University of Reading

Modelling Roman concepts of copper-alloy recycling and mutability: the chemical characterisation hypothesis and Roman Britain

Book or Report Section

Accepted Version

Figures

Bray, P. (2020) Modelling Roman concepts of copper-alloy recycling and mutability: the chemical characterisation hypothesis and Roman Britain. In: Duckworth, C. and Wilson, A. (eds.) Recycling and reuse in the Roman Economy. Oxford Studies on the Roman Economy. Oxford University Press, Oxford, UK. ISBN 9780198860846 Available at https://centaur.reading.ac.uk/84733/

It is advisable to refer to the publisher's version if you intend to cite from the work. See Guidance on citing.

Publisher: Oxford University Press

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the End User Agreement.

University of Reading

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

Figure 7.1

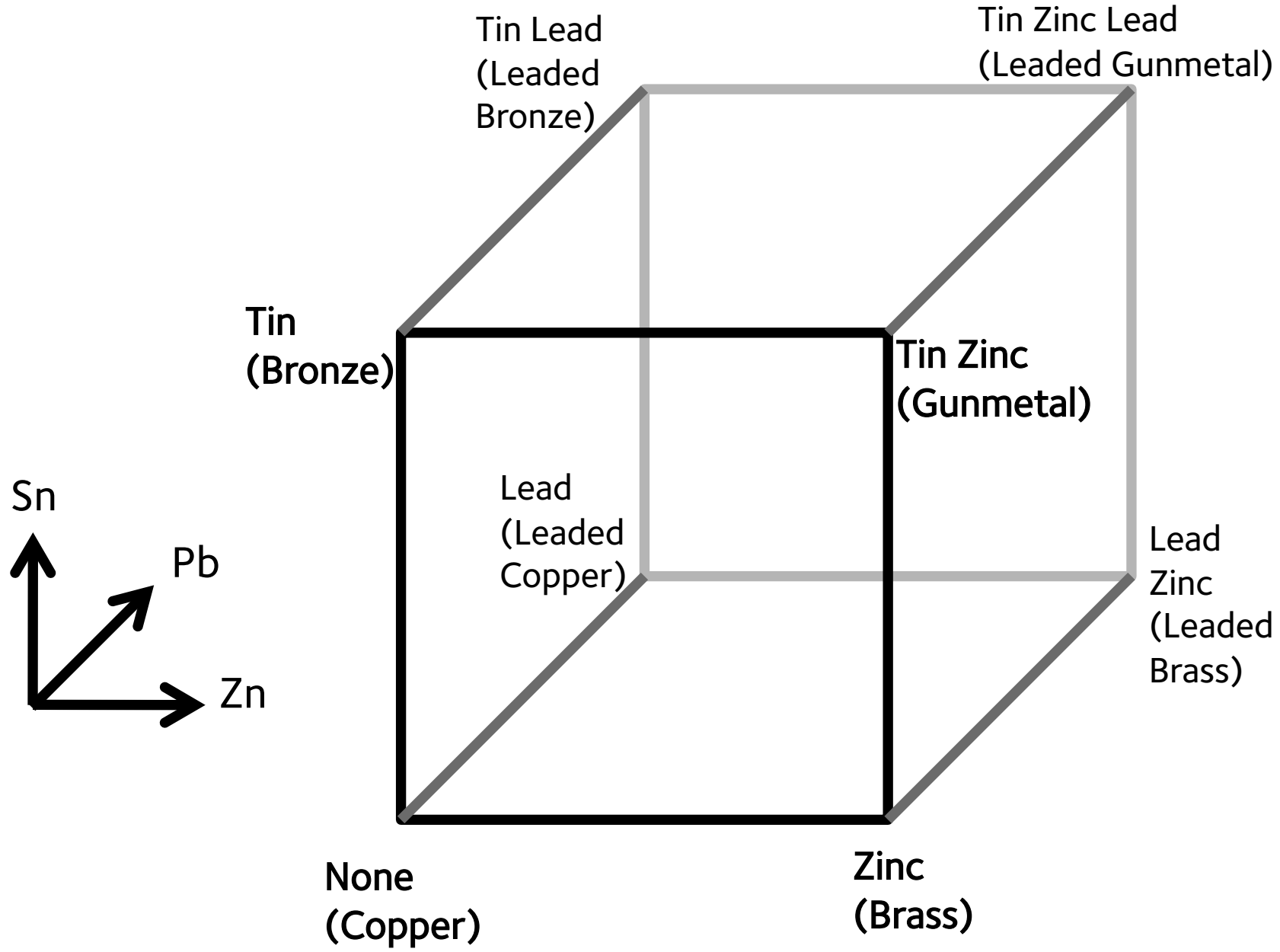

Tin Lead
(Leaded
Bronze)
Tin Zinc Lead
(Leaded Gunmetal)
Tin
(Bronze)
Tin Zinc
(Gunmetal)
Lead
(Leaded
Copper)
Lead
Zinc
(Leaded
Brass)
Sn
Pb
Zn
None
(Copper)
Zinc
(Brass)

