THE METROLOGY OF THE ENGLISH CIVIL WAR COINAGES OF CHARLES I

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ONE aspect of the coinages of the English Civil War of 1642–9 which has never been systematically assessed is the extent to which the apparently largely inexperienced persons who produced many of them succeeded in providing what was required: coin of the realm of full weight and metallic standard. To one writer '. . . notwithstanding the King's distress for money, it is remarkable, he never debased the coin, or raised the value of it'; to another 'the poor representation of Charles's provincial coins has long been recognised as characteristic of Civil War hoards, and it may be that some of them laboured under a not unjustified suspicion of being slightly base'.[1] To some extent, the relative rarity of royalist issues may now be seen as a function of small original output, but there are coins whose appearance is unprepossessing, whether in shape, design or metal. As part of a wider project on the Civil War issues,[2] built initially on hoard evidence, the opportunity has been taken to examine various technical elements of minting in England at this time. This paper presents the results of a series of analyses of royalist and other coinages and a survey of the weights of surviving specimens. Minting technology itself has been discussed elsewhere and will not be dealt with here, nor will judgement be attempted on the artistic or other abilities of the engravers involved.[3]

Early in the seventeenth century, all English minting in precious metals took place at the Tower of London, a monopoly broken only in 1637 with the establishment of a small branch mint at Aberystwyth for the coining of newly-refined Welsh silver. Gold and silver coins were produced to strict standards, which during Charles I's reign were:

Gold, 22 carats fine ('crown' gold), £41 to the pound Troy;
Silver, 11 ounces 2 pennyweights fine, 62 shillings to the pound Troy.[4]

In terms of the denominations most commonly encountered today, these equate with gold pieces of twenty shillings (unites) weighing 9.10 grams, 916.67 parts per mille (ppm) fine and silver shillings of 6.02g and half crowns of 15.05g, 925 ppm fine. The correct fineness was achieved not by refining, but by the assay and blending of parcels of bullion of differing finenesses submitted for coining, with the addition of alloy (base metal) if required. At the Tower, the dies for coins struck during a given period, generally, it would seem, the official (old style) year, were marked with a distinctive 'privy-mark'. Random samples taken from production were assayed roughly annually in the Trial of the Pyx.[5] The difficulty of

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[1] S.M. Leake, *An Historical Account of English Money . . .*, 3rd Edition (1793), pp. 316–17; J.P.C. Kent, *BNJ* 37 (1968), 142.

[2] E. Besly, *English Civil War Coin Hoards*, British Museum Occasional Paper No. 51 (1987).

[3] E. Besly, 'The York Mint of Charles I', *BNJ* 54 (1984), 210–41; 'Rotary coining in Britain', *Metallurgy in Numismatics* III, in press.

[4] J.D. Gould, 'The Royal Mint in the early seventeenth century', *EcHR* 2nd series 5 (1952–3), 246–7.

[5] H. Symonds, 'Charles I; the Trials of the Pyx, the mint-marks and the Mint accounts', *NC* 1910, 388–97.

achieving precision was however recognised and a 'remedy' or tolerated deviation of 2 dwt per pound (about 0.83 per cent) above or below the set standards was allowed, both for fineness and for weight.

The mints set up to assist the royalist war effort fall into four groups, with their management delegated as follows:

i. Shrewsbury (1642), moved to Oxford (1642/3–1646); the Aberystwyth mint, relocated. Joint wardens, Thomas Bushell and Sir William Parkhurst. A branch mint set up at Bristol (1643–5) was run by Thomas Bushell.
ii. The West: Truro (1642–3), moved to Exeter (1643–6); Sir Richard Vyvyan.
iii. The North: York (1643–4); the Marquis of Newcastle (see below, p. 131).
iv. The Welsh Marches (1644–6); mints in the counties of 'Hereford Worcester Salop and Chester'; Sir Thomas Cary.

Bushell's indenture for Aberystwyth included provision for a pyx trial (probably never carried out) and this presumably carried over to Shrewsbury and Oxford. The other mints seem to have had no provision for any such check, but Vyvyan and Cary were explicitly required to conform to Tower standards in design, weight and fineness.[6]

Metallurgical analysis

Materials and methods

The materials most commonly surviving are silver coins. For the Tower mint, the 1630s saw heavy activity as Spanish-American silver was converted in large quantities into English coin, and this remained the principal source until 1647, supplemented by plate in 1642–3.[7] For royalist mints, there is documentary evidence for the use of plate, jewellery (probably), foreign coin and Welsh silver, producing by comparison with the Tower a very small output. The sole denomination common to all English mints was the half crown (30*d*.) and this was also the type best suited to the analytical method employed. In all, ninety-eight English and five foreign coins have been examined, fifteen from the National Museum of Wales, the remainder from the British Museum. Despite large outputs early in the century, gold coins form a very small proportion of the surviving material. Nineteen specimens have been examined. Of the royalist mints, Oxford alone seems to have produced a significant quantity of gold coins.

The silver coins have been examined at the British Museum Research Laboratory using X-Ray fluorescence analysis of an area of approximately 1 × 2 mm on the edge of each coin, abraded to provide a flat uniform surface and to remove the outermost layer, thereby reducing any surface enrichment of silver resulting from the manufacturing process or from any subsequent leaching out of base metal. At least two measurements were made on the same area on each coin, with additional abrasion, until consistent results were obtained. This method of analysis gives values for the two main elements, silver and copper, and five further minor constituents (gold, lead, zinc, tin and arsenic) were sought.[8] The main

[6] G.C. Boon, *Cardiganshire Silver and the Aberystwyth Mint in Peace and War* (Cardiff, 1981), p. 169; Vyvyan's 1642 commission: Cornwall Record Office V/BO/18; Cary: W.H. Black, *Docquets of Letters Patent and Other Instruments passed under the Great Seal of King Charles I at Oxford* (1837), p. 211.

[7] J.S. Kepler, *The Exchange of Christendom. The International Entrepôt at Dover 1622–1651* (Leicester, 1976).

[8] Detection limits were: gold, 0.1%; lead, 0.1%; zinc, 0.2%; tin, 0.3%; arsenic, 0.3%. In table 1, '-' implies a level below these. Precisions (absolute) are ±0.1%: gold, lead, tin, zinc and arsenic; ±1–2%: silver and copper.

advantage of the method is its simplicity, but it is unsuited to small denominations, requiring the broad edges of half crowns or larger coins to provide a suitable area for examination. Providing there is no residual surface enrichment it gives a representative idea of a coin's composition, accurate to 1–2 per cent for the major elements. Thus, coins produced to a silver standard of 925 ppm may give results in the range 91–94 per cent silver. Those lying outside these limits are therefore significantly different from the standard, while those giving results below 90 per cent or above 95 per cent may be regarded as certainly 'out of remedy'.

Four further specimens have been examined by atomic absorption spectrometry (AAS) on 10mg samples drilled from their edges, giving silver finenesses accurate to ± 1 per cent and adding bismuth and nickel to the elements detected. Unpublished analyses from two other sources are also included, for comparison. A large series of silver coins, mainly from the Aberystwyth mint, was analysed for the National Museum of Wales in 1984, and the results are listed and discussed in Appendix 1. Several specific gravity determinations (for silver a very much less precise method) are included as footnotes to Table 1.

The rarity and high value of the gold coins necessitated a different approach. Here, the specific gravities of a series of coins have been measured and the ratios of the alloying elements determined by XRF examination of their degreased but unabraded surfaces. Assuming a binary alloy (Au/Ag or Au/Cu), the specific gravities give two possible gold content values. The true gold content lies between the two, depending on the silver: copper ratio determined by XRF, and an approximate value for this was estimated from equations derived from SG measurements on gold alloys of known composition. This should be accurate to 1–2 per cent.

Results and discussion

1. SILVER

Results for the silver coins are given in Table 1. The first striking point is the solid consistency of the Tower Mint coins, whose measured fineness varies over a range of a mere 0.8 per cent, the lowest failing to attain the standard by 0.1 per cent only. It is likely that most, if not all, are of Spanish-American silver. Gold is generally very low, or not detected; zinc is found only in the specimen examined by AAS, and then in tiny amounts. It is against this background, which incidentally increases confidence in the analytical methods used, since the pyx trials of the time confirmed the Tower's adherence to standard, that the capabilities of the royalists must be compared. Not surprisingly, since for the most part the mint staff lacked experience or training, their control of fineness is much less tight. Of eighty-four coins, forty-nine (58 per cent) give silver finenesses within the range 91–94 per cent, three (3.6 per cent) are above 94 per cent and thirty-two (38 per cent) lie below 91 per cent. If the intrinsic value of the small amounts of gold frequently found is included (the royalist mintmasters paid higher rates for gilt plate), the number of coins which may be regarded as irredeemably debased drops to nine (10.7 per cent), with a further six (7 per cent) which are borderline. In general terms, therefore, it appears that efforts were made to maintain the appropriate silver standard. Indeed, Sir William Parkhurst complained subsequently that when the small but steady supply of Thomas Bushell's highly-refined Welsh silver was diverted from Oxford to Bristol following the establishment of the branch mint there in 1643 'I was forced to refine much soldered plate to uphould his majesties standard'.[9]

[9] Boon, *Cardiganshire Silver*, p. 271.

