COMPOSITION OF ENGLISH SILVER COINS (870–1300)

By J. S. FORBES, B.SC., F.R.I.C., and D. B. DALLADAY

Introduction

ALTHOUGH a number of investigators have determined the composition of individual coins, as far as can be ascertained no comprehensive results of analysis covering a whole range of silver coins of the period 870 to 1300 have previously been published. It had been suggested that information in regard to the composition of the coins of this period might throw some interesting sidelights on the state of the coinage and coining methods. It was accordingly decided to obtain a representative selection of coins and to determine not only the silver content of each coin but also the percentages of the various alloying and impurity elements.

The analyses were carried out on twenty-nine broken silver pennies which were selected with some care to ensure that (*a*) the extent of any corrosion was reasonably small and (*b*) they had not been subjected to any cleaning process which might have altered their composition.

Method of Analysis

The coins were thoroughly scraped with a steel knife to remove as far as possible any surface contamination or corrosion products. Samples representing a cross-section of each coin were then taken for analysis.

(i) *Silver*

0·13 g. of sample were dissolved in dilute nitric acid and the solution filtered from any insoluble residue. The silver in solution was determined by potentiometric titration with sodium chloride. In most cases a small amount of silver was also present in the insoluble residue. This was presumably due to slight corrosion of the coins resulting in the formation of silver chloride. The silver in the residue was determined by cupellation with lead, due allowance being made for the gold in the sample, all of which was also present in the residue.

(ii) *Acid Insoluble Chloride*

It was assumed that the portion of the silver which was insoluble in nitric acid was present as silver chloride and the acid insoluble chloride content of the sample was calculated accordingly.

(iii) *Copper*

The solution which had been reserved from the potentiometric determination of silver was filtered and the copper in the filtrate determined by a spectrophotometric method using bis-cyclohexanone oxalyldihydrazone.

(iv) *Other Metallic Elements*

A large Hilger quartz spectrograph and ancillary apparatus were employed for the determination of other elements. In brief, the method consisted of the

total combustion of 0·005 gm. of the sample with 0·001 gm. of pure nickel powder using graphite electrodes and a constant current D.C. arc source, the nickel serving as an internal standard. Suitable portions of the spectrum were photographed and line densities converted to percentages of the various elements by standard spectrographic procedure. For the determination of nickel the same method was followed, except that ferric oxide was used as the internal standard.

The zinc contents of a number of the samples were also determined chemically and the results were in good agreement with those obtained spectrographically.

Results of Analysis

(i) *General*

The results are given in detail in Table I. In addition to the elements shown, very small traces of iron were present in most of the samples. Apart from acid insoluble chloride, non-metallic elements were not specifically determined and are reported by difference.

(ii) *Silver*

The values for silver content in Table I are not necessarily those of the newly minted coins. In order to arrive at the original silver contents two factors must be considered:

(*a*) Corrosion of the coins since they were minted, resulting in the presence of non-metallic elements or radicals (e.g. chloride or carbonate).

(*b*) The possibility of some enrichment in silver due to preferential corrosion and subsequent removal of base metal constituents, particularly copper. It is to be noted that the copper contents of many of the coins are lower than would be expected in a straight silver/copper alloy of the sterling standard.

In Table II, the silver contents of the coins have been recalculated as percentages of the metallic portions of the samples. This effectively corrects for (*a*) if it is assumed that the non-metallic elements are due entirely to corrosion and were not present in the newly minted coins. It is not possible to correct for (*b*) since the extent of the enrichment, if any, is not known. It is thought, however, that the silver contents of the newly minted coins may have been somewhat lower than the values in Table II.

The corrected silver contents are also shown graphically in Fig. 1.

(iii) *Copper and Zinc*

The values for copper and zinc have been similarly recalculated where necessary and are included in Table II.

Discussion

The authors prefer to leave any comments on the results to numismatists but would like to make the following observations as being of interest:

(i) The silver content of the coins is variable prior to *c.* 1163. At certain

periods it is close to the sterling standard (e.g. *c.* 1060 to 1063) whereas at other periods it is well below (e.g. *c.* 1047).

(ii) The silver content is consistently high after *c.* 1163. If due allowance is made for corrosion products, all the coins dated *c.* 1163 and later are up to the sterling standard.