Figure 7.2

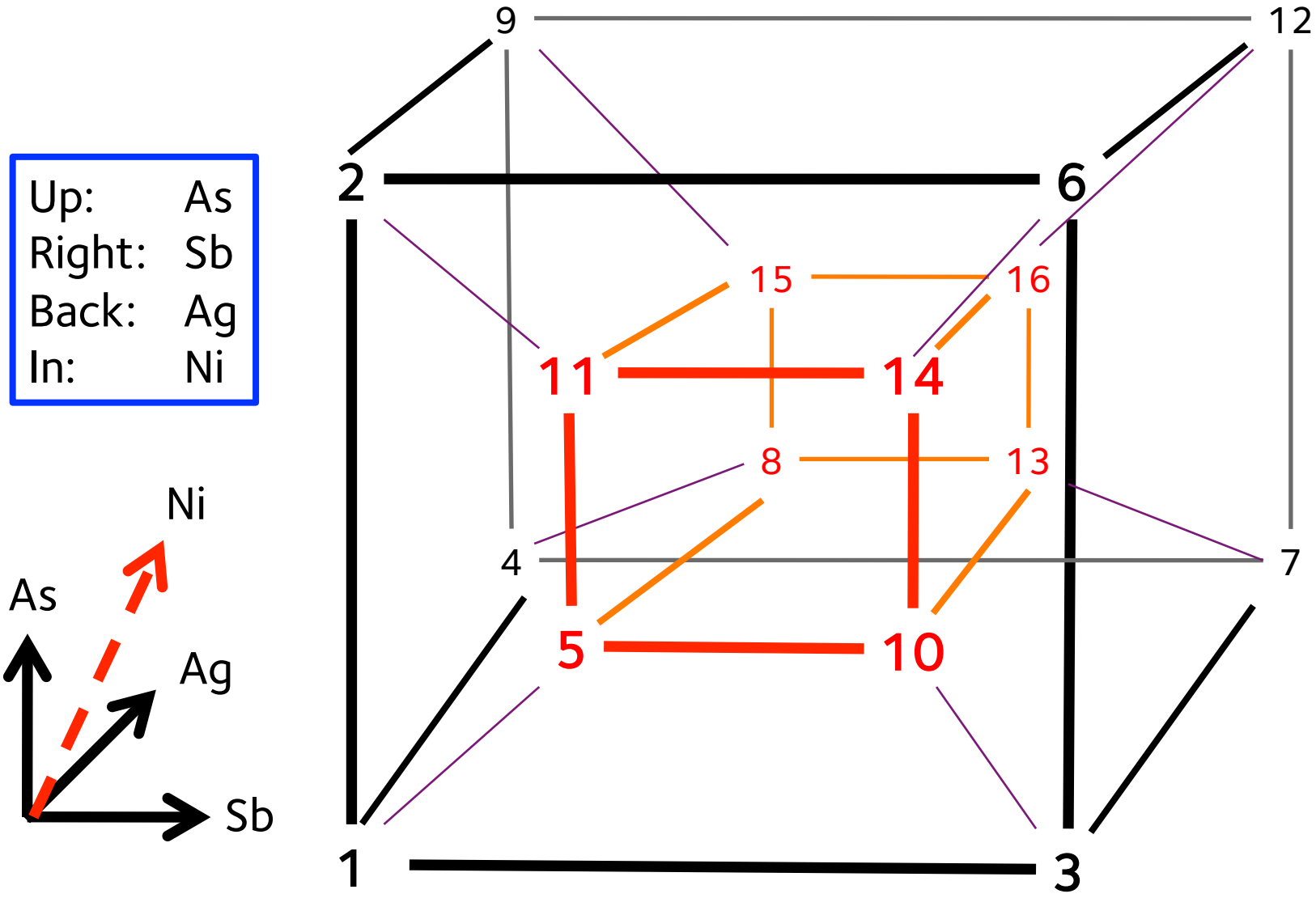

Up: As
Right: Sb
Back: Ag
In: Ni
Ni
As
Ag
Sb
9
12
2
6
15
16
11
14
8
13
4
7
5
10
1
3

Table 7.1

Defining the chemical impurity space for copper:

Arsenic // Antimony // Silver // Nickel

1	NNNN	No Minor
2	YNNN	As
3	NYNN	Sb
4	NNYN	Ag
5	NNNY	Ni
6	YYNN	As, Sb
7	NYYN	Sb, Ag
8	NNYY	Ag, Ni
9	YNYN	As, Ag
10	NYNY	Sb, Ni
11	YNNY	As, Ni
12	YYYN	As, Sb, Ag
13	NYYY	Sb Ag, Ni
14	YYNY	As, Sb, Ni
15	YNYY	As, Ag, Ni
16	YYYY	As, Sb, Ag, Ni