The fifteen exceptional results are therefore of some interest. They lie mainly towards the end of the war. At Exeter, the single 1645 half crown (no. 52) shows a drop to 88.9 per cent, but includes a trace of gold; this is paralleled by a threepence dated 1644 (see Appendix 1). At Oxford, all five 1644 and 1645 half crowns (nos 17–21) show reduced silver fineness, partially compensated by their gold contents. A slight deliberate debasement may be indicated, but other factors may have been at work, the poor quality of some raw materials (above), or disruption caused by the serious fire of 6 October 1644.[10] A threepence of 1644, however, appears to have a high fineness (Appendix 1), while the half crowns dated 1646 (i.e. struck after 25 March 1646, and for the most part therefore during the final siege) indicate an improvement.

The remaining cases of debasement relate to mints in the Welsh Marches, the area under the control of Sir Thomas Cary. One 'Chester' coin (no. 77) of Lyall's type b ii drops to 85.3 per cent silver, though with a relatively high gold content. In the 'Worcester – Salopia' series, which at first seems to have maintained a reasonable fineness, the latter part (Allen's types H-L, nos 63–72) shows distinct debasement, with five of the ten coins analysed dropping below 90 per cent silver. At the very end, debasement is severe and rapid, with two die-duplicate coins (nos 70–71) giving 85.7 and 57.1 per cent silver. These coins cannot be dated precisely, but late 1645 (O.S.) or 1646 is likely.

The most consistent case of serious debasement may be seen in the enigmatic 'Garter' half crowns which, from their date and the evidence of Elias Ashmole, who worked for the royalist excise at Lichfield and Worcester, that they were issued in the West, are likely to be products of one of Cary's mints.[11] While the sole surviving undated specimen (no. 89), though slightly low in silver, is reasonably close to standard, the three dated 1645 that have been analysed are all base (nos 90–92, 68.1–78.1 per cent Ag). Traces of arsenic, a metal known to have been used by counterfeiters to whiten debased alloys, make their only appearance in these analyses.[12] Two of these coins, however, show the highest gold contents of all.

Whether these debasements are to be laid at the door of the mintmasters is another question. It is possible that they result from dies falling into unauthorised hands at the end of the 'first' Civil War. It is known that Parliament made every effort to secure royalist minting equipment. A search of trunks taken from Oxford shortly after its surrender was ordered on 16 July 1646, while at Exeter the local Committee lost no time in seizing Vyvyan's equipment, including his dies. That some dies got into the wrong hands is suggested in the following letter, written in 1652:

'. . . the last king went squirting up and down with his mints at Bristol, at Shrewsbury, at York, at Oxford, at Carlisle, and many other places; and when these garrisons were surrendered, these irons were carelessly neglected and come into knaves' hands and they fell first a-coining of great quantities of money in Lancashire and the materials they wrought on was only the clipping of English silver and pewter dishes.'[13]

Two 'blacksmith' issues – half crowns of very crude appearance, both in die-cutting and minting – have also been examined, and on the evidence of silver contents of 90 per cent

[10] F.J. Varley, *The Siege of Oxford* (Oxford, 1932), pp. 21–2.

[11] *DNB* i, pp. 644–6. Ashmole was a native of Lichfield.

[12] See A. Macfarlane, *The Justice and the Mare's Ale* (1981), pp. 214–15 (Appendix C: The Method of Counterfeiting Coins), which quotes a contemporary (*c.* 1682) deposition 'The ingredients and materials these rogues use. . .' relating to counterfeiting in Lancashire and Westmorland. There, silver clipped from lawful coin was mixed [2:3] with copper 'whitened with white arsenic'. The technique was evidently widespread: three counterfeit half crowns from the Ashdon, Essex, hoard of 1644 conform to this description, and five of the seven counterfeits from Breckenbrough, N. Yorks. (also 1644) were of silver debased with arsenical copper: Besly, *English Civil War Hoards*, pp. 17 and 8.

[13] J. Thirsk and J.P. Cooper, *Seventeenth Century Economic Documents* (1972), p. 646.

and more and their weights (below) both must be regarded as official issues. The first type (nos 87–88, **pl.10, 6**), an 'Exurgat' half crown dated 1644 which copies Bristol half crowns, is likely to be another Cary product, presumably a parallel issue to the 'HC' half crowns. The second 'blacksmith' type, included for comparison, has long been regarded as Irish (no. 96, **pl.10, 7**), an attribution confirmed by specimens in the Templetuohy (Co. Tipperary) and Abbeylands (Co. Kildare) hoards.[14]

There are no surprises in the minor elements. Varying amounts of gold, together with lead and, occasionally, tin confirm the documented use of plate, some of it gilt, as raw material for much of the royalist output. Zinc, which is frequently found, seems to imply the introduction of brass as alloy, perhaps from traces of hard solder. (See also the York and Exeter threepences in Appendix 1.) The use of foreign coin is attested by three deliveries of 'ryalls' to the Exeter mint during 1643.[15] Our single analysis (no. 102) suggests that these were of high fineness, like the ducatons from the Spanish Netherlands (no. 101), which were struck at 944 ppm fine silver.[16] They probably served to improve the melt where untouched or soldered plate was involved. One Exeter coin of exceptionally high fineness (no. 48) may owe its origin to Spanish 'ryalls', but the significant presence of gold in this coin confuses the picture.[17] Other foreign coin types known to be current in royalist areas are patagons ('cross-dollars') from the Spanish Netherlands and German Reichstaler (nos 99–100, 103). These may have been used in the mints, but were of lower theoretical fineness, 875 and 889 ppm respectively.[18]

In the light of the foregoing, one late group of royalist coins stands out for its uniform high silver purity, which betters even that of the Tower issues. This is the 'Late Declaration' coinage dated 1645 and 1646, struck from altered Bristol dies or dies of Bristol type after the loss of that city in September 1645 (nos 31–35). Unlike other royalist issues, most of this group also contain no detectable gold (i.e., < 0.1 per cent) and have high lead contents. Similar high lead contents were observed in two threepences of this series (Appendix 1), while the detection of gold in trace quantities only (<0.01 per cent) by the sensitive microprobe method is also surely significant. The locations of their mints are not known with certainty: Welsh sites have been suggested (a small coinage at Aberystwyth late in Old Style 1645 is documented), while there is also a strong and logical case for Ashby (Leics.), Bridgnorth (Shropshire) and a third, unknown, site.[19] The closest parallels to these compositions seem to lie in the Aberystwyth and Silver Mills coins (nos 93, 95 and the extensive series in Appendix 1). Since most were analysed using a different technique, direct comparison may not be sensible (no. 94, of Aberystwyth, also appears not to conform to this pattern, but again was examined by another different method). The similarities are, however, remarkable and there appears, *prima facie*, to be a distinct possibility that the 'A', 'B' and 'Plumes' mints of 1645–6 employed Welsh silver.

[14] Abbeylands: *BNJ* 29 (1958–9), 410–12; Templetuohy: *BNJ* 27 (1952–4), 215.

[15] Exeter mint book 'A', Cornwall Record Office V/BO/21, pp. 4, 6, 8.

[16] 'The Spanish Ryalls fine, eleven ounces, 3½ pennie weight' [=941 ppm]: G. Malynes, *Lex Mercatoria* (1622), p. 300; ducatons: H. Enno van Gelder and M. Hoc, *Les Monnaies des Pays-Bas Bourguignons et Espagnols 1434–1713* (Amsterdam, 1960), p. 162.

[17] Analyses of four similar coins quoted by D.G. Liddell and P.A. Rayner, 'Charles I Truro/Exeter half-crowns', *BNJ* 30 (1960–1), at p. 158, give gold contents of 3 per cent, though the (unspecified) silver contents of all, calculated by difference, are distinctly lower.

[18] Patagons: van Gelder and Hoc, p. 163; Reichstaler: W. Hess and D. Klose, *Vom Taler zum Dollar* (Munich, 1986), p. 63.

[19] Boon, *Cardiganshire Silver*, pp. 122–30.