(iii) The lead content of the coins is fairly consistent, all values lying between 0·44 and 2·1 per cent. It is clear, therefore, that no attempt was made by the moneyers to debase any of the coins with large amounts of lead. The presence of a small amount of lead in the coins is to be expected since it was normally used in the process for recovering and refining silver.

(iv) With only one exception, zinc is present in all the coins dated prior to *c.* 1163, the amount varying between 0·32 and 9·5 per cent. It is thought that the higher percentages must be the result of purposeful alloying additions, possibly in the form of brass.[1]

(v) Zinc is virtually absent in all the coins dated between *c.* 1163 and 1300.

(vi) The fact that zinc is present in all the coins datable between 950 and 1136 suggests that a determination of zinc might provide a useful method of identifying comparatively recent forgeries of coins of this period, since it is only occasionally found in significant amounts in coins of a later period.[2]

A determination of the percentage of other metals such as gold and lead might also give an indication of the genuineness or otherwise of a particular coin.

Acknowledgements

The authors wish to thank Messrs. A. H. Baldwin & Sons Ltd. for supplying the coins used in this investigation. They are indebted also to Mr. R. H. M. Dolley, Department of Coins and Medals, British Museum, for helpful advice, including the dating and attribution of the coins.

The analyses were carried out at the Assay Office, Goldsmiths' Hall, London, E.C. 2, and publication is by permission of the Wardens of the Worshipful Company of Goldsmiths.

[1] Seven sceattas dated *c.* 695 to 730 (?) have also been analysed. These were found to be low in zinc, the highest containing only 0·05 per cent. The results on these coins must, however, be treated with reserve since they had been subjected to an electrolytic cleaning treatment which might have altered their composition. Coins dated prior to 950 obviously require further investigation.

[2] In the present investigation zinc was not found in excess of 0·02 per cent. in any of the coins dated between *c.* 1163 and 1300. Of 30 coins which have also been analysed with dates between *c.* 1510 and 1838, 5 had zinc contents greater than 0·1 per cent., the highest being 0·5 per cent.

TABLE I

Results of Analysis

(*Calculated as percentages of the total sample taken in each case*)

N.D. in the table signifies 'Not Detected' < Signifies 'less than'