Figure 7.3

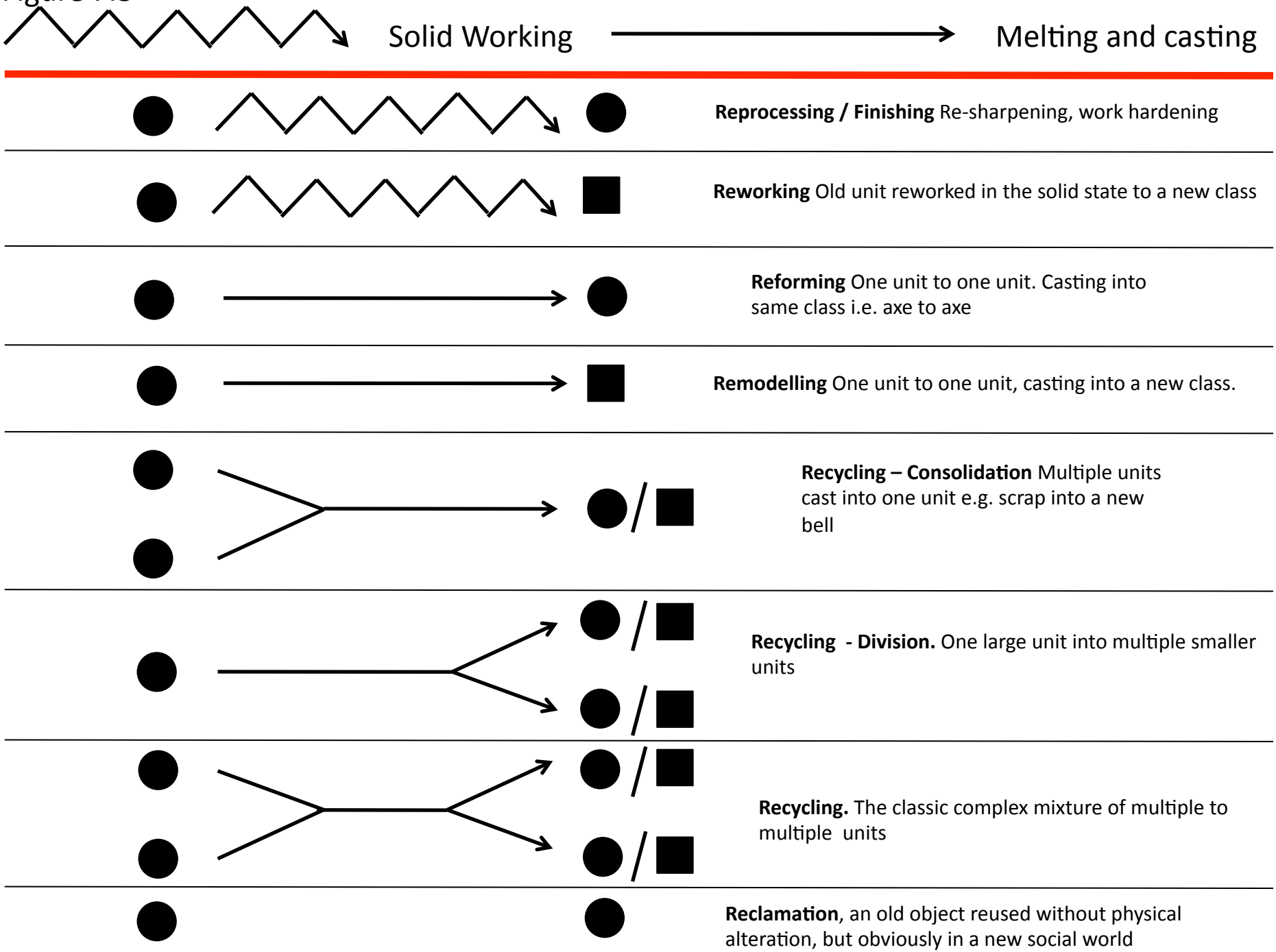

Solid Working
Melting and casting
Reprocessing / Finishing Re-sharpening, work hardening
Reworking Old unit reworked in the solid state to a new class
Reforming One unit to one unit. Casting into same class i.e. axe to axe
Remodelling One unit to one unit, casting into a new class.
Recycling – Consolidation Multiple units cast into one unit e.g. scrap into a new bell
Recycling - Division. One large unit into multiple smaller units
Recycling. The classic complex mixture of multiple to multiple units
Reclamation, an old object reused without physical alteration, but obviously in a new social world

Figure7.4

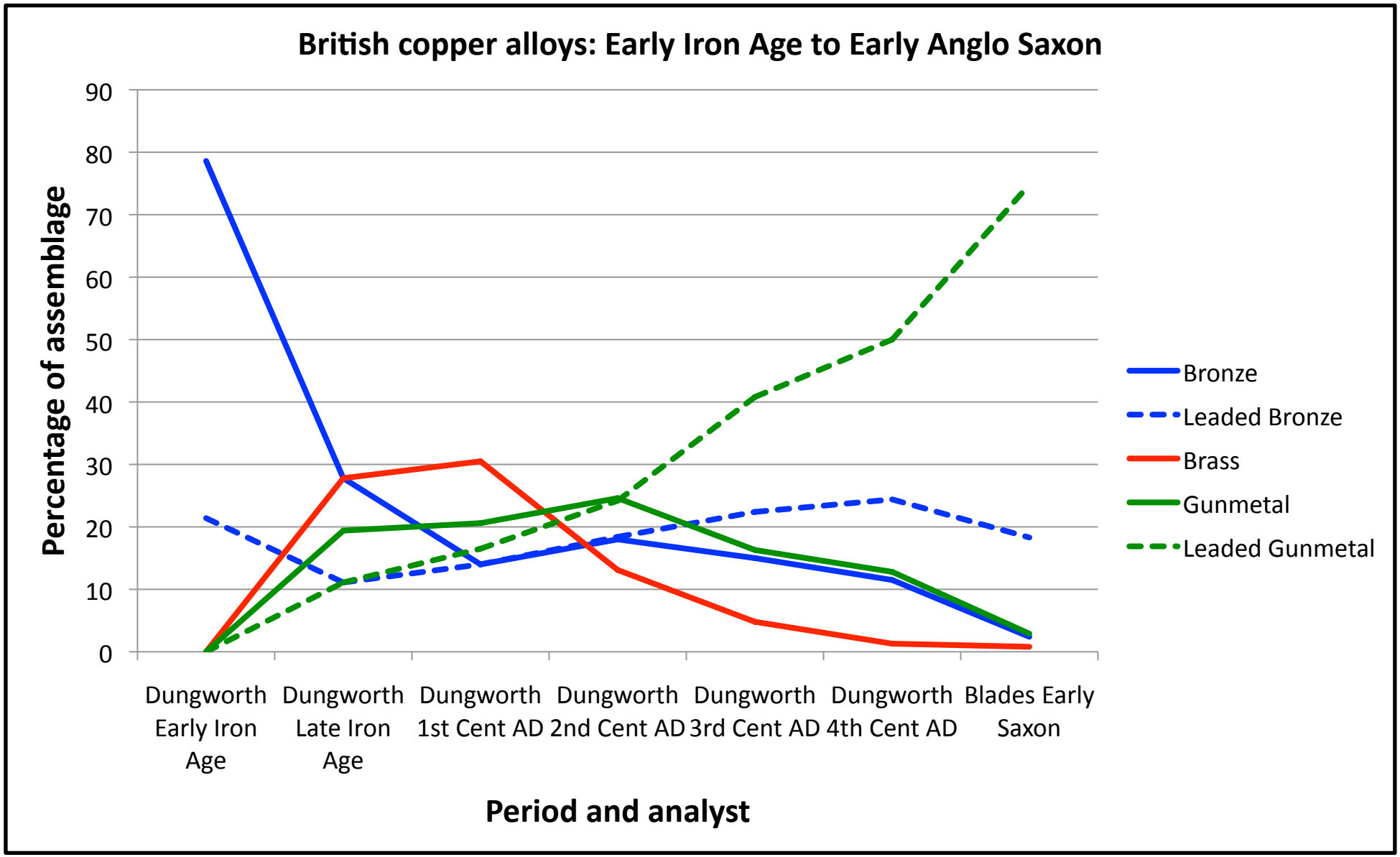

British copper alloys: Early Iron Age to Early Anglo Saxon
Percentage of assemblage
90
80
70
60
50
40
30
20
10
0
Dungworth Early Iron Age
Dungworth Late Iron Age
Dungworth 1st Cent AD
Dungworth 2nd Cent AD
Dungworth 3rd Cent AD
Dungworth 4th Cent AD
Blades Early Saxon
Period and analyst
Bronze
Leaded Bronze
Brass
Gunmetal
Leaded Gunmetal