TABLE 1. Analyses of silver coins (half crowns except where indicated)[20]

No.			*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Other*	*Reference*
	Tower Mint								
1	Portcullis (1633–4)		92.8	7.0	–	0.2	–		CT 7393
2	Crown (1635–36/7)		93.0	6.7	–	0.3	–		E 0969
3	Star (1640–1)		92.9	6.4	0.1	0.6	–		1895–7–5, 28
4	Tr.-in-circle (1641–3)		93.0	6.4	–	0.6	–		1895–7–5, 33
5	(P) (1643–4)		93.0	6.4	0.1	0.4	–		E 1009
6	(P) (1643–4)		92.4	7.4	0.03	0.19	0.03	Bi 0.03	CC 1608 [AAS]
7	(R) (1644–5)		93.2	6.3	–	0.5	–		CT 7420
8	Sceptre (1647–49)		92.6	6.8	0.1	0.5	–		E 1032
	Shrewsbury								
9	1642	A1	91.3	8.0	0.2	0.5	–		E 1062
10	1642	D4	92.6	6.3	0.2	0.9	–		CT 7470
11	1642 [10 shillings]	F3	92.0	6.9	0.11	0.5	0.45	Bi 0.04	CT 7349 [AAS]
	Oxford								
12	1642 [10 shillings]	A2	92.1	6.9	0.14	0.5	0.35	Bi 0.04	CT 7347 [AAS]
13	1642	B4	92.5	6.7	0.2	0.6	–		1896–12–2, 104
14	1643	F10	91.9	7.1	0.3	0.5	0.2		E 1055
15	1643	A2	91.4	7.7	0.1	0.5	0.2		1984–2–20, 1
16	1643	I24	91.0	8.1	0.2	0.7	–		E 1058
17	1644	C4	89.8	9.5	0.2	0.5	–		1896–12–2, 112
18	1644	D8	90.0	9.0	0.1	0.6	–		1984–2–20, 2
19	1645	E7	88.0	10.1	0.3	1.6	–		SSB 67–1
20	1645	B1	86.5	12.4	0.4	0.5	–		1984–2–20, 3
21	1645	F4	90.6	8.9	–	0.4	–		1984–2–20, 4
22	1646	A1	90.2	8.4	0.5	0.7	0.2		E1061
23	1646	B-	91.4	7.6	0.4	0.5	–		1984–2–20, 5
	Bristol								
24	1643	D10	88.7	10.0	0.3	0.7	0.3		E 1066
25	1643	A5	91.6	7.2	0.3	0.8	–		NMW 83.124H/2
26	1644	B1	90.6	8.5	0.2	0.7	–		CT 7435
27	1644	D5	91.9	6.5	0.1	1.5	–		1984–2–20, 6
28	1644	B1	92.6	6.7	0.2	0.5	–		NMW 84.2H/2
29	1645	B1	89.9	9.4	0.2	0.5	–		CT 7436
30	1645	A2	91.7	7.6	0.2	0.5	–		NMW 84.2H/3
	'Late Declaration'								
31	1645 A		92.6	5.7	0.1	1.6	–		38–9–21, 74
32	1645 A		92.9	5.5	–	1.6	–		1984–2–20, 7
33	1646 A/B		93.9	4.6	–	1.5	–		SSB 67–15
34	1646 'Plumes'		93.8	4.9	–	1.3	–		CT 7438
35	1646 'Plumes'		93.7	5.1	–	1.2	–		NMW 78.9H/1
	York								
36	n.d.	1A	91.1	7.2	0.1	0.8	–	Sn 0.7	E1080
37	n.d.	1D	93.2	6.0	0.2	0.6	–		CT 7488
38	n.d.	1E	92.1	6.7	0.3	0.9	–		SSB 65–65
39	n.d.	2D	92.4	6.7	0.2	0.6	–		CT 7482

[20] In Table 1, NMW references are accession numbers. All other refs. are BM coins, as follows: C = Continental Series; CC = Chancery Coins [see *Coin Hoards* 7 (1985), no. 572]; CT = Clark-Thornhill bequest [1935–4–1]; E = English Series; ER = English Reserve; GHB = Grueber, *Handbook*, SSB = Sarah Banks collection [1811]. For individual coin types – *Shrewsbury*: H.W. Morrieson, *BNJ* 12 (1918), 195–211; *Oxford*: H.W. Morrieson, *BNJ* 16 (1924), 129–88; *Bristol*: H.W. Morrieson, *BNJ* 18 (1929), 135–57; *York*: E. Besly, *BNJ* 54 (1984), 210–41; *Truro and Exeter*: R.C. Lockett, *BNJ* 22 (1934–7), 227–46; *W. SA*: D.F. Allen, *BNJ* 23 (1938–41), 97–118; *Chester*, etc.: R. Lyall, *NCirc* March, 1971, 98–9.

TABLE 1 (Cont.)

No.			*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Other*	*Reference*
40	n.d.	2G	93.0	6.1	0.2	0.6	–		E 1086
41	n.d.	3A	92.7	6.3	0.2	0.6	–		CT 7485
42	n.d.	3E	92.3	6.6	0.3	0.6	–		1920–9–7, 1000
	Truro and Exeter								
43*	'Truro' (Bugle)	–	92.9	6.4	0.2	0.5	–		E 1039
44	Truro, n.d.	4	90.7	7.6	0.5	1.2	–		41–7–30, 395
45	Truro, n.d.	8	92.2	6.9	0.2	0.7	–		1895–7–5, 46
46	Exeter, n.d.	14	90.8	8.2	0.2	0.6	0.2		1895–7–5, 51
47	Exeter, n.d.	19a	94.2	6.9	0.3	0.5	–		E 1041
48	Exeter, '1642'	1	96.5	3.1	0.4	0.2	–		CT 7441
49	Exeter, 1644	25	92.5	6.4	0.3	0.6	0.2		1898–3–1, 48
50	Exeter, 1644	22	92.9	6.3	0.3	0.5	–		CT 7442
51	Exeter, 1644	29	91.3	7.7	0.3	0.7	–		E 1045
52	Exeter, 1645	32a	88.9	10.6	0.1	0.4	–		CT 7444
	W, SA, etc.								
53	1644	A1	91.7	7.7	0.2	0.4	–		CT 7480
54	n.d.	B6	92.2	6.9	0.2	0.7	–		E 1047
55	n.d.	B17	90.5	8.6	0.3	0.3	0.2		1984–2–20, 8
56	n.d.	C13	87.2	11.2	0.5	0.8	0.3		47–5–18, 2
57	n.d.	C16	93.7	5.5	0.2	0.5	0.2		NMW 84.125H
58	n.d.	D22	92.2	7.1	0.2	0.5	–		CT 7477
59	n.d.	E25	89.3	9.8	0.4	0.5	–		CT 7476
60	n.d.	F29	91.3	7.9	0.2	0.6	–		(Lockett)
61	n.d.	F -	92.2	6.6	0.1	0.7	0.4		1984–2–20, 9
62	n.d. [SA]	G30	93.0	6.2	0.3	0.5	–		54–6–21, 63
63	n.d.	H32	88.8	10.5	0.2	0.5	–		E 1050
64	n.d.	H32	93.4	5.7	0.3	0.6	–		NMW 83.30H/12
65	n.d.	I34	93.9	5.2	0.2	0.7	–		39–9–21, 66
66*	n.d.	I -	94.4	4.8	0.2	0.5	–		NMW 86.39H
67	n.d.	J48	92.5	6.8	0.1	0.6	–		42–7–29, 118
68	n.d.	J52	91.1	8.1	–	0.6	–		E 1053
69	n.d.	K55	86.4	12.5	0.2	0.5	0.3		1984–2–20, 10
70	n.d.	L57	85.8	13.0	0.3	1.2	–		NMW 83.114H
71	n.d.	L57	57.1	41.5	0.1	1.3	–		E 1054
72*	n.d.	L -	75.5	22.9	0.5	1.1	–		1984–11–5, 1
	Chester and related								
73	1644	C3	92.3	6.8	0.2	0.5	0.2		E 1075
74	n.d. [CHST]	B2	93.0	6.1	0.2	0.7	–		CT 7439
75	n.d.	ai	90.5	8.3	0.3	0.6	0.3		CT 7290
76	n.d.	ai	93.9	5.2	0.1	0.7	–		NMW 79.86H/10
77	n.d.	bii	85.3	12.8	0.5	0.8	0.6		CT 7489
78	n.d.	bii	93.2	5.6	0.3	0.6	0.4		NMW 79.106H/103
79	n.d.	bii	90.3	8.5	0.3	0.7	0.2		NMW 79.106H/104
80	n.d.	biii	91.9	7.5	–	0.5	–		E 1037
81	n.d.	biv	90.3	8.2	0.5	0.7	0.3		E 1038
	Unattributed, probably Cary mints								
82	1644 CH		90.3	8.6	0.3	0.8	–		E 1076
83*	1644 CH		93.7	5.3	0.2	0.7	–		NMW 79.106H/105
84*	1644 CH		90.3	7.9	0.8	0.7	0.1		1984–7–2, 1
85	n.d. HC		91.1	7.9	0.2	0.8	–		GHB 649
86	n.d. HC		90.8	8.1	0.2	0.6	0.3		1984–2–20, 11
87	1644 Declaration		90.0	8.7	0.2	0.8	0.3		E 9999
88*	1644 Declaration		91.9	7.0	0.4	0.5	0.2		NMW 87.491H/3