Coin	*Date*	*Mint*	*Per cent.*											
			Ag	Cu	Zn	Au	Bi	Pb	Sb	Sn	As	Ni	*Acid Insol.* Cl	*Other non-metallic elements (by diff.)*
1	*c.* 870	—	71·0	20·2	1·5	0·62	0·05	1·6	0·05	1·3	0·15	0·007	0·05	3·5
2	*c.* 920	—	93·5	3·9	N.D.	0·94	0·05	0·78	0·005	0·03	N.D.	—	0·05	0·7
3	*c.* 950	Chester Area	78·4	11·6	5·5	0·57	0·14	0·92	0·01	0·36	0·05	N.D.	—	2·4
4	*c.* 950	Chester Area	76·7	16·9	3·3	0·62	0·09	0·70	0·007	0·27	N.D.	0·004	—	1·4
5	*c.* 970	Chester	82·9	9·8	3·2	0·63	0·14	0·73	0·008	0·34	N.D.	N.D.	0·04	2·2
6	*c.* 985	London	88·9	3·0	0·55	0·18	0·07	1·4	0·007	0·06	N.D.	0·004	4·7	1·1
7	*c.* 1020	Southampton	87·5	5·4	3·0	0·37	0·04	1·4	0·007	0·66	0·03	N.D.	0·01	1·6
8	*c.* 1047	London	51·7	36·2	9·5	0·17	0·04	1·7	0·14	0·03	0·05	0·14	0·01	0·5
9	*c.* 1047	London	86·9	7·0	3·0	0·30	0·03	1·3	0·07	0·08	N.D.	N.D.	0·16	1·2
10	*c.* 1047	London	69·9	17·6	6·6	0·48	0·04	1·8	0·12	0·09	0·05	0·002	0·08	3·2
11	*c.* 1057	Dover	83·9	11·4	3·0	0·34	0·02	1·2	0·03	0·09	N.D.	0·004	0·11	—
12	*c.* 1060	Lewes	94·5	2·3	0·32	0·36	0·006	0·46	0·005	0·01	N.D.	N.D.	1·3	0·7
13	*c.* 1060	York	92·1	3·9	0·58	0·37	0·02	1·9	0·008	0·02	N.D.	N.D.	0·21	0·9
14	*c.* 1060	York	90·7	4·8	2·2	0·34	0·03	1·3	0·02	0·11	N.D.	N.D.	0·37	0·1
15	*c.* 1063	York	91·8	4·6	0·5	0·35	0·02	1·8	0·006	0·01	N.D.	N.D.	0·09	0·8
16	*c.* 1063	York	89·3	5·1	2·5	0·35	0·04	1·4	0·04	0·11	N.D.	N.D.	0·69	0·5
17	*c.* 1063	Wilton	94·2	3·4	0·58	0·41	0·01	0·78	0·007	0·01	N.D.	N.D.	0·04	0·6
18	*c.* 1133	London	85·5	5·2	4·7	0·57	0·07	1·8	0·12	0·16	N.D.	0·002	0·11	1·8
19	*c.* 1136	Canterbury	73·5	14·8	4·0	0·44	0·04	2·1	0·09	0·11	N.D.	< 0·001	0·14	4·8
20	*c.* 1163	Bury St. Edmunds	93·6	4·0	N.D.	0·46	0·04	1·1	0·008	N.D.	N.D.	N.D.	0·02	0·8
21	*c.* 1200	London	94·0	4·1	N.D.	0·22	0·03	0·62	0·01	N.D.	N.D.	< 0·001	0·11	0·9
22	*c.* 1205	Bury St. Edmunds	95·1	3·4	N.D.	0·20	0·06	0·63	0·005	0·01	N.D.	N.D.	0·16	0·4
23	*c.* 1225	London	81·7	3·3	N.D.	0·28	0·20	1·5	0·009	0·08	N.D.	< 0·001	6·2	6·7
24	*c.* 1225	Canterbury	93·5	4·9	N.D.	0·25	0·02	0·44	0·01	0·04	N.D.	0·004	0·09	0·7
25	*c.* 1251	London	93·5	3·7	N.D.	0·67	0·05	1·1	0·008	0·06	N.D.	N.D.	0·16	0·8
26	*c.* 1251	London	86·5	4·3	N.D.	0·08	0·48	0·90	0·12	< 0·002	N.D.	0·003	3·6	4·1
27	*c.* 1253	London	92·8	4·9	N.D.	0·29	0·09	1·2	0·005	0·004	N.D.	N.D.	0·04	0·7
28	*c.* 1283	London	92·6	3·9	< 0·02	0·27	0·12	0·86	0·01	0·06	N.D.	N.D.	0·93	1·2
29	*c.* 1300	London	91·4	5·8	N.D.	0·26	0·02	1·4	0·02	0·003	N.D.	0·004	0·22	0·9

TABLE II

Results for Silver, Copper and Zinc Contents
(*Calculated as percentages of the metallic portion of the sample*)

N.D. in the table signifies 'Not Detected' < Signifies 'less than'

Coin	*Date*	*Mint*	*Silver* %	*Copper* %	*Zinc* %
1	*c.* 870	—	73·6	20·9	1·6
2	*c.* 920	—	94·2	3·9	N.D.
3	*c.* 950	Chester Area	80·3	11·9	5·6
4	*c.* 950	Chester Area	77·8	17·0	3·3
5	*c.* 970	Chester	85·5	10·0	3·3
6	*c.* 985	London	94·4	3·2	0·58
7	*c.* 1020	Southampton	88·9	5·5	3·0
8	*c.* 1047	London	52·2	36·4	9·5
9	*c.* 1047	London	88·1	7·1	3·0
10	*c.* 1047	London	72·3	18·1	6·8
11	*c.* 1057	Dover	84·0	11·4	3·0
12	*c.* 1060	Lewes	96·4	2·3	0·32
13	*c.* 1060	York	93·2	3·9	0·58
14	*c.* 1060	York	91·2	4·8	2·2
15	*c.* 1063	York	92·7	4·6	0·50
16	*c.* 1063	York	90·4	5·1	2·5
17	*c.* 1063	Wilton	94·8	3·4	0·58
18	*c.* 1133	London	87·2	5·3	4·8
19	*c.* 1136	Canterbury	77·3	15·6	4·2
20	*c.* 1163	Bury St. Edmunds	94·4	4·0	N.D.
21	*c.* 1200	London	95·0	4·1	N.D.
22	*c.* 1205	Bury St. Edmunds	95·6	3·4	N.D.
23	*c.* 1225	London	93·8	3·8	N.D.
24	*c.* 1225	Canterbury	94·3	4·9	N.D.
25	*c.* 1251	London	94·4	3·7	N.D.
26	*c.* 1251	London	93·7	4·7	N.D.
27	*c.* 1253	London	93·5	4·9	N.D.
28	*c.* 1283	London	94·6	4·0	< 0·02
29	*c.* 1300	London	92·5	5·9	N.D.