Table 7.2

	CS 1	CS 2	CS 3	CS 4	CS 5	CS 6	CS 7	CS 8	CS 9	CS 10	CS 11	CS 12	CS 13	CS 14	CS 15	CS 16
Peter Northover "Iron Age"	25.1	27.1	11.3	2.4	1.0	9.5	4.2	0.2	4.0	0.4	2.2	3.6	1.0	3.2	1.6	3.4
Nigel Blades Roman	9.6	0.0	64.9	4.3	0.0	1.1	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nigel Blades Early Saxon	2.1	0.0	28.1	2.7	0.3	3.2	49.9	0.0	0.3	1.1	1.1	4.8	0.5	2.1	0.8	3.2
Nigel Blades Middle Saxon	8.1	5.4	12.1	2.0	2.0	8.1	34.9	0.7	0.7	0.0	0.0	18.1	0.0	0.7	0.7	6.7
Nigel Blades Late Saxon	5.5	1.4	41.1	6.8	1.4	6.8	23.3	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	2.7

Figure 7.5

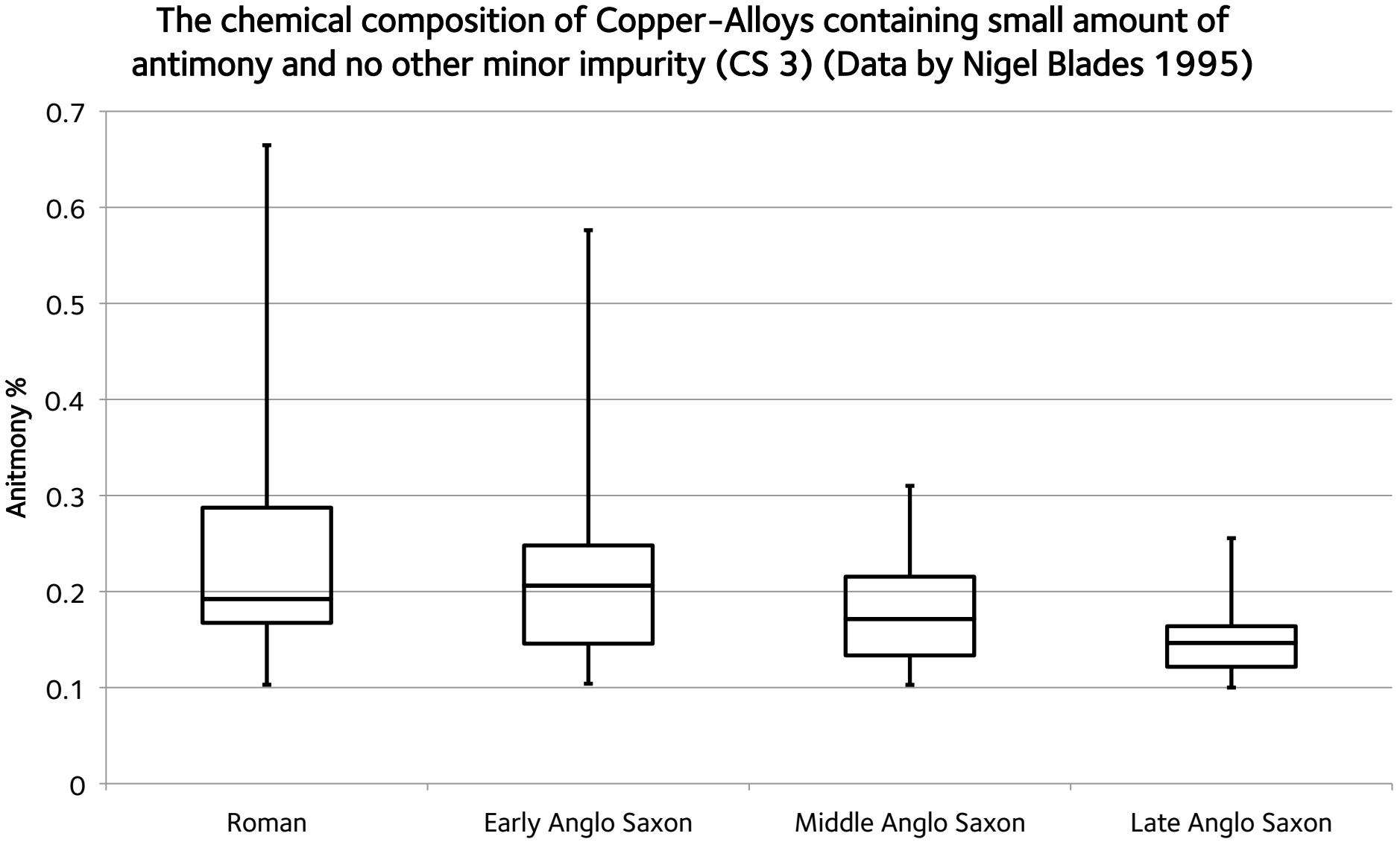

The chemical composition of Copper-Alloys containing small amount of antimony and no other minor impurity (CS 3) (Data by Nigel Blades 1995)
Anitmony %
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Roman
Early Anglo Saxon
Middle Anglo Saxon
Late Anglo Saxon