No.		*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Other*	*Reference*
89	n.d. Garter	90.0	8.4	0.3	1.0	0.3		E 1078
90	1645 Garter	68.1	26.8	–	4.2	–	As 0.9	CT 7440
91	1645 Garter	74.2	19.8	1.2	3.5	0.5	As 0.6; Sn 0.2	E 1077
92	1645 Garter	78.1	18.7	0.9	1.8	–	As 0.4	NMW 84.67H/4
	Other British issues							
93	Aberystwyth (1639–42)	93.1	5.6	–	1.2	–		CT 7429
94	Aberystwyth (1639–42)	91.4	8.3	0.01	0.25	–		ER 250 [AAS]
95	Silver Mills (1648)	93.4	4.9	–	1.7	–		E 1035
96*	'Blacksmith' half crown	90.7	7.9	0.4	0.8	0.3		54–6–21, 62
97	Carlisle siege 3s., 1645	90.2	8.2	0.5	0.6	0.3		E 1397
98	Newark siege 2s 6d, 1646	94.0	5.5	0.1	0.2	–		CT 7720
	Foreign coins							
	Patagon							
99	Brabant, 1618	92.8	6.8	–	0.4	–		49–7–3, 1
100	Brabant, 1634	85.7	11.0	0.2	3.1	–		NMW 88.44H
	Ducaton							
101	Brabant, 1638	95.4	4.4	–	0.2	–		C 1125
	Spanish dollar (8-reales)							
102	Potosi, n.d., 1632–70	96.3	3.7	–	0.1	–		77–2–4, 1
	Reichstaler							
103	Mansfeld, 1610	88.0	10.9	0.4	0.5	–		SSB 72–54

* : coin illustrated in **Plate 10**

Comparative SG figures (E.G.V. Newman, for Spink & Son Ltd, 1984):
1. 'Bugle' half crowns as no. 43: three specimens, all approx. 92.5% silver.
2. W/SA, Allen F 29, as no. 60: approx. 81% silver.
3. HC, as no. 85: approx. 89% silver.
4. 1644 Declaration no. 88, this coin, approx. 85% silver; three others: approx. 79, 85 and 85% silver.
5. 1645 Garter, as no. 90, approx. 75% silver.

2. GOLD

Results for the gold coins are given in Table 2. Once again, the Tower examples are consistent and close to the standard. The royalist coins all lie below, to a greater or lesser degree, the best achieving around 21½ carats (89.6 per cent fine gold), the worst around 20½ ct (85.4 per cent gold). Whether or not this always represents deliberate debasement is another question, though in the Oxford series the drop in fineness appears to parallel that of the silver during 1644–5. It may be noted that a one-carat drop is equivalent to eleven pence (*d*) or 4½ per cent off the intrinsic value of a twenty shillings piece. At mints such as Truro and Exeter, however, the gold outputs were clearly very small (one specimen survives that can be attributed to Truro and three to Exeter) and the measured fineness may simply reflect the quality of the jewellery or plate melted. While the standard for silver had since 1300 stood at 11oz 2dwt (sterling), that for gold had been set at 22 carats as recently as 1576.[21] Previously the minimum standard for gold wares in England had since 1477 been 18 carats (75 per cent), so an admixture of a modest amount of pre-1576 gold might have a marked effect on the fineness of a small melt.

[21] *Jackson's Silver and Gold marks of England, Scotland & Ireland*, edited by I. Pickford, 3rd Edition (1989), pp. 26–9.

TABLE 2. Analyses of gold coins

No	*Mint*	*SG*	*% Au if binary alloy*		*XRF Analysis*			*% Au*	*Reference*
			Au/Cu	*Au/Ag*	*% Au*	*% Ag*	*% Cu*	*(Approx)*	
	Tower								
1	Anchor, 1628–9	17.76	93.1	89.2	92	5.8	2.0	90.8	CT 7212
2	Crown, 1635–6	17.87	93.7	90.0	92	6.4	1.7	91.2	GHB 566
3	(R), 1644–5	17.73	93.0	89.0	91	6.8	2.3	90.6	43–1–24, 1
	Oxford								
4	1642	17.72	92.9	88.9	93	6.4	0.5	89.4	96–12–2, 96
5	1643*	17.70	92.8	88.7	93	6.1	0.8	89.6	52–6–26, 4
6	1643	17.51	91.9	87.4	89	9.2	1.4	88.4	E 0860
7	1643	17.25	90.4	85.3	90	6.3	3.3	88.1	1954–10–2, 30
8	1644	17.77	93.2	89.3	90	9.8	0.3	89.5	96–12–2, 98
9	1644*	17.61	92.4	88.1	89	9.5	1.1	88.8	E 0845
10	1644	16.82	88.1	81.9	86	8.1	5.8	85.7	E 0863
11	1645	17.13	89.8	84.4	86	13.9	0.4	84.7	41–9–28, 24
12	1646	16.95	88.8	83.0	87	9.3	4.1	85.9	E 0864
	Bristol								
13	1645	17.35	91.0	86.1	89	8.4	2.5	88.0	GHB 610
14	1645	17.23	90.3	85.2	90	7.7	1.9	86.9	96–12–2, 86
	Exeter								
15	n.d.	17.11	89.7	84.3	90	8.7	1.6	85.7	1956–10–10, 2
16	n.d.	17.18	90.1	84.8	91	9.0	0.5	85.3	1954–10–2, 35
	W/SA								
17	n.d.	17.25	90.4	85.3	90	8.5	1.9	87.0	1957–10–11, 1
18	n.d.	17.06	89.4	83.9	89	7.0	3.9	87.0	46–6–26, 2
	Chester								
19	n.d.	17.45	91.5	86.9	89	7.3	8.4	89.2	47–5–18, 1

* = £3 pieces ('Triple Unites')

Survey of weights

The results of a survey of the weights of 395 Tower Mint and 1,332 royalist silver coins are given in Tables 3 and 4 and of 368 Tower Mint and 166 royalist gold coins in Table 5. The comparison of the weights of surviving specimens with the prescribed standards is less straightforward than for their metallic compositions, since the contemporary prevalence of culling and clipping makes it harder today to be sure that the sample available reflects accurately the original output. Although the set weights of the different denominations may be deduced from the general standards, and mint workers might be paid bonuses for accurate sizing, the weights of individual specimens can vary considerably, and this was tolerated as long as a given batch conformed to the required overall weight. It follows, though, that every freshly-minted batch of silver coin which left the Tower Mint contained a proportion of overweight coins. The culling for profit of these heavy coins from large batches seems to have been a veritable industry in the London of the 1630s. The net result was an underweight circulating silver currency. Likewise, because English silver was of fixed faced value, 'heavy' coins or those of larger than usual diameter might also be clipped, a practice which seems to have been particularly prevalent in the north of

England.[22] The rapid dissemination (and burial) of Tower coins during the war has, however, resulted in several hoard groups of fresh coins of full weight, for example,

Ryhall, Rutland (1987): 1,712 Triangle-in-circle shillings, average 6.03 g (100.2%);

Taunton, Somerset (1981): 45 Triangle-in-circle shillings, 6.04g (100.3%); 11 (P) shillings, 6.02g (100%).[23]

Typically, even hoard groups fall a small way short of the prescribed weight. The (R) coins which formed the latest portion of the Ashdon (Essex) hoard found in 1984 may be cited: 147 shillings, 5.94 g (98.7%) and 23 half crowns, 14.97g (99.5%). These coins were all both mint-fresh and perfectly preserved.[24]

Royalist coins are generally too rare for a significant group of any one type to be found in a single deposit, the sole exceptions being group 3 York half crowns from Pocklington (48 or more) and undated Exeter half crowns of Lockett's types 13 and 14 from East Worlington (around 35).[25] The vast majority of specimens of these types surviving today are derived from the uncirculated batches contained in these two hoards. For most royalist issues, the weights recorded are therefore of specimens from museums, private collections and the trade, as well as those from hoards.[26] For a fairer comparison, Tower half crowns of 1643–9 in the survey include specimens from the same sources. Where possible, each coin has been examined personally and clipped or significantly worn specimens excluded. Where coins have been drawn from sale catalogues and other illustrated sources, coins that are obviously clipped or worn have also been excluded but, apart from specimens of machine-made issues (York, Briot), removal of all clipped coins cannot be guaranteed. Examples of characteristic weight distributions represented by the summaries in Tables 3 and 4 are given in Figures 1 and 2.

