acid; while in proportions above 5 per cent., they all, with the exception of antimony, increase the solubility.

2. Antimony when present even to the amount of 10 per cent. decreases the solubility of the lead.

3. Tin and zinc alloys are more affected than pure lead.

ACTION OF CONCENTRATED SULPHURIC ACID, AT 100° C., ON LEAD AND ITS ALLOYS.

By L. Pitkin.

The only work of any importance done, in the estimation of the effect produced upon lead by hot concentrated sulphuric acid, is that of Bauer. The acid used by him was 170° T. (Sp. Gr. 1.848), the amount of lead or alloy taken 0.2 gramme, and the amount of acid used 50 c.c. A brief abstract of his work, so far as it relates to alloys used by me, is here given.

I. *Pure lead.*—The first sensible evolution of gas was at 175° C., a stronger action taking place at 190° C., while at 230°—240° C. all of the lead was suddenly changed to sulphate.

II. *Lead and bismuth alloys.*—

(*a*). Pb. 90 per cent., Bi. 10 per cent.

Action begins at 150° C., continues quietly to 190° C., when all of the metal is decomposed.

(*b*). Pb. 96 per cent., Bi. 4 per cent.

This alloy decomposes more quickly than (*a*), the action terminating at 130°—140° C.

(*c*). Pb. 99.27 per cent., Bi. 0.73 per cent.

Rapid and sudden decomposition at 160° C.

III. *Lead and antimony alloys.*—

(*a*). Pb. 90 per cent., Sb. 10 per cent.

A slow and even decomposition takes place, beginning at 190° C., terminating at 240° C.

(*b*). Pb. 95 per cent., Sb. 5 per cent.

Decomposition begins at 180° C., terminating at 225° C.

(*c*). Pb. 99 per cent. Sb. 1 per cent.

Action begins at 250°, ends at 280° C.

IV. *Lead and tin alloys.*—Sudden decomposition at 200° C.

The alloys used by me in determining the effect of hot acid were the same as those employed in estimating the action of cold acid, namely, lead with antimony, tin, bismuth, cadmium, silver, and zinc. The amount of acid was as before, 10 c.c. and the surface exposed 2 sq. in., but the time of exposure was 1 hour, instead of 24 hours, as in testing with cold acid. The amount of gas given off per square foot was not calculated, as that factor would be essential only in the employment of lead for cases. The amount of lead or alloy converted into sulphate per square foot is given in grammes.

The four samples of pure lead, exposed to the action of concentrated acid at 100° C. for one hour, gave very concordant results, as follows :

41.	Pure lead	1.368 Grammes.
42.	"	1.152 "
43.	"	1.224 "
44.	"	1.080 "

The effect of antimony in composition with lead is shown in the following experiments :

45.	Pb. 100 parts,	Sb. ½ part....	2.952 G.
46.	"	" 1 "	3.672 G.
47.	"	" 2 "	3.528 G.
48.	"	" 3 "	3.096 G.
49.	"	" 5 "	2.736 G.
50.	"	" 10 "	2.952 G.

Upon immersing the alloy, very little gas was given off, and for 40 minutes the acid remained clear. It then commenced to cloud, and the alloy taken out at the end of the hour was covered with black slime. It will be seen that at 100° C. the action of antimony is not that of a preservative of the lead, as is the case with cold acid ; while from the experiments of Bauer, quoted above, it seems quite likely that at elevated temperatures the alloy with antimony may be more resisting than pure lead. The relative solubilities of the alloys at ordinary temperatures and at 100° C. are by no means constant, and this forms one of the most interesting features of the investigation ; thus, if at common temperatures the alloys with antimony, are found more insoluble than those with zinc, we cannot predicate the same relation with acid at 100° C. In regard to the action of tin upon lead, as affecting its solubility, the following results were obtained :

51.	Pb. 100 parts,	Sn. ½ part	.... 1.008 G.
52.	"	" 1 "	.... 0.792 G.
53.	"	" 2 "	.... 0.864 G.
54.	"	" 3 "	.... 0.792 G.
55.	"	" 5 "	.... 0.864 G.
56.	"	" 10 "	.... 0.864 G.

It will be remembered that one of the general results obtained from the experiments with cold acid was, that at ordinary temperatures the alloys of lead and tin were more easily attacked than those with antimony, or pure lead itself, and yet at this temperature we see the case reversed.

It is, however, in regard to bismuth that the most curious effects were found to be produced by the composition of the alloy. The following figures will fully explain the peculiar action of the bis muth :

57.	Pb. 100 parts,	Bi.	½ part	..... 24.840 G.
58.	"	"	1 "	..... 22.248 G.
59.	"	"	2 "	..... 1.800 G.
60.	"	"	3 "	..... 1.008 G.
61.	"	"	5 "	..... 1.008 G.
62.	"	"	10 "	..... 2.160 G.