Figure 7.6

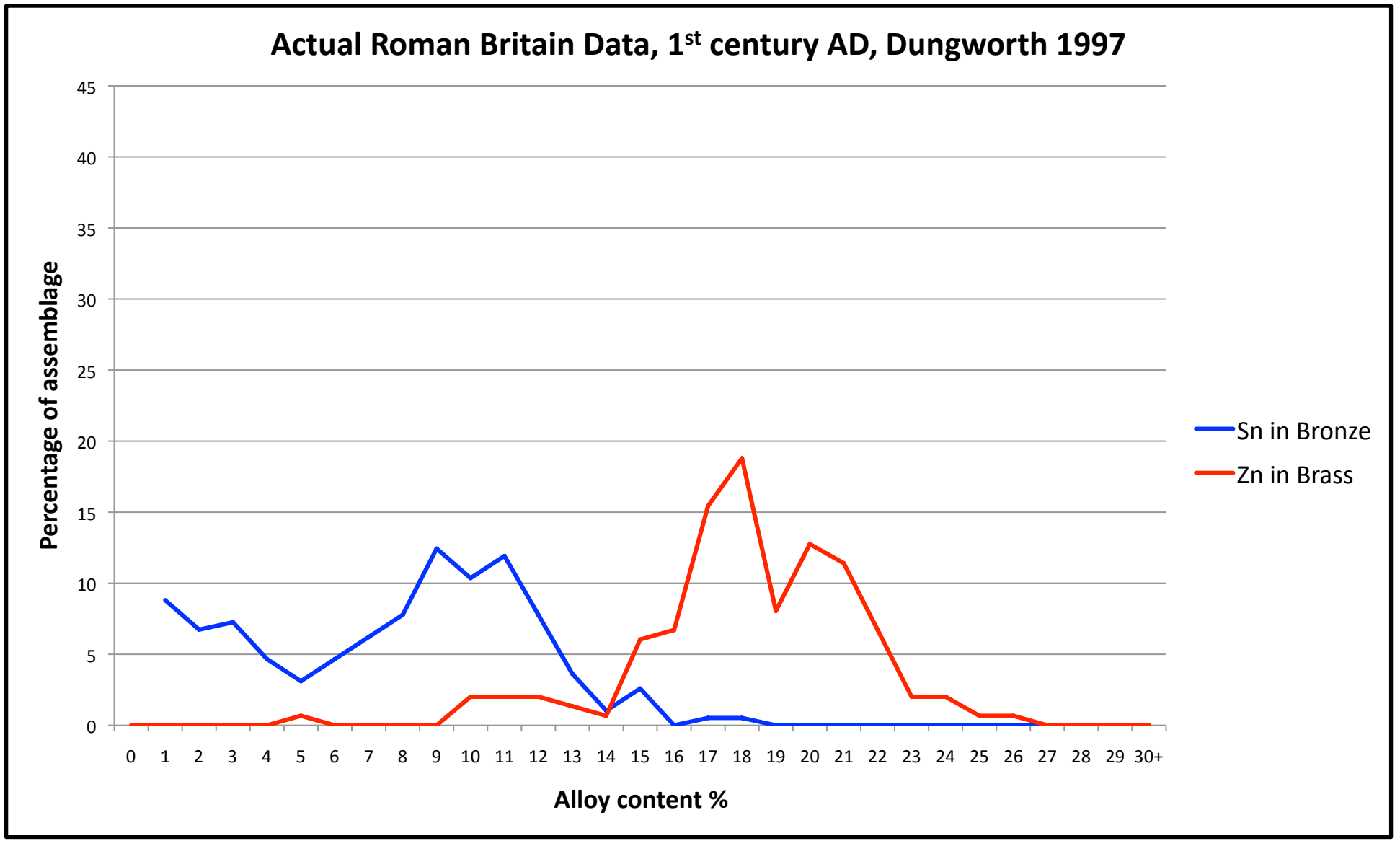

Actual Roman Britain Data, 1st century AD, Dungworth 1997
Percentage of assemblage
45
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30+
Alloy content %
Sn in Bronze
Zn in Brass