TABLE 3. Weights of silver half crowns

Mint	*No. of coins*	*Mean wt. (g)*	*% of Standard*	*Range (g)*
Tower				
(P) (1643–4)	55	14.88	98.9	13.77–15.53
(R) (1644–5)	58	14.93	99.2	13.09–15.96
Eye (1645)	35	14.87	98.8	13.96–15.62
Sun i (1645–7)	43	14.87	98.8	14.05–15.93
Sun ii (1645–7)	21	14.77	98.1	13.97–15.70
Sceptre (1647–9)	11	14.82	98.5	14.11–15.59
Briot i (1631–2)	9	14.92	99.1	14.73–15.14
Briot ii (1638–9)	11	15.00	99.7	14.81–15.33
Aberystwyth				
n.d. (1639–42)	32	14.74	97.9	13.55–15.30
Shrewsbury				
1642	54	14.76	98.1	13.14–15.46

[22] Besly, *English Civil War Coin Hoards*, pp. 64–6; see also below, p. 76 (Grewelthorpe hoard).

[23] Ryhall: *BNJ* 58 (1988), 96–101; Taunton: *CH* 7 (1985), no. 566, weights information by courtesy of S. Minnitt.

[24] Ashdon: Besly, *English Civil War Coin Hoards*, pp. 18–22.

[25] Pocklington: *NC* 1851, 42–3; E. Worlington: *NC* 1897, 145–58.

[26] Principal sources: BM, NMW, Ashmolean, Fitzwilliam, Hunterian, ANS; A.H. Baldwin & Sons Ltd (including Lingford collection); Ashdon, Priorslee, Soham and Guildford hoards; Brooker collection (*SCBI* 33); Spink Sale catalogues.

Mint	*No. of coins*	*Mean wt. (g)*	*% of Standard*	*Range (g)*
Oxford				
1642	56	14.65	97.3	13.20–16.63
1643	104	14.77	98.1	13.39–15.92
1644	70	14.61	97.1	13.60–15.47
1645	23	14.60	97.0	13.13–15.46
1646	25	14.83	98.5	13.59–15.59
Bristol				
1643	28	14.61	97.1	13.85–15.94
1644	79	14.53	96.5	12.54–17.71
1645	18	14.57	96.8	13.00–15.26
'Late Declaration'				
1645 A	9	14.37	95.5	13.42–14.84
1646 'Plumes'	14	14.91	99.1	13.82–15.42
York				
n.d., Group 1	27	14.23	94.6	13.20–15.02
n.d., Group 2	81	14.15	94.0	12.37–15.57
n.d., Group 3	59	14.58	96.9	13.28–15.51
Truro				
n.d., RCL 2–11	32	14.50	96.3	13.15–16.29
Exeter				
n.d., RCL 13–20	43	14.22	94.5	12.61–14.97
1644	32	14.16	94.1	12.85–14.89
1645	21	14.36	95.4	12.80–15.17
W, SA, etc.				
n.d., Allen A–F	66	14.46	96.1	12.59–15.81
n.d., Allen G–L	41	14.41	95.8	13.08–15.25
Chester and related				
1644 [C3]	6	14.70	97.7	14.18–15.22
n.d., CHST [B2]	14	14.19	94.3	13.62–14.68
n.d., Gerb [ai]	9	14.64	97.3	14.45–14.83
n.d., [bii]	7	14.48	96.2	14.16–14.74
Unattributed				
1644 CH	2	14.71	(97.7)	(14.57–14.84)
n.d. HC	12	14.65	97.3	14.28–14.86
1644 Declaration	6	14.53	96.5	14.23–14.78
1645 Garter	11	14.44	96.0	13.37–15.06
Other				
n.d., 'Blacksmith'	14	13.99	92.9	12.83–14.98

Once again, the Tower Mint output seems to have been of great consistency, average weights of the half crowns varying little from year to year, just below the standard – out of remedy as a result of culling. Again, these provide the yardstick against which to judge the royalist issues. Shrewsbury and Oxford, especially in the crowns and larger denominations (Table 4), seem to have achieved results close to those required. In general, the crowns and the 'medals' of ten and twenty shillings are perhaps the best indicators, since they were not coins of everyday circulation and are rarely found in worn or in clipped condition, and were less easily available for culling. Among the half crowns, those of Oxford dated 1644

and 1645 parallel in their weights the drop in fineness noted above, again with an improvement in 1646. Bristol, the 'late declaration' and Cary's mints vary somewhat, but generally achieve figures over 96 per cent of standard, as does Truro.

TABLE 4. Weights of the larger silver denominations

Denomination and mint	*No. of coins*	*Mean wt. (g)*	*% of Standard*	*Range (g)*
Crowns				
Tower				
Group I (1625–30)	37	29.82	99.1	29.22–30.48
Group II (1630–4)	38	29.84	99.1	28.39–30.66
Group III (1634–40)	42	29.88	99.3	29.43–30.48
Groups IV+V (1643–9)	27	29.83	99.1	28.90–30.24
Briot (1631–2)	8	29.89	99.3	29.79–29.97
Shrewsbury				
1642	22	29.75	98.8	29.12–30.42
Oxford				
1642	16	29.68	98.6	29.21–30.49
1643	25	29.67	98.6	28.30–30.53
1644	6	28.92	96.1	27.18–29.60
Truro				
n.d. (RCL 1)	34	29.36	97.6	28.55–30.43
Exeter				
n.d. (RCL 2–5)	27	28.29	94.0	25.57–29.95
1644	32	28.44	94.5	25.74–29.89
1645	74	28.49	94.6	25.69–30.03
Ten Shillings				
Shrewsbury				
1642	37	60.28	100.1	58.10–73.98
Oxford				
1642	22	59.85	99.4	59.17–60.82
1643	11	59.73	99.2	58.61–60.36
Exeter				
n.d. (RCL 1)	1	59.18	98.3	–
Twenty Shillings				
Shrewsbury				
1642	24	119.4	99.2	118.7–122.2
Oxford				
1642	28	119.7	99.4	118.4–120.2
1643	18	119.9	99.6	117.8–120.5
1644	6	119.4	99.2	118.6–119.9

Exeter and York stand out from the other mints, in that surviving coins consistently fail to reach 95 per cent of the standard. These two mints also show very poor control of weights (Fig. 1f, h; Fig. 2e, f), so it is possible that their overall figures are artificially depressed by the very light weights of some specimens, the correspondingly very heavy specimens having disappeared through culling. However, it is noticeable that of 167 Truro and Exeter crowns in this survey, three only (two of them Truro) exceed thirty grams and of 128 half crowns, six (four Truro) exceed fifteen grams. From York, twelve half crowns in 167 exceed 15g. At Oxford, in contrast, roughly one in four of all specimens achieves these weights. The poor control of weights at Exeter and York may reflect the relative lack of experience at these mints compared with the Bushell/Parkhurst series (though the Truro workmen achieved better results than their Exeter counterparts), compounded perhaps at York by the nature of the machinery used. But it is also possible that bullion was 'stretched' a little

