these issues have generated suspicion that these stamps are the result of progressive damage to a comb perforator that was not sufficiently robust due to the small pin size [1,2,3].

However, it is unlikely that the tolerances in the perforator could be loose enough for bent pins to create the irregularity observed on these stamps and still have an operating perforator. For sharp punching of holes, the pin clearance with the mating hole needs to be small.

The need for uniform hole spacing is exemplified no better than by rotary perforators, where pins have to align with multiple sets of matching holes as the drum rotates. This was so critical that a major effort in numerical machining methods was undertaken by the U.S. National Institute of Standards (NIST) in the 1970s to set new standards of precision [6].

The comb perforators used for the Malaya small head issues, however, involved only a single alignment between the pins and matching holes. Because of this, a stroke perforator can have significant irregularity in its pin spacing as long as the pin and hole positions align with each other. Manufacture is simplified because of the tolerance of this irregularity, and its presence results in rich "fingerprints" [4].

Methods

Two marginal blocks from Singapore (Figure 1) were examined, the 50c. with more uniform hole spacing, and the 20c. with relatively irregular spacing. The perforations were scanned at 2400 dpi and hole sizes and spacings analyzed with software [4].

Figure 1. Blocks showing relatively well-aligned (left) and misaligned (right) perforations. Each numbered row of horizontal and vertical perforations was separately analysed.

Irregularity was quantified both inline – along the direction of a given row of perforations – and perpendicular to the row. Measurements were taken with reference to a straight line fitted to the centres of the holes using least squares.

The standard deviation of the inline hole spacing for a given row is an indicator of the overall irregularity of that row's inline spacing. Perpendicular shifts, sometimes called "zig-zag," were measured as distances to the fitted straight line from the hole centres, and standard deviations were calculated as well.

Results and discussion

High-resolution measurements of gauge (Table 1) agree well with those of Ref.7. See Ref.4 for mathematical details of gauge calculation.

Table 1: Analysis of the rows of perforations as numbered in Figure 1. Standard deviations of the hole diameter, the inline spacing between holes, and the perpendicular offset from the straight-line fit through the row of holes (zig-zag) are given by STD, σ_x, and σ_y, respectively. D is the average distance between the actual centre of a perforation hole and its ideal position.

Row Number	Gauge	Diameter (mm)	STD (mm)	σ_x (mm)	σ_y (mm)	D (mm)
1	17.71	0.556	0.010	0.044	0.037	0.051
2	17.70	0.562	0.010	0.046	0.036	0.052
3	18.22	0.568	0.008	0.050	0.020	0.047
4	18.20	0.568	0.012	0.034	0.037	0.044
5	17.64	0.596	0.020	0.125	0.047	0.116
6	17.64	0.598	0.018	0.120	0.047	0.113
7	18.22	0.594	0.022	0.073	0.089	0.105
8	18.21	0.608	0.020	0.080	0.096	0.114

The average hole diameters are remarkably small, as small as 0.56 mm (Table 1) compared with the more typical hole size of approximately 1 mm. Hole size is quite consistent within each row, with standard deviations in the range of 0.01–0.02 mm (Table 1). Hole diameters less than 0.8 mm are only infrequently encountered, examples familiar to us being some early 19th century U.S. local stamps and U.S. state revenue stamps, all thought to be privately perforated, with diameters in the range of 0.7–0.8 mm.

With such a high gauge value in the Malaya small heads issue, very small hole size is an appropriate choice for maintaining the attachment of the stamps in sheet form. Numerous examples exist of the abandonment of high gauges with larger hole sizes in favour of lower gauges to avoid unwanted separation during distribution of stamps in sheet form, such as the change in the Penny Red from perforation 16 to 14.

The pattern of repetition of the irregularities across stamps within a block reveals that a single horizontal comb was used. This is visually discernible in the 20c. (Figure 1), but in the 50c. block it was characterised by analysing the raw data. Incidentally, the same comb was used on the 20c. as on the blocks illustrated in Ref 1 and 2. The matching perforation patterns also show that the sheet of stamps could be fed into the perforator head-first or foot-first: our Singapore 20c. and Hale's Negri Sembilan [1] example were fed one way while the Penang QEII of Hale [2] was fed the opposite way.

In the 20c., while the zig-zag of rows 7 and 8 are perhaps the most visually striking irregularity of the overall perforation, this zig-zag is less than the inline deviation in rows 5 and 6 (Table 1). The reason for this is unclear; the precision positioning of drill bits is a difficult mechanical problem at such scales.

We now consider the direct distance between an actual perforation and what its ideal position would be – if it were perfectly placed (see Table 1). We found perforations as far as 0.3mm from their ideal positions (Figure 2). If perforator pins had been uniformly spaced during manufacture and subsequently became bent to give the irregularities, this would require very large matching holes in the perforator to accommodate the wayward pin tips. In fact, the diameters of the perforator holes would have to be approximately equal to the pin diameter plus twice this this range of variation, about 0.6 mm, to account for different directions of the pin spacing irregularity. This would require a minimum perforator hole size of 1.2 mm. The hole size is nearly double the pin diameter – implausibly large compared with known perforators.