The results given in 57 and 58 appear so exceptional, not only in comparison with other alloys, but in regard to the sudden change shown in 59 and 60, that it was decided to make Experiments 57, 58 and 60 in duplicate.

57.	(Duplicate) Pb.	100 parts,	Bi. ½..	25.920
58.	"	"	Bi. 1..	22.750
60.	"	"	Bi. 3..	1.224

We here have a case in which not only the relative solubility in hot and cold acid is changed as regards other alloys, but one in which an excess of the deleterious substance seems to act as a corrective.

The alloys containing ½ and 1 part of bismuth to 100 of lead gave off gas very plentifully, not only at the start, but throughout the whole hour, while the acid became opaque almost immediately, and the lead sulphate formed could be removed in scales at the end of the experiment.

The experiments with cadmium alloy gave very constant results, and in general it may be said that, with the exception of bismuth alloy, the figures obtained from the same alloy varied much less than in the corresponding trials with cold acid.

63.	Pb. 100 parts,	Cd.	½ part	1.440 G.
64.	"	"	1 "	1.224 G.
65.	"	"	2 "	1.296 G.
66.	"	"	3 "	1.080 G.
67.	"	"	5 "	1.368 G.
68.	"	"	10 "	1.152 G.

The action of cadmium at this temperature seems to be neither increasing or diminishing the action of the H_2SO_4 on the lead.

In the case of silver combined with the lead, we have the same general behavior, six determinations with varying quantities of silver giving the following results :

69.	Pb. 100 parts,	Ag.	½ part	1.296 G.
70.	"	"	1 "	1.080 G.
71.	"	"	2 "	0.864 G.
72.	"	"	3 "	0.792 G.
73.	"	"	5 "	0.936 G.
74.	"	"	10 "	1.440 G.

The action of zinc in determining the solubility of lead in hot acid is in accordance with its effect on cold concentrated acid—that is, increases the effect of the acid, but the action is not so marked as at ordinary temperatures. The figures for the experiments are :

75.	Pb. 100 parts,	Zn.	½ part	1.800 G.
76.	"	"	1 "	1.296 G.
77.	"	"	2 "	1.152 G.
78.	"	"	3 "	1.080 G.
79.	"	"	5 "	1.296 G.
80.	"	"	10 "	1.080 G.

We can easily see from the results we have obtained the importance of testing the lead employed in H_2SO_4 working, and for this no extended analysis is required. The operation consists simply in immersing the lead in acid, more or less concentrated according to the strength of the acid with which it will be brought into contact in actual working, and at the temperature to which it will be subjected in the manufacture of acid.

Mr. McTear says : "The simplest safeguard against risk to pans, etc., giving way would be a careful testing of the lead previous to being made into sheets. For this purpose it will not be necessary to make an analysis, but simply to put clean, thin shavings of lead into a test-tube and cover with pure, cold vitriol, the amount of action would then be clearly visible."

It is, however, clear that the action of cold acid is no sure criterion of the effect that hot acid will have upon the lead; so, to avoid error, it is much safer to test the lead under the conditions of its actual employment.

In order to briefly sum up the results of experiment, it will be advantageous to compare the average of the alloys with pure lead as unity both at ordinary temperatures and at 100° C. The following table will therefore express the average solubility or liability to formation of sulphate of the alloys in terms of lead. In each case the total of the relative solubilities is divided by six (the number of members in the class), for the average solubility of the alloys :

	20° C.	100° C.
Pure lead	1.00	1.00
Pb. 100, Sb. 1 to 10 parts	0.81	2.75
Pb. 100, Sn. 1 to 10 "	1.42	0.75
Pb. 100, Bi. 1 to 10 "	1.10	7.69
Pb. 100, Cd. 1 to 10 "	0.86	1.10
Pb. 100, Ag. 1 to 10 "	0.87	0.93
Pb. 100, Zn. 1 to 10 "	1.53	1.10

OBITUARY.

DR. JOHN LAWRENCE SMITH, died at his home in Louisville, Kentucky, on the 12th of October last, in his 65th year, having been born near Charleston, South Carolina, on the 16th of December, 1818. He had been for some years in rather delicate health and had of late retired very much from the active duties of the laboratory, but maintained his interest in scientific studies.

Dr. Smith pursued his academic studies at the University of Virginia, with which he was later connected as a professor. His medical degree was taken at the Medical College of Charleston. Immediately after this he went to France and Germany, where he zealously followed his medical studies, as also chemistry, physics and mineralogy. While yet a student of medicine at Charleston, he commenced his original work by sending to Silliman's Journal a paper, "On a new method of making permanent magnets by