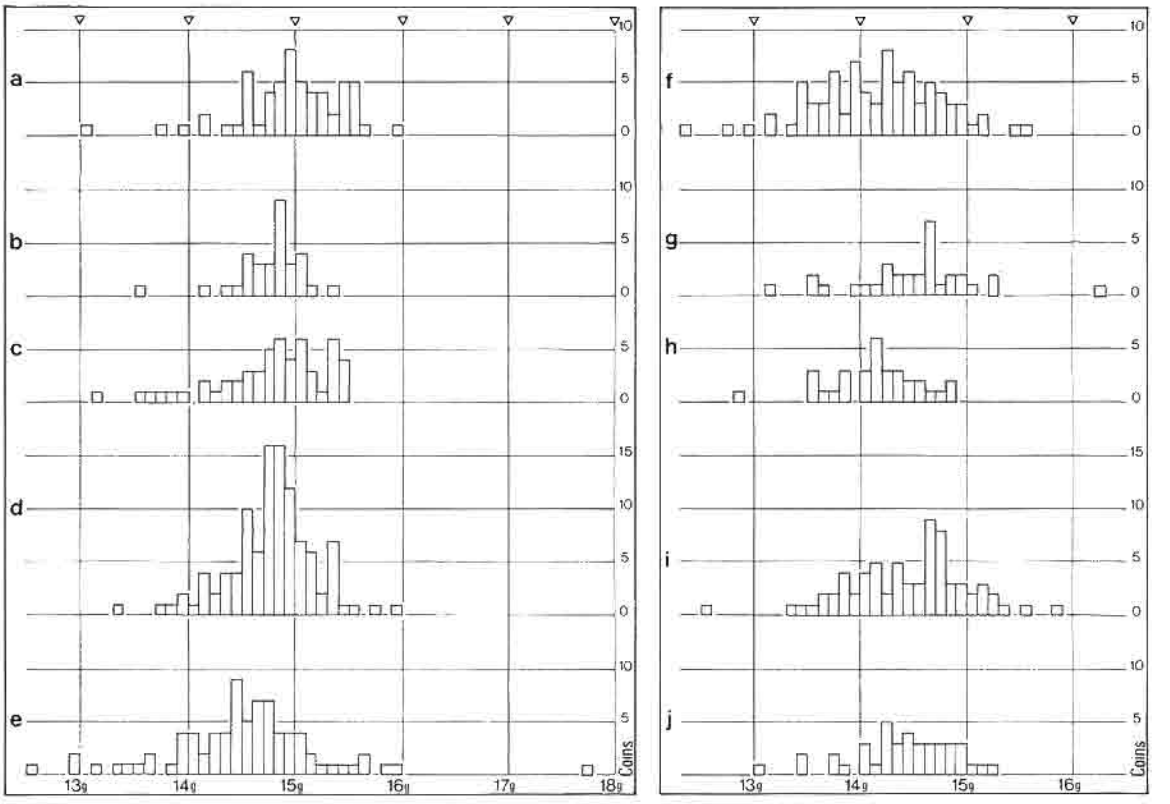


Fig. 1. Characteristic weight distributions: half crowns.
a: Tower, (R); b: Aberystwyth; c: Shrewsbury, 1642; d: Oxford, 1643; e: Bristol, 1644; f: York, Group 2; g: Truro; h: Exeter, 1644; i: W, Allen A–F; j: SA, etc., Allen G–K.

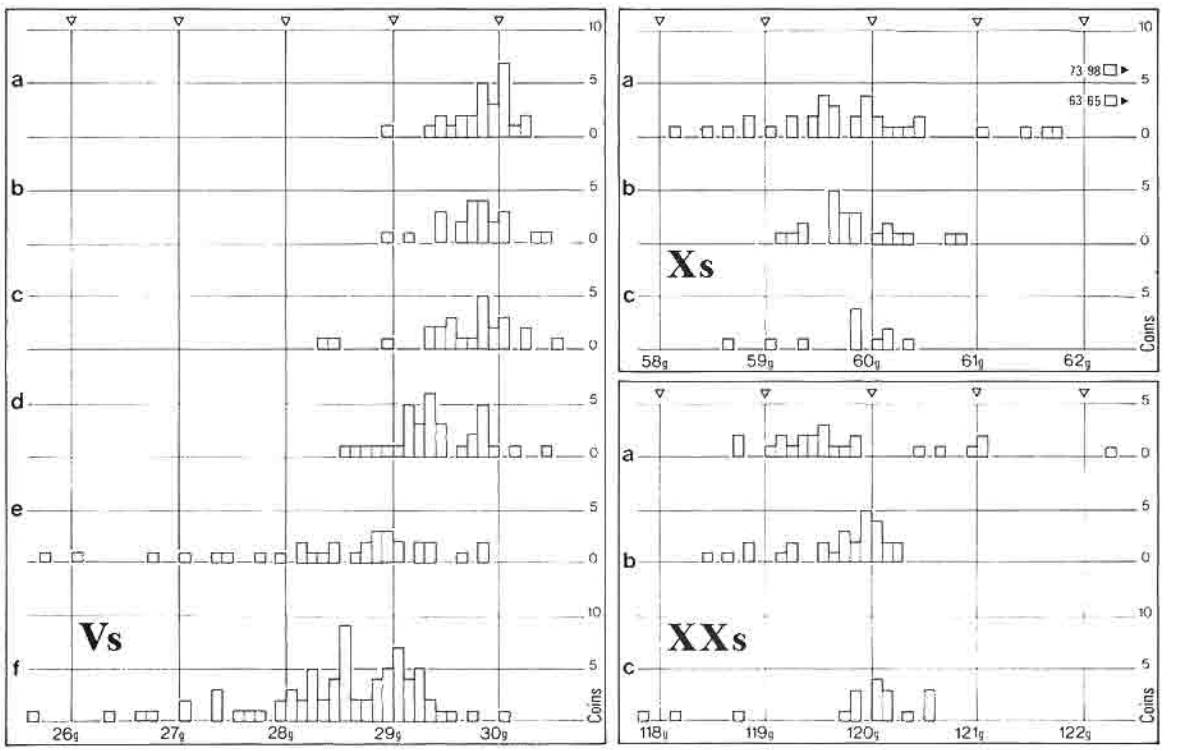


Fig. 2. Weight distributions, larger denominations
Crowns, a: Tower, (P) – Sun; b: Shrewsbury, 1642; c: Oxford, 1643; d: Truro (RCL. 1); e: Exeter, 1644; f: Exeter, 1645. *Ten shillings*, a: Shrewsbury, 1642; b: Oxford, 1642; c: Oxford, 1643. *Twenty shillings*, a: Shrewsbury, 1642; b: Oxford, 1642; c: Oxford, 1643.

by the production of coins that were under weight, though normally by no more than those that were already in general circulation. The 96–97 per cent of standard observed for many royalist half crown issues matches exactly the overall average weights noted for several recent Civil War hoards, which contain a mixture of worn (and to some extent clipped) silver of Elizabeth and James I alongside fresh issues from the Tower Mint.[27]

TABLE 5. Weights of gold coins

Denomination and mint	*No. of coins*	*Mean wt. (g)*	*% of Standard*	*Range (g)*
Twenty shillings				
Tower				
n.d. (1625–6)	49	8.99	98.8	8.78–9.10
n.d. (1626–30)	114	9.00	98.9	8.72–9.28
n.d. (1630–39)	149	9.01	99.0	8.53–9.21
n.d. (1639–49)	56	9.00	98.9	8.79–9.18
Oxford				
1642	18	9.02	99.1	8.84–9.23
1643	31	8.95	98.4	8.69–9.10
1644	20	8.94	98.2	8.64–9.15
1645	5	8.83	97.0	8.34–9.05
1646	5	8.90	97.8	8.48–9.05
Bristol				
1645	3	8.72	95.9	(8.46–8.89)
Chester				
n.d. (1644–5)	2	8.92	98.0	(8.84–8.99)
Exeter				
n.d. (1643–4)	3	9.06	99.6	(9.04–9.08)
W/SA				
n.d. (1644–6)	3	8.84	97.2	(8.78–8.94)
Sixty shillings				
Oxford				
1642	25	27.01	98.9	26.72–27.24
1643	32	26.91	98.6	26.24–27.41
1644	19	26.93	98.6	26.25–27.28

Of the royalist gold coins, sufficient survive only from Oxford for a meaningful survey of their weights (Table 5). Indeed, it is the wartime Tower issues which are rare today, because of disproportionate survival of the distinctive Oxford coins, so comparative Tower weights are drawn from a wider date span.[28] As might be expected, average weights lie close to the standard, with tighter control of weights at all mints and Oxford achieving results comparable with those of the Tower Mint. The 1645 and 1646 coins drop away, but with such a small sample this may not be significant. The very few twenty shillings pieces from other royalist mints (Bristol, Exeter, Chester and W/SA) are comparable.

Conclusions

The coins analysed in this survey, though numerous, represent for the most part single specimens of a wide variety of issues, so their evidence can only be indicative. Likewise, their weights, for the reasons given, must be interpreted with caution. However, there seems to be little doubt that, despite their inexperience and the lack of strict accounta-

[27] Besly, *English Civil War Coin Hoards*, pp. 64–7.

[28] Royalist gold: principal sources as for silver (note 26). The figures for Tower gold are based on the BM, Brooker and I. Round (Spink Sale 50) collections.

bility, the royalist mintmasters produced coinage which at best matched that of the Tower Mint, and in general was not inferior to the quality of the contemporary circulating medium. There is a systematic drop in quality of Oxford's output during 1644–5, but this may reflect attested operating difficulties. Drastic debasement of the silver coinage took place in two series only, both probably within Sir Thomas Cary's franchise, and both very late in the 'first' Civil War.

