*New Plastic Metallic Alloy.**

This metallic alloy, which has been discovered by M. Gersheim, not only adheres forcibly to other substances or compositions, such as glass and porcelain, but serves also to unite them in the same way as mastic. After ten or twelve hours, this plastic alloy attains a hardness which renders it capable of bearing a high polish, similar to silver or brass.

In preparing this alloy, oxide of copper is reduced by means of hydrogen, or sulphate of copper is precipitated with zinc parings. By this means a pure copper is obtained, twenty, thirty, or thirty-six parts of which are taken according to the hardness desired—the more copper in the alloy the greater being the hardness thereof. This is moistened in a cast iron or porcelain mortar with concentrated sulphuric acid, of a density of 1.85. To this species of metallic paste are added seventy parts by weight of mercury—the mass being kept continually stirred or agitated. When the copper is completely amalgamated, the composition is washed with boiling water to remove the sulphuric acid; it may then be left to cool, and ten or twelve hours will be sufficient to render it hard enough to bear an excellent polish, and to scratch tin and bone. It is not acted upon either by weak acids, alcohol, ether, or boiling water; and its density remains the same whether it is plastic or hard. When required as a mastic, it may at any time be reduced to a soft and plastic condition by submitting it to a heat of about 375° Centigrade, and working it in an iron mortar, heated to about 125° Centigrade, until it has attained the malleability and consistency of wax. If in this state it is placed between two metallic surfaces well freed from oxidation, it will unite them so perfectly that in ten or twelve hours afterwards they may be submitted to any usage. This composition, in a soft state, may also be poured into hollows, into which it will adhere forcibly after it has hardened, as it is found that it does not shrink in changing its condition.

The peculiar properties of this alloy admit of its application to a great variety of uses, but it is especially useful in the uniting of metallic surfaces where it would be inconvenient to employ heat for soldering or brazing the parts. Whilst on this subject, we may mention that Professor Pettenkofer, of Munich, discovered a sure method of preparing the amalgam of copper, which is now employed by dentists in stopping teeth, as far back as 1845.

On the Specific Gravities of Alloys.† By F. CRACE CALVERT, Ph.D., F.R.S., F.C.S., and RICHARD JOHNSON, F.C.S., &c.

The study of alloys and amalgams having been made especially with impure or commercial metals, the results obtained have been such that it has been impossible to solve the important question, Are alloys and amalgams chemical mixtures or compounds? It is with the hope of throwing some light on this subject, that we have for the last two years

* From the *Practical Mechanic's Journal*, Nov. 1859.

† From the *London, Edinburgh, and Dublin Philosophical Magazine*, Nov., 1859.

been engaged in examining comparatively some of the physical properties, such as the conductivity of heat, tenacity, hardness, and expansion of alloys and amalgams made with pure metals, and in multiple and equivalent quantities, as follows:—

1 Copper and 1 Tin.	1 Tin and 2 Copper.
1 " and 2 "	1 " and 3 "
1 " and 3 "	1 " and 4 "
1 " and 4 "	1 " and 5 "
1 " and 5 "	

By this method we have succeeded in ascertaining, first, the influence which each additional equivalent quantity of a metal exerts on another; secondly, the alloys which are compounds and those which are simple mixtures; for compounds have special and characteristic properties, whilst mixtures participate in the properties of the bodies composing them. This method of investigating alloys and amalgams has enabled us to ascertain which metals combine together to form definite compounds, and those which, when melted together, only form mixtures. Thus, for example, bronze alloys are definite compounds, for each alloy has a special conductivity of heat. Thus the alloy.

	Obtained.	Calculated.*	Difference.
Sn Cu ²	13.65	19.87	6.22
Sn Cu ³	15.75	21.37	5.62
Sn Cu ⁴	4.96	21.88	16.92
Sn Cu ⁵	6.60	22.50	15.90

These same alloys have a specific gravity of their own. Thus:—

	Obtained.	Calculated.*	Difference.
Sn Cu ²	8.533	8.059	0.474
Sn Cu ³	8.954	8.208	0.756
Sn Cu ⁴	8.948	8.306	0.642
Sn Cu ⁵	8.965	8.374	0.591

The same fact is also observed in the expansion or contraction of these alloys. Whilst, on the contrary, the alloys of tin and zinc being mixtures, conduct heat, have a specific gravity, and expand according to theory, or the proportion of tin and zinc which compose each alloy. Thus for heat:—

	Obtained.	Calculated.*	Difference.
Zn Sn ²	15.15	14.90	0.25
Zn Sn	16.00	15.80	0.10
Zn ² Sn	16.65	16.95	0.30

Specific Gravity.

	Obtained.	Calculated.*	Difference.
Zn Sn ²	7.274	7.193	0.081
Zn Sn	7.262	7.134	0.128
Zn ² Sn	7.188	7.060	0.128

We shall divide our researches on the specific gravity of alloys and amalgams under two heads: first, those which have a higher specific gravity than indicated by theory; and secondly, those which have a less specific gravity or expand.