Figure 7.7

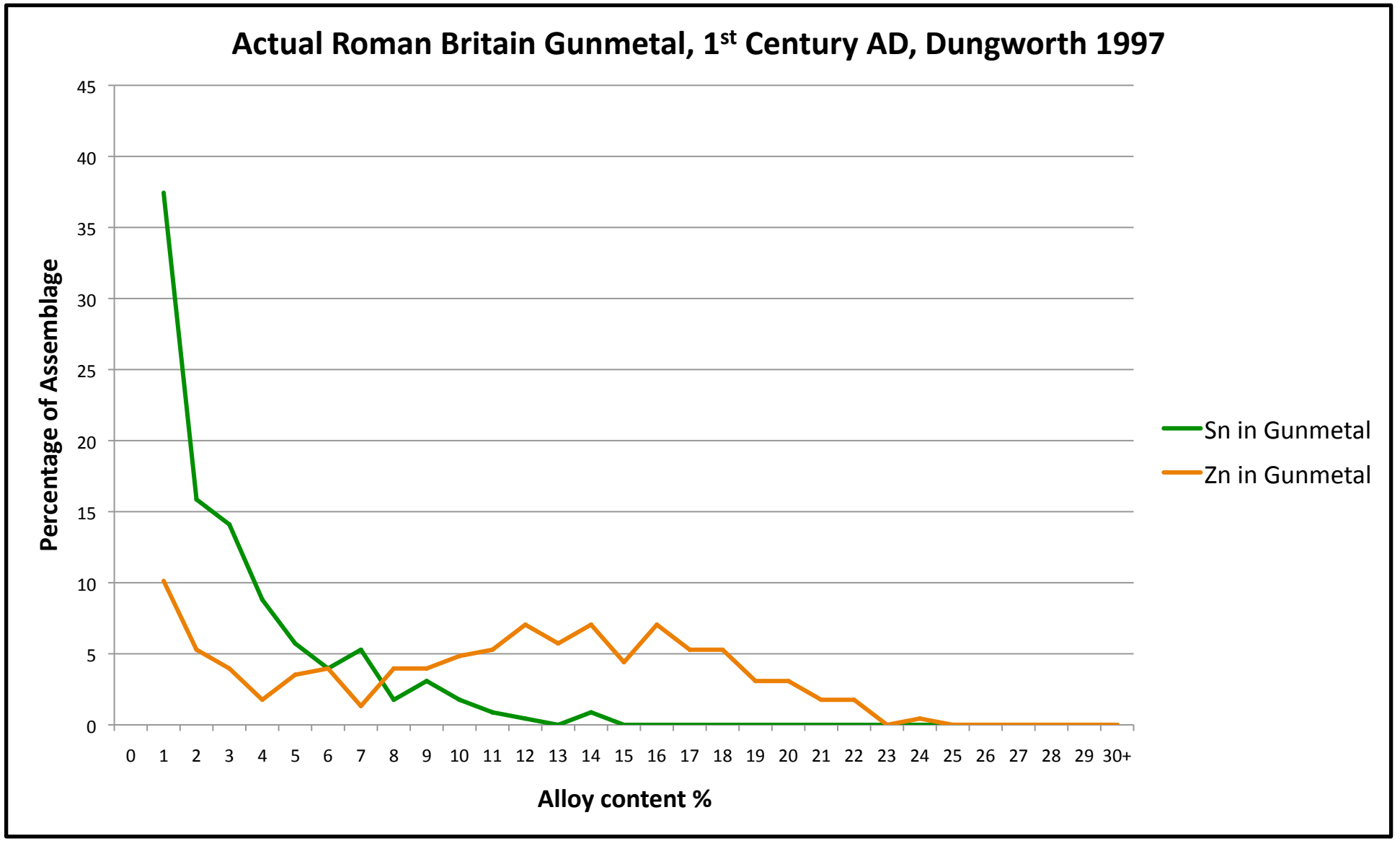

Actual Roman Britain Gunmetal, 1st Century AD, Dungworth 1997
Percentage of Assemblage
45
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30+
Alloy content %
Sn in Gunmetal
Zn in Gunmetal

Figure 7.8

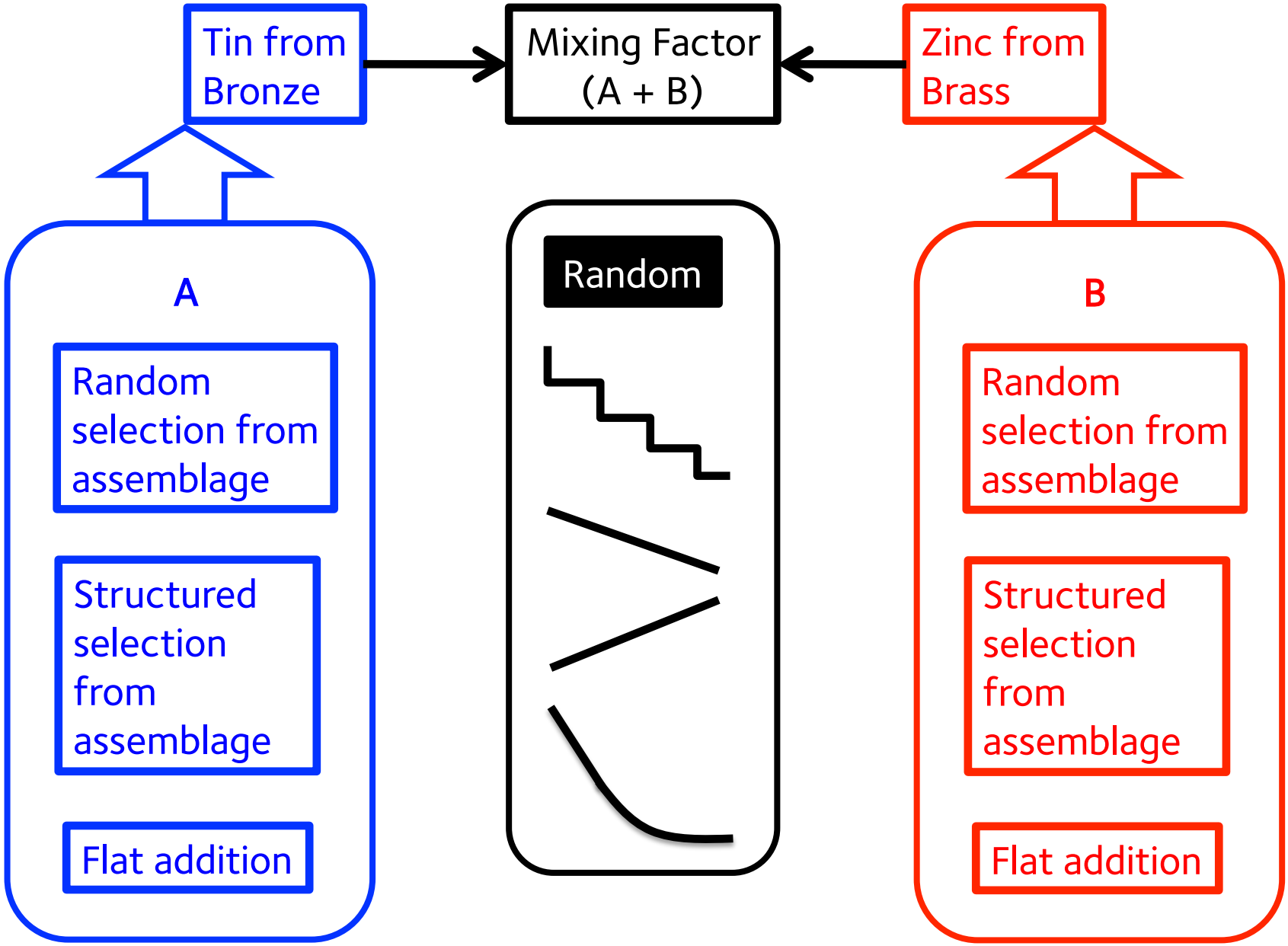
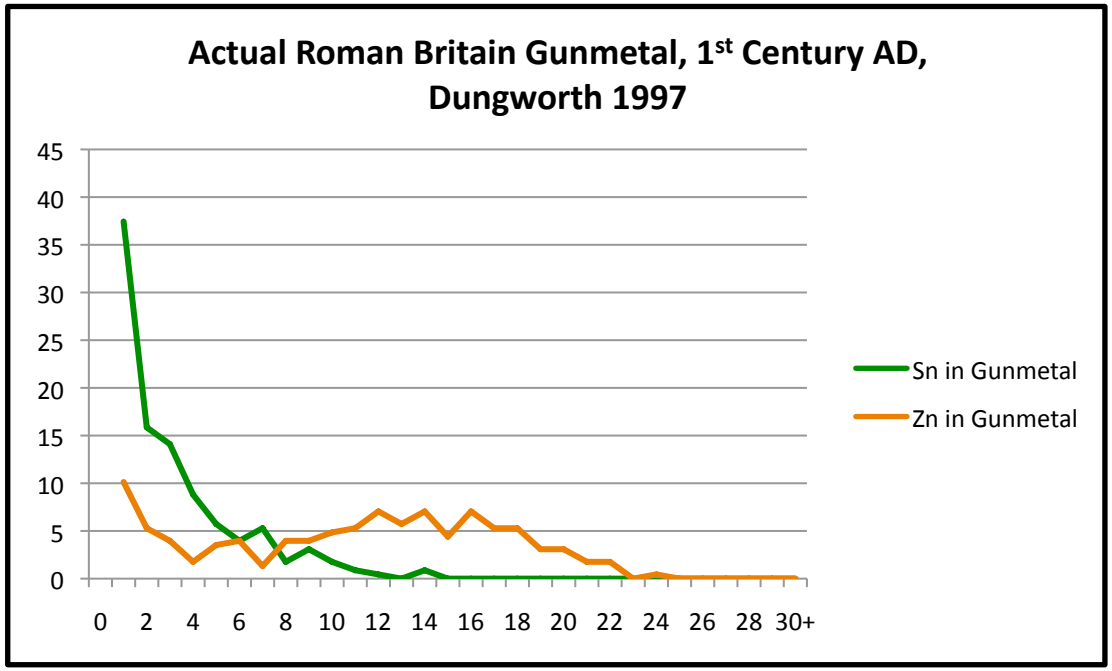