APPENDIX 1
Electron Microprobe Analyses of Aberystwyth and related silver coins

In 1984, a series of electron microprobe analyses of silver coins of the Aberystwyth and Silver Mills mints was carried out for the National Museum of Wales by Dr J.P. Northover. These, and a small series of comparative figures for Tower Mint and other coins, are presented in the accompanying table. (Small quantities of Iron, Cobalt, Nickel and Antimony were also measured, all on average of the order of 0.01 per cent; Tin was not detected in any sample).

The electron microprobe method is both sensitive and precise in measuring the composition of small areas (50μm square) on prepared surfaces. The results quoted were obtained by averaging three such readings on each coin. For half groats and threepences, these areas were on the edges of the coins, but for larger coins (4d, 6d, 1s) it was necessary to examine small areas of the faces, by abrading raised punctuation points. For these coins, silver figures may tend to be too high, since full removal of any surface enrichment could not be guaranteed, because of the caution required in abrading.

Mint and denomination		*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Bi*	*Reference*
Tower								
Twopence	1631–2	91.38	7.02	tr	0.68	0.75	–	79.56
	1632–3	92.10	6.32	0.08	0.59	0.71	0.08	85.56
	1637–40	90.61	8.12	–	0.22	0.61	0.36	41.261
	1637–40	89.00	9.25	0.16	0.48	0.56	0.49	41.261
	1637–40	92.01	6.97	–	0.34	0.35	0.27	41.261
Shilling	1639–40	92.87	6.86	0.03	0.08	–	0.09	83.11H/276
Aberystwyth								
Threepence	Morr. A	90.47	7.29	–	1.58	0.55	0.08	56.458/9
		90.90	6.76	–	1.69	0.38	0.21	28.110
		91.46	7.50	–	0.51	0.20	0.25	28.110
		92.97	6.33	–	0.49	0.16	–	28.110
		92.00	6.55	0.10	0.73	0.44	0.18	79.57
		89.68	8.47	–	0.82	0.27	0.46	83.11H/203
		(91.2	*7.2*	*0.02*	*0.97*	*0.33*	*0.20*	*6 coins)*
	Morr. B	91.37	6.90	–	1.57	0.16	–	56.458/10
		91.93	6.35	–	1.21	0.13	0.36	56.458/8
		91.44	7.92	–	0.41	0.03	0.11	28.110
		93.08	5.82	0.05	0.96	tr	–	83.11H/172
		(92.0	*6.7*	*0.01*	*1.04*	*0.08*	*0.12*	*4 coins)*
Sixpence	Morr. A	91.42	8.14	tr	0.41	0.02	–	28.110
		91.03	7.78	0.05	1.04	0.04	–	78.18H/4
		91.70	7.81	0.02	0.32	0.01	0.11	57.354/3
	Morr. B	92.73	5.41	0.02	1.81	tr	–	28.110
		93.31	6.14	–	0.59	0.04	–	76.16H/1
Shilling	Morr. A	95.26	4.43	–	0.14	0.02	0.08	80.30H/1
		93.31	6.19	–	0.39	–	–	56.458/2
		93.87	5.64	–	0.37	tr	0.05	78.18H/3
		92.44	6.72	0.05	0.69	0.02	–	83.109II/3
		91.72	7.35	0.02	0.85	0.01	–	83.11H/12

Mint and denomination		*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Bi*	*Reference*
		91.79	7.37	tr	0.73	0.04	–	/13
		94.45	5.10	–	0.35	0.03	–	/14
		92.60	6.88	–	0.32	0.03	0.20	/15
		94.82	4.83	–	0.32	0.01	–	/16
		93.44	6.32	–	0.33	0.03	0.07	/17
		92.17	6.17	tr	1.54	0.02	tr	/18
		92.17	7.31	0.03	0.24	0.02	0.21	/20
		93.82	5.11	0.05	1.02	0.01	–	/21
		94.10	5.24	0.04	0.44	0.03	0.05	/22
		92.59	6.43	0.01	0.94	0.03	0.08	/23
		91.51	7.81	tr	0.52	0.03	0.07	/24
		(93.13	*6.18*	*0.01*	*0.57*	*0.02*	*0.05*	*16 coins)*
	Morr. C	94.10	5.48	0.04	0.36	0.03	–	47.48
		92.56	5.55	–	1.72	tr	0.14	78.13H/6
		93.48	5.91	0.03	0.48	0.01	–	83.11H/25
		92.98	6.24	tr	0.68	–	0.04	/26
		92.06	6.14	0.05	1.67	0.02	–	/27
		92.02	5.86	tr	2.13	tr	–	/28
		93.50	5.97	0.03	0.47	0.03	–	/29
		95.58	4.14	0.02	0.12	tr	0.09	/30
		93.00	6.32	tr	0.62	–	–	/31
		92.06	6.31	0.01	1.60	–	–	/32
		93.48	5.89	–	0.53	tr	–	/34
		93.54	5.49	0.03	0.74	0.02	0.09	/35
		93.05	6.32	0.02	0.57	–	–	/36
		92.13	5.90	–	1.90	0.03	–	/38
		92.63	6.83	0.03	0.44	tr	–	/39
		94.24	5.25	–	0.31	0.06	0.13	/40
		91.61	7.26	–	1.02	0.02	–	/41
		(93.06	*5.91*	*0.02*	*0.90*	*0.01*	*0.03*	*17 coins)*
	Morr. B	95.00	4.55	–	0.34	–	0.05	56.458/3
		95.40	3.57	0.04	0.91	0.03	–	83.11H/42
		92.75	5.88	0.02	1.31	tr	–	/43
		93.51	6.01	0.02	0.42	–	–	/44
		91.88	7.01	0.03	1.06	–	–	/45
		92.96	5.57	tr	1.38	tr	–	/46
		93.06	5.68	0.02	1.15	0.04	–	/47
		93.19	5.72	–	0.74	–	0.26	/48
		92.97	6.27	–	0.55	0.05	0.07	/50
		(93.41	*5.58*	*0.01*	*0.87*	*0.01*	*0.04*	*9 coins)*
	Morr. D	92.35	5.76	0.02	1.82	0.02	–	83.11H/52
		*91.65	7.04	0.21	0.63	0.41	–	83.11H/51
Silver Mills								
Threepence		93.77	5.03	–	0.82	0.11	0.17	78.9H/5
		92.93	4.67	0.03	2.49	0.11	0.27	83.72H/3
		92.34	5.65	–	1.54	0.07	0.32	83.11H/281
		93.32	5.47	–	0.80	0.11	0.20	/282
		93.81	4.94	–	1.17	0.04	–	/283
		93.32	4.65	–	1.71	0.08	0.10	/284
		88.77	9.63	0.16	0.63	0.38	0.29	/285
		(92.61	*5.72*	*0.03*	*1.31*	*0.13*	*0.19*	*7 coins)*
Fourpence		94.24	3.43	–	1.93	0.30	–	76.16H/3
		95.76	3.56	0.02	0.58	0.03	–	78.9H/4
		94.01	5.15	tr	0.72	0.03	–	83.11H/279
		91.94	6.30	tr	1.65	0.01	0.05	/280
		(93.99	*4.61*	*tr*	*1.22*	*0.09*	*0.01*	*4 coins)*
Sixpence		92.86	4.98	0.03	2.04	0.03	–	82.64H
Shilling		92.54	5.10	0.03	2.14	–	–	82.46H

Mint and denomination	*Ag*	*Cu*	*Au*	*Pb*	*Zn*	*Bi*	*Reference*
Oxford							
Threepence, 1644	93.11	5.39	–	1.24	0.13	0.07	83.45H/2
Bristol							
Threepence, 1644	90.89	7.24	0.14	1.19	0.41	–	78.26H/2
Late Declaration							
Threepence, 1646	92.50	5.52	–	1.69	0.11	–	77.22H/8
Threepence, 1646	90.69	6.27	–	1.22	1.17	0.34	83.78H
York							
Threepence	86.09	10.28	–	0.67	2.23	0.62	83.30H/14
Exeter							
Threepence, 1644	88.11	9.36	0.29	0.86	1.05	0.22	82.61H

In general the measured silver contents of the shillings are indeed higher than those of the smaller coins, with the exception of the Silver Mills coins.The earlier Aberystwyth sixpences show lower silver, but whether this is systematic cannot be determined from so small a sample. Gold, zinc and bismuth levels are consistent and low for the shillings, but for the smaller coins both zinc and bismuth are consistently higher. Experimental factors (such as transfer from the brass holder during sample preparation) cannot be ruled out, but the figures may suggest that alloy preparation at Aberystwyth could have differed depending upon the denomination intended to be produced – i.e., that different denominations were made on different occasions.