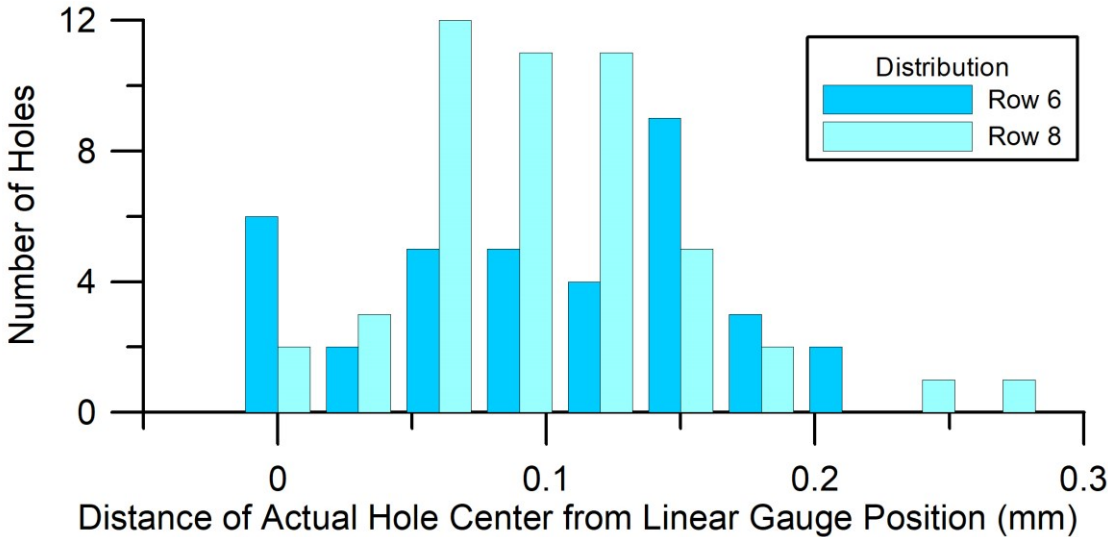

Figure 2. Distances between the actual perforation hole centres and their ideal positions. Row numbers refer to those in Figure 1. See Table 1 for distance data for all rows.

Furthermore, the relatively crisp holes in the stamps (Figure 1) are typical of stamps punched with small clearance between the pin and matching hole. Larger clearances would yield more ragged and uneven paper cuts as the paper is pushed and stretched into the hole before the pin bursts through the paper [5]. In the case of the Malayan stamps, if crooked 0.6 mm pins in large holes of 1.2 mm or greater had been used – as required by the damaged-pin hypothesis – they would have produced quite rough and messy perforations, even after considering that the smaller area of the pin face would reduce the force required for the pins to burst through the paper. Moreover, some of these crooked pins would be near the edges of the matching holes, resulting in a shear near the edge and only pushing or tearing the paper on the opposite side of the pin, but this phenomenon was not observed on the stamps we examined.

Perforators trended toward smaller tolerances, or differences between pin and hole diameters, by the 1950s, as suggested by specific developments in the U.S.; the Bureau of Engraving and Printing (BEP) reported a historical range of tolerance of 0.03–0.11 mm for rotary perforators [5]. Even a late 19th-century stroke perforator of early manufacture was found to have an average tolerance of about 0.13 mm. Even this worst-case example is only about 25% of the almost 0.6 mm tolerance that would have been needed to produce the observed perforations in the Malaya issues. It would not be unreasonable to suppose that these stamps, which were printed by De La Rue, would have had the service of perforators manufactured up to contemporary standards, and this seems consistent with the sharply cut holes.

Conclusion

Pronounced perforation irregularities in the Malaya small heads issues are probably due to perforator manufacturing quirks rather than progressive pin damage. A machining template may have provided the needed alignment between the pins and holes in the stroke perforator without the need for precise uniformity of spacing. This could have made manufacturing simpler and cheaper – an advantage in the frugal post-war years.

References

1. Hale, R. 2014. Negri Sembilan 1948 definitive issue 30c. perforator damage. TMP55/86.
2. Hale, R. 2016. More on irregular perforations. TMP57/73.
3. Lin, Y. 2015. Letter to the Editor. TMP 56/65.
4. Mustacich, R. 2014. Freak or Fake? A New Fingerprinting Method for Distinguishing between Original and Fraudulent Extra Perforations of 19th Century Revenue Stamps. *The American Revenuer,* **67**(1): 2-19.
5. Mustacich, R. 2015. Fake Perforations on 19th Century U.S. Revenue Stamps: A Stroke of Luck. *The American Revenuer,* **68**(4): 90-96.
6. Mustacich, R. 2015. Measurements of stamp separation features by digital image analysis. In *Proceedings of the Second International Symposium on Analytical Methods in Philately* eds. Barwis, J. H. & Lera, T. pp. 73–85. The Institute for Analytical Philately, Ohio, USA.
7. Stanway, L. C. 2009. *Malaysia and the Federation of Malaya: Their Stamps and Postal Stationery Volume 1.* Malaya Study Group.

STRAITS SETTLEMENTS 4c. WATERMARK INVERTED
by Terry Russell

Now for something completely different! Straits 4c. SG155 inverted watermark. I came across this on a dealer's rejigged website. As far as I'm aware, it is unrecorded.

NEW CATALOGUE ENTRIES

In Gibbons Stamp Monthly April 2018, Hugh Jefferies reported that the 2019 “Part 1” catalogue will list FMS S.G. 38ay, a 4c. scarlet Die II with Multiple Crown CA watermark inverted and reversed. The discovery is credited to our own Gordon Peters.

He will also be adding Kelantan S.G. Z396, the 10c.black and purple used with the Type M cancellation of Batu Menkebang, discovered by Mike Vokes, also a MSG member.