Tin from Bronze
Mixing Factor (A + B)
Zinc from Brass
A
Random selection from assemblage
Structured selection from assemblage
Flat addition
Random
B
Random selection from assemblage
Structured selection from assemblage
Flat addition

Figure 7.9


Actual Roman Britain Gunmetal, 1st Century AD, Dungworth 1997
45
40
35
30
25
20
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30+
Sn in Gunmetal
Zn in Gunmetal

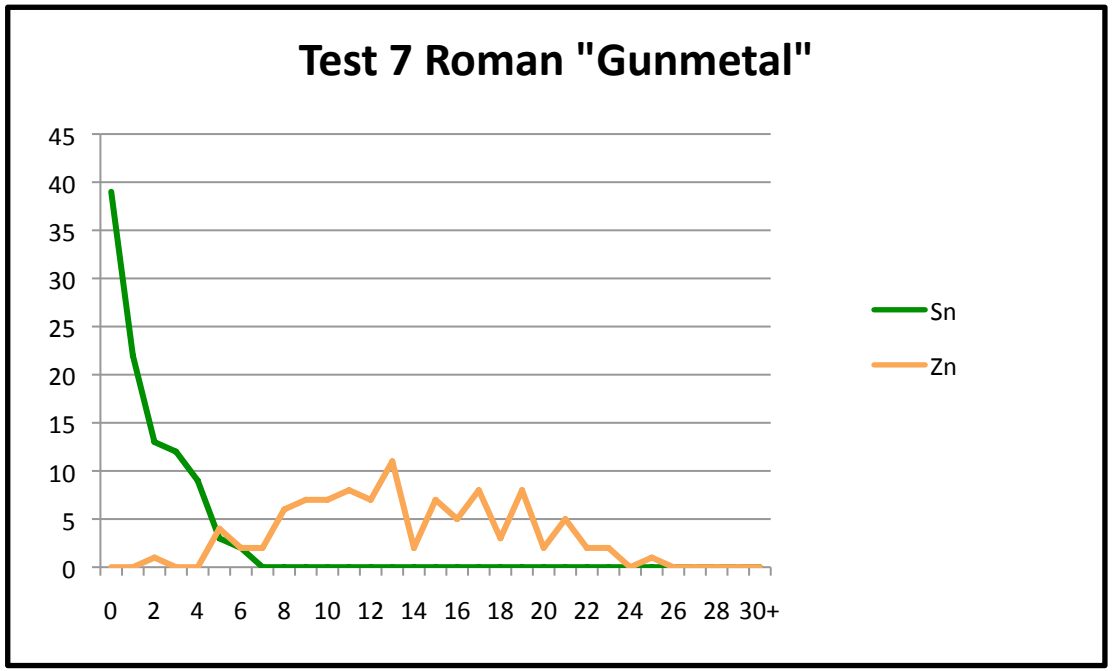

Test 7 Roman "Gunmetal"
45
40
35
30
25
20
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30+
Sn
Zn