One particular coin is worthy of comment in this context, being one of the two latest Aberystwyth shillings analysed (no. 83.11H/51, **pl.10, 8**). Its silver content is the third lowest measured, its zinc twenty times the average of the others, its gold (0.21 per cent) ten times the average for Aberystwyth shillings, half of which contained 0.01 per cent or less, and there is no bismuth. This combination may indicate a different source of its silver, and it may be noted that this obverse die was among those taken to Shrewsbury in September 1642. A reverse die may have accompanied it (this was certainly true of the half crown dies), in which case it is conceivable that this shilling may represent one of the very first strikings using melted plate at Shrewsbury.

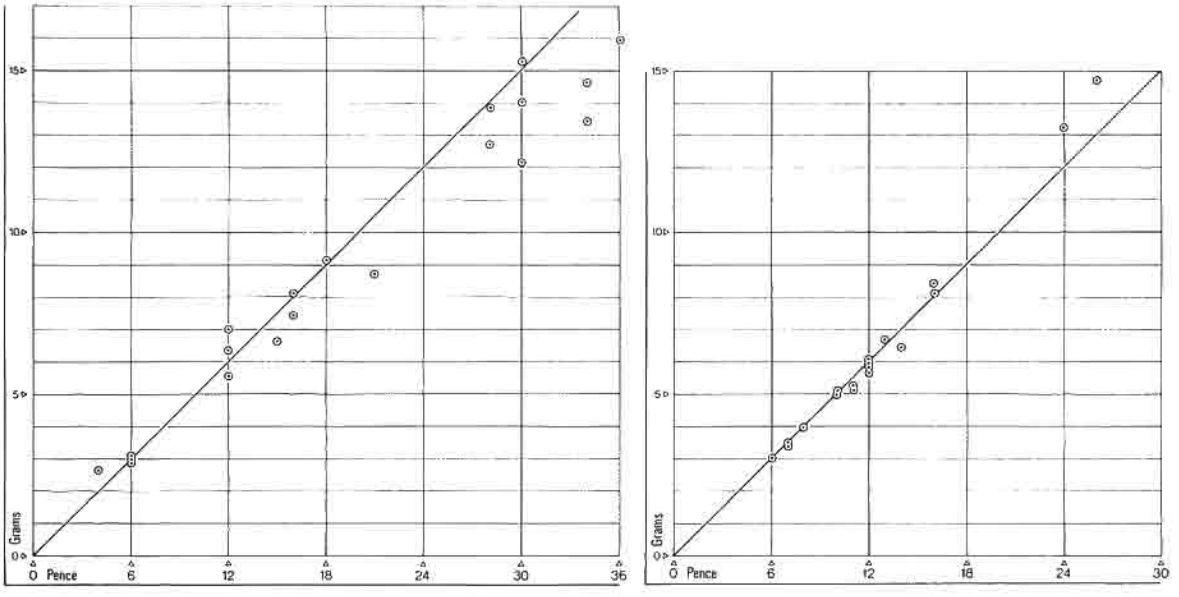
APPENDIX 2
Siege Coinages

The siege issues, because of their exceptional nature, were not originally intended to form part of this survey, though two examples, from Carlisle and Newark, were analysed for comparison with the other types (Table 1, nos 97–8). However, the chance to examine a large group of Newark coins prompted a survey of the weights of all types, though this is less comprehensive than that of the mainstream royalist coinages and is accordingly presented as an appendix. The following table summarises the weights of coins from Carlisle, Newark and Pontefract. Worn and holed specimens (of which many were encountered) are omitted.

Mint and denomination	*No. of coins*	*Mean wt. (g)*	*% of Standard*	*Range (g)*
Carlisle				
1645, shilling	20	5.01	83.2	4.27–5.21
1645, three shillings	13	15.32	(84.8)	14.45–16.36
Newark				
1645, ninepence	30	4.40	(97.3)	4.01–4.65
1645, shilling (NEWARKE)	23	5.83	96.8	5.29–6.12
1645, shilling (NEWARK)	18	5.70	94.7	4.97–6.11
1645, half crown	9	14.42	95.8	13.70–15.07
1646, sixpence	20	2.86	95.0	2.36–3.03
1646, ninepence	18	4.34	(96.2)	3.65–4.56
1646, shilling	29	5.82	96.8	5.45–6.16
1646, half crown	28	14.89	98.9	14.00–15.48
Pontefract				
1648, shilling (P-C, N.2646)	16	5.70	94.6	4.40–6.91
1648, shilling ('P-O', N.2647)	10	5.46	90.6	4.67–7.50
1648, 1s (C II, N.2648)	21	4.78	79.5	3.87–6.13
1648, 1s (C II, N.2649)	16	4.84	80.4	3.87–6.36

The Carlisle coins confirm that precisely six shillings were struck for every five shillings' weight of plate melted (i.e., 83.33 per cent of the Tower standard).[29] At Newark, no advantage seems to have been taken of the exceptional circumstances of a siege issue. The Tower standard was adhered to with as much success as at the regular royalist mints, and the Newark weight ranges are typical of normal issues. Pontefract coins are characterised by a wide range of weights, but overall the first issues appear to be little short of normal coinage. The issues in the name of Charles II appear to have aimed at three-quarters, or perhaps (as at Carlisle) five-sixths of the theoretical standard.

The wide range of denominations and small surviving numbers of each make the above exercise pointless for the Scarborough issues of 1645, though we know from the Governor, Sir Hugh Cholmley, that '[the plate] was cutt in pieces, and passed currant according to there severall weights'.[30] Presented graphically, Scarborough weights are as follows.



Weights of Scarborough siege coins. a: 'broaken castle type'; b: 'two towers' type. The solid lines represent the Tower Mint standard.

Cholmley's comment is borne out, especially for the 'two towers' type (N.2652), where most of the weights were adjusted with great precision. Only above two shillings in the 'broaken castle' issue (N.2650) do some weights start to fall away from the Tower standard. The following are not shown on the graph:

Five shillings and eightpence, 'broaken castle': 30.29g (Hunter)
Five shillings, 'broaken castle': 27.31g (Hunter)
Five shillings, different punch, castle type: 18.92g (BM[Lockett 2574]); 12.69g, 12.53g (both Hunter).

In this context it is interesting to note that the three specimens of five shillings whose weights bear no relationship at all to the rest of the series are all from the same castle punch, which differs from that of the 'broaken castle' group. It is possible therefore that these form an unrelated issue, but whether or not it is contemporary with the others is hard to say. Other pieces which bear a form of 'broaken castle' and the engraved words 'Caroli Fortuna resurgam' (N.2651) are not certainly part of the siege coinage (though contemporary examples are attested by Cholmley's narrative). Of a sample of twelve specimens (seven in the British Museum, two at Oxford, two at Cambridge and one at the ANS) ten weigh between 7.60 and 8.04g, but

[29] P. Nelson, 'The obsidional money of the Great Rebellion', *BNJ* 2 (1905), 291–357, quotes on pp. 301–2 a list dated May 13, 1645 of all plate melted at Carlisle 'Received . . . at 5s per oz . . . stamped out of 1076 oz – ½ – ⅛ at 6s per oz'.

[30] C.H. Firth, 'Sir Hugh Cholmley's narrative of the siege of Scarborough, 1644–5', *English Historical Review* 32 (1917), 568–87, at p. 584.

the two Cambridge pieces weigh 4.33g and 9.13g. Most of the weights correspond to coins of 1s 3d or 1s 4d, though none bears a mark of value, a fact which separates them from all other Scarborough specimens.[31]

In gold, two Pontefract pieces in the name of Charles II weigh 6.08g (BM) and 8.98g (Christie's, 25 April 1989). The 'Colchester ten shillings' in the British Museum weighs 4.26g (93.6 per cent of the prevailing standard).

KEY TO PLATE

1.	Half crown, p.m. 'Bugle', n.d.	Table 1, no. 43
2.	Half crown, W/SA series, n.d.	Table 1, no. 66
3.	Half crown, W/SA series, n.d.	Table 1, no. 72
4.	Half crown, CH, 1644, first type.	Table 1, no. 83
5.	Half crown, CH, 1644, second type.	Table 1, no. 84
6.	Half crown, 1644, Declaration type.	Table 1, no. 88
7.	Half crown, 'Blacksmith' type.	Table 1, no. 96
8.	Shilling, Aberystwyth type D, n.d. See Appendix 1, p. 73.	

[31] H.E. Manville, "'Caroli fortuna resurgam" siege pieces', *NCirc* September 1982, 229–31.

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