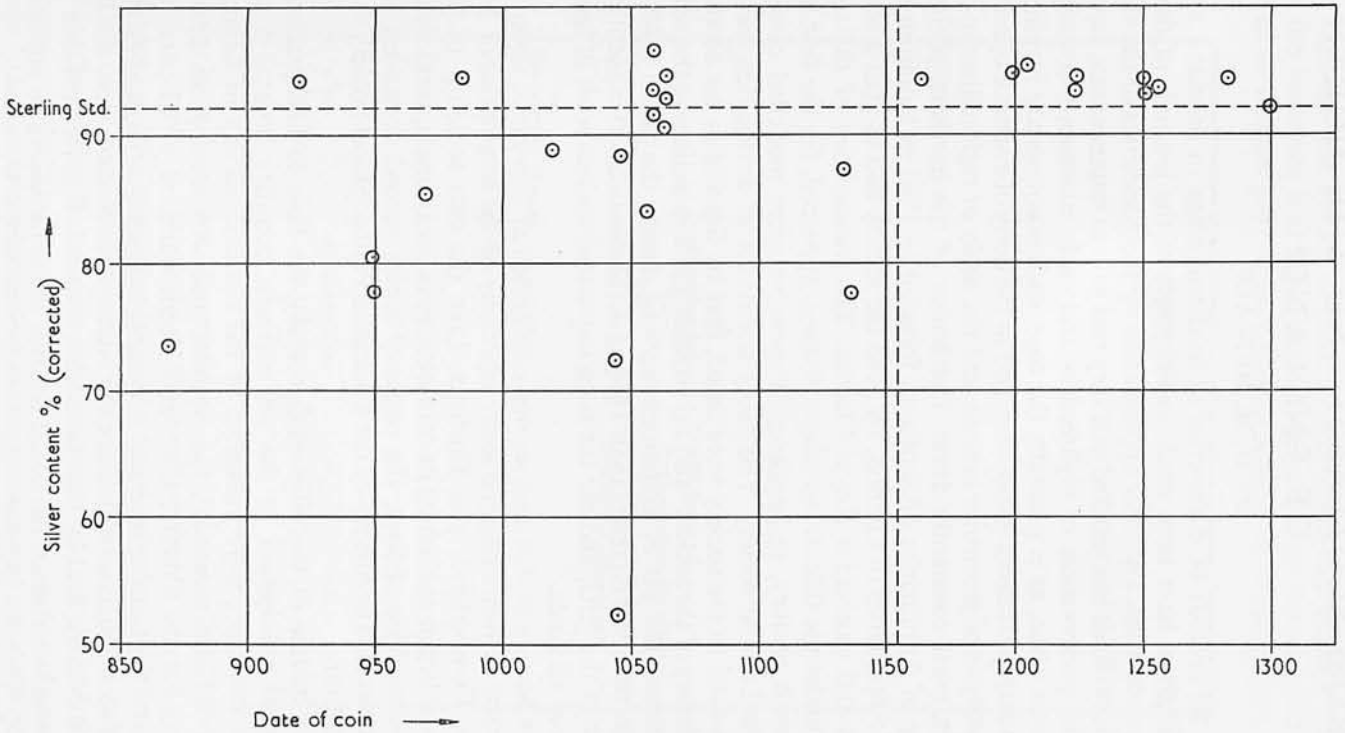

FIG. 1. Graphical illustration of silver contents in Table II