Figure 7.10

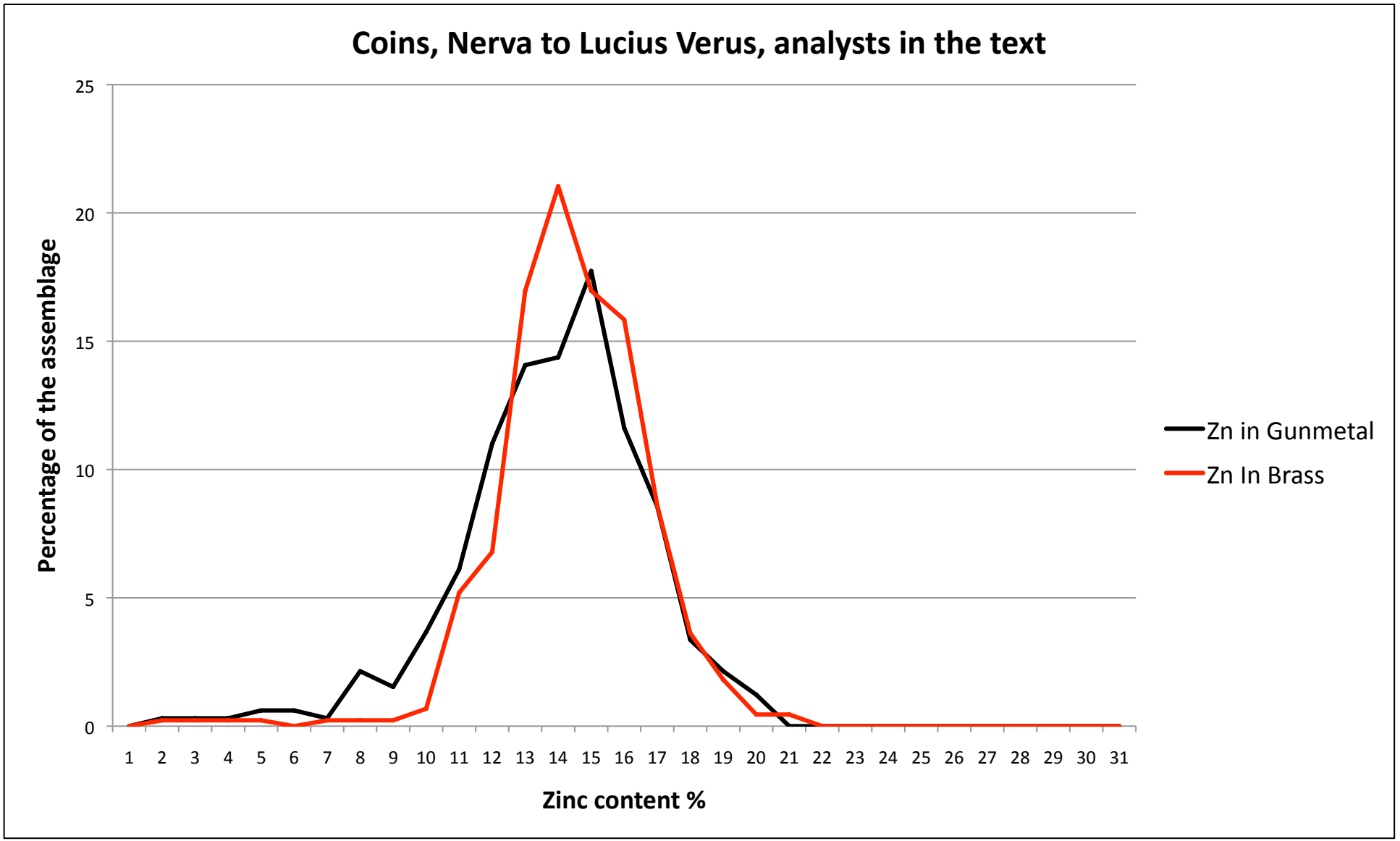
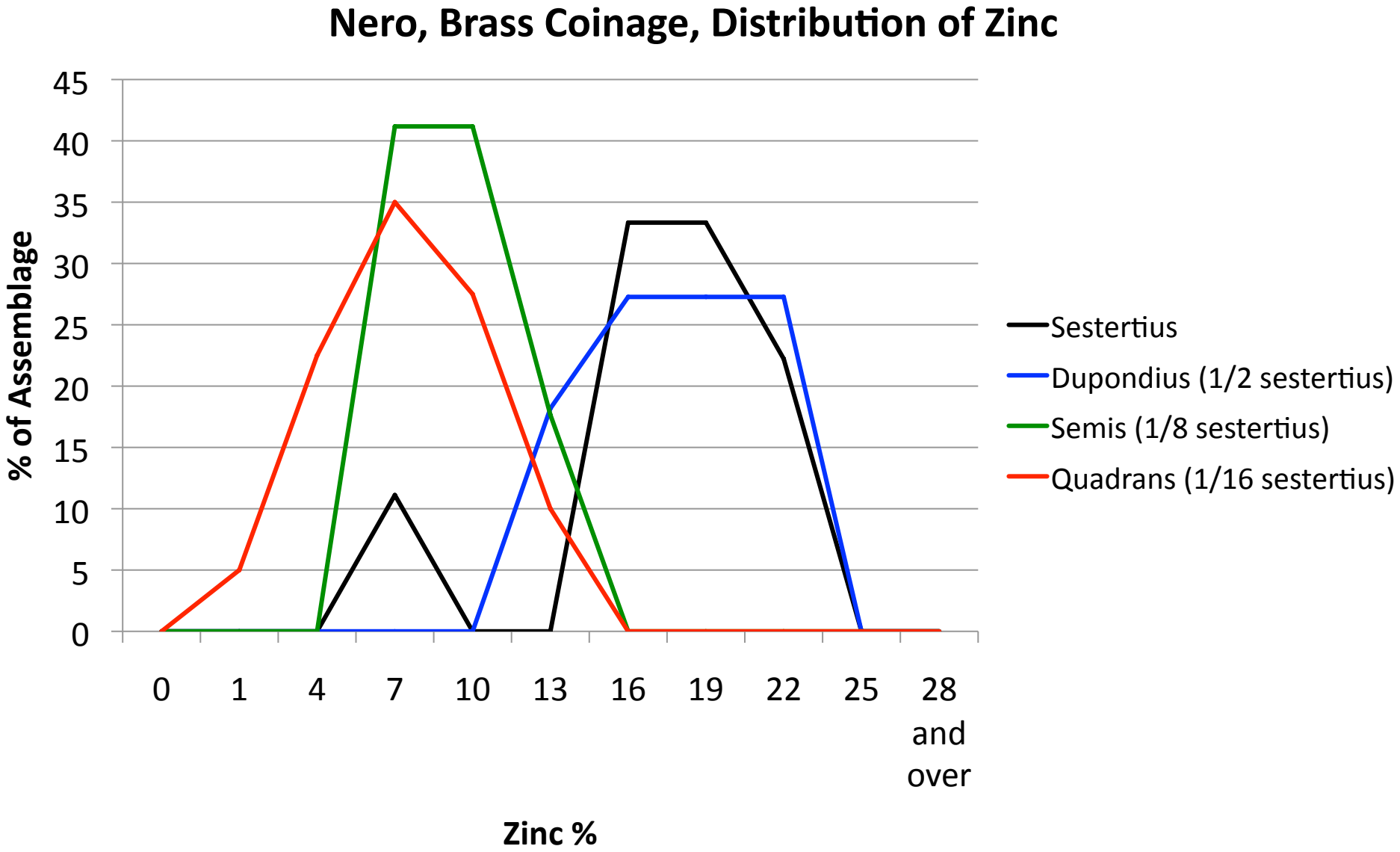

Coins, Nerva to Lucius Verus, analysts in the text
Percentage of the assemblage
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Zinc content %
Zn in Gunmetal
Zn In Brass

Figure 7.11


Nero, Brass Coinage, Distribution of Zinc
% of Assemblage
45
40
35
30
25
20
15
10
5
0
0
1
4
7
10
13
16
19
22
25
28 and over
Zinc %
Sestertius
Dupondius (1/2 sestertius)
Semis (1/8 sestertius)
Quadrans (1/16 sestertius)