* The principle upon which the theoretical conductivity, specific gravity, and expansion are calculated, is similar to that followed with respect to hardness, for which see page 4 of our paper "On Hardness."
(See Jour. Franklin Ins. present Series, Vol. xxxvii. p. 199.)

I. Alloys which have a higher specific gravity than indicated by theory. Results:—

Copper and Tin (Bronze).

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Cu Sn ⁵ { Cu 9·73 } { Sn 90·27 } . .	7·517	7·431	0·086
Cu Sn ⁴ { Cu 11·86 } { Sn 88·14 } . .	7·558	7·462	0·096
Cu Sn ³ { Cu 15·21 } { Sn 84·79 } . .	7·606	7·514	0·092
Cu Sn ² { Cu 21·21 } { Sn 78·79 } . .	7·738	7·580	0·158
Cu Sn { Cu 34·98 } { Sn 65·02 } . .	7·992	7·805	0·187
Sn Cu ² { Sn 51·83 } { Cu 48·17 } . .	8·533	8·059	0·474
Sn Cu ³ { Sn 38·21 } { Cu 61·79 } . .	8·954	8·208	0·746
Sn Cu ⁴ { Sn 31·73 } { Cu 68·27 } . .	8·948	8·306	0·642
Sn Cu ⁵ { Sn 27·10 } { Cu 72·90 } . .	8·965	8·374	0·591
Sn Cu ¹⁰ { Sn 15·68 } { Cu 84·32 } . .	8·832	8·545	0·287
Sn Cu ¹⁵ { Sn 11·03 } { Cu 88·97 } . .	8·825	8·615	0·210
Sn Cu ²⁰ { Sn 8·51 } { Cu 91·49 } . .	8·793	8·634	0·159
Sn Cu ²⁵ { Sn 6·83 } { Cu 93·17 } . .	8·820	8·677	0·143

Copper and Zinc (Brass).

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Zn Cu ⁵ { Cu 82·95 } { Zn 17·05 } . .	8·673	8·453	0·220
Zn Cu ⁴ { Cu 79·56 } { Zn 20·44 } . .	8·650	8·387	0·263
Zn Cu ³ { Cu 74·48 } { Zn 25·52 } . .	8·576	8·290	0·286
Zn Cu ² { Cu 66·06 } { Zn 33·94 } . .	8·488	8·129	0·359
Zn Cu { Cu 49·32 } { Zn 50·68 } . .	7·808	8·319	0·511
Cu Zn ² { Cu 32·74 } { Zn 67·26 } . .	7·859	7·489	0·370
Cu Zn ³ { Cu 24·64 } { Zn 75·36 } . .	7·736	7·334	0·401
Cu Zn ⁴ { Cu 19·57 } { Zn 80·43 } . .	7·445	7·237	0·208
Cu Zn ⁵ { Cu 16·30 } { Zn 83·70 } . .	7·442	7·174	0·268

Copper and Bismuth.

Cu Bi	9·634	9·566	0·068
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Copper and Antimony.

Cu Sb	7·990	7·386	0·604
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Tin and Zinc.

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Zn Sn ² { Zn 21.65 } . .	7.274	7.193	0.081
{ Sn 78.35 }			
Zn Sn { Zn 35.60 } . .	7.262	7.134	0.128
{ Sn 64.40 }			
Sn Zn ² { Sn 47.49 } . .	7.188	7.060	0.128
{ Zn 52.51 }			
Sn Zn ³ { Sn 37.57 } . .	7.180	7.021	0.159
{ Zn 62.43 }			
Sn Zn ⁴ { Sn 31.14 } . .	7.155	6.993	0.162
{ Zn 68.86 }			
Sn Zn ⁵ { Sn 26.57 } . .	7.140	6.974	0.166
{ Zn 73.43 }			
Sn Zn ¹⁰ { Sn 15.32 } . .	7.135	6.927	0.208
{ Zn 84.68 }			

II. Alloys and amalgams having a less specific gravity, or which expand.

Mercury and Tin.

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Hg Sn { Hg 62.97 } . .	10.255	11.259	1.004
{ Sn 37.03 }			
Hg Sn ² { Hg 45.88 } . .	9.314	10.180	0.866
{ Sn 54.12 }			
Hg Sn ³ { Hg 36.18 } . .	8.805	9.568	0.763
{ Sn 63.82 }			
Hg Sn ⁴ { Hg 29.84 } . .	8.510	9.168	0.658
{ Sn 70.16 }			
Hg Sn ⁵ { Hg 25.38 } . .	8.312	8.885	0.573
{ Sn 74.62 }			
Hg Sn ⁶ { Hg 22.08 } . .	8.151	8.678	0.527
{ Sn 77.92 }			

Mercury and Bismuth.

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Hg Bi { Hg 48.44 } . .	11.208	11.638	0.430
{ Bi 51.56 }			
Hg Bi ² { Hg 31.82 } . .	10.693	11.007	0.314
{ Bi 68.18 }			
Hg Bi ³ { Hg 23.86 } . .	10.474	10.704	0.230
{ Bi 76.14 }			
Hg Bi ⁴ { Hg 19.03 } . .	10.350	10.522	0.172
{ Bi 80.97 }			
Hg Bi ⁵ { Hg 15.82 } . .	10.240	10.410	0.170
{ Bi 84.18 }			
<i>Mercury and Zinc.</i>			
Hg Zn	11.304	11.944	0.640

Antimony and Bismuth.

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Bi Sb ⁵ { Bi 24.81 } { Sb 75.19 } . . .	7.271	7.470	0.201
Bi Sb ⁴ { Bi 29.20 } { Sb 70.80 } . . .	7.370	7.606	0.235
Bi Sb ³ { Bi 35.48 } { Sb 64.52 } . . .	7.561	7.801	0.240
Bi Sb ² { Bi 45.21 } { Sb 54.79 } . . .	7.829	8.102	0.273
Bi Sb { Bi 62.26 } { Sb 37.74 } . . .	8.364	8.630	0.268
Sb Bi ² { Sb 23.26 } { Bi 76.74 } . . .	8.859	9.077	0.218
Sb Bi ³ { Sb 16.81 } { Bi 83.19 } . . .	9.095	9.277	0.182
Sb Bi ⁴ { Sb 13.17 } { Bi 86.83 } . . .	9.276	9.391	0.115
Sb Bi ⁵ { Sb 10.82 } { Bi 89.18 } . . .	9.369	9.464	0.095
<i>Bismuth and Zinc.</i>			
Bi Zn	9.046	9.132	0.086

Tin and Lead.

Formulae of alloys and per centages.	Obtained.	Calculated.	Difference.
Pb Sn ⁵ { Pb 26.03 } { Sn 73.97 } . . .	8.093	8.367	0.254
Pb Sn ⁴ { Pb 30.57 } { Sn 69.43 } . . .	8.196	8.548	0.352
Pb Sn ³ { Pb 36.99 } { Sn 63.01 } . . .	8.418	8.823	0.405
Pb Sn ² { Pb 46.82 } { Sn 53.18 } . . .	8.774	9.232	0.458
Pb Sn { Pb 63.78 } { Sn 36.22 } . . .	9.458	9.938	0.480
Sn Pb ² { Sn 22.11 } { Pb 77.89 } . . .	10.105	10.525	0.420
Sn Pb ³ { Sn 15.91 } { Pb 84.09 } . . .	10.421	10.783	0.362
Sn Pb ⁴ { Sn 12.43 } { Pb 87.57 } . . .	10.587	10.927	0.340
Sn Pb ⁵ { Sn 10.20 } { Pb 89.80 } . . .	10.751	11.017	0.266

Lead and Antimony.

Formulae of alloys and per centages.				Obtained.	Calculated.	Difference.
Sb Pb ⁶	{	Sb 11.08	}	10.556	10.919	0.363
		Pb 88.92				
Sb Pb ⁴	{	Sb 13.48	}	10.387	10.805	0.418
		Pb 86.52				
Sb Pb ⁸	{	Sb 17.20	}	10.136	10.629	0.493
		Pb 82.80				
Sb Pb ²	{	Sb 23.68	}	9.723	10.321	0.598
		Pb 76.32				
Sb Pb	{	Sb 38.39	}	8.953	9.624	0.671
		Pb 61.61				
Pb Sb ²	{	Pb 44.53	}	8.330	8.959	0.629
		Sb 55.47				
Pb Sb ³	{	Pb 34.86	}	7.830	8.355	0.525
		Sb 65.14				
Pb Sb ⁴	{	Pb 28.64	}	7.525	8.059	0.534
		Sb 71.36				
Pb Sb ⁵	{	Pb 24.31	}	7.432	7.854	0.422
		Sb 75.69				

These researches reveal two important facts: first, that there is one metal the alloys of which always contract, viz: those of copper, whilst all the amalgams expand or have a less specific gravity; secondly, that the maximum expansion or contraction of alloys and amalgams generally occurs in those which are composed of one equivalent of each metal, the exception being those of tin and zinc. But this arises no doubt from the fact that all the alloys, with the exception of the latter, are compounds and not mixtures.

We must, in conclusion, draw attention to the extraordinary contraction or expansion that some of these alloys experience. Thus, for example, the alloy of 3 of copper and 1 of tin:—

Found.	Calculated.	Difference.
8.954	8.208	0.746

whilst the amalgams of tin expand to nearly the same extent, as shown by these results:—

	Found.	Calculated.	Difference.
1 of Mercury, } 1 of Tin, }	10.255	11.259	1.004

*On the Coating of Engraved Copper Plates by the Galvanoplastic Process.** By Dr. H. MEIDINGER.

The extremely remarkable application of the electrotype, which cannot fail to come into general use in the preparation of copper plates, and to diminish their cost considerably, has recently been repeated by a Frenchman of the name of Jacquin. Several years ago Prof. Böttger showed that iron could be easily separated by the galvanic current from a solution of 1 part of ammonia and 2 parts of sulphate of iron. It then presents the appearance of a silver-white speculum, and ad-

* From the Lond. Chemical Gazette, No. 406.