if applied exactly, could at best give only the partial volumes of the components, which may be more easily derived from density and compressibility data.

I am very much indebted to Mr. L. H. Adams for his many valuable suggestions made in the course of this work, and to Dr. E. G. Zies for his help in the purification of the materials.

Summary

Experimental measurements of the compressions to 1000 bars of various solutions of eleven sulfates have been made over the whole range of concentration, and the results indicate that, for those sulfates which are not greatly hydrolyzed in solution, the bulk compressions of solutions of the same molality are approximately the same. A deviation function, A, giving the difference between the specific compression of pure water and water in any solution, has been examined and found to be expressible within the error of experiment by the equation $A = am + bm^{3/2}$. A short discussion of the influence of the nature of the solute on the coefficients of this equation and of the general effects of solute on the compression of water is given. The equation for A is particularly useful for the calculation of the changes in the partial volumes of the components from the specific compression of the solutions.

The most recent results for the compression of water may be expressed with useful accuracy as a function of pressure by a two-constant equation proposed by Tait, and when this equation is modified by the introduction of a constant representing the change of the internal pressure of the water produced by the addition of solute, a procedure suggested by an hypothesis of Tammann, the resulting formula represents very accurately the volume-pressure relations in salt solutions. Indeed, it is possible to compute with an error of less than 4% the compression of a salt solution up to 10,000 bars without a single measurement of the compressibility of a solution.

In certain cases new experimental values of the specific volumes of the salt solutions are given.

The pressures at which very pure benzene freezes at definite temperatures between 20 and 30° have been measured and the results are given as the quadratic equation (1). It is suggested that this equation may be used in the establishment of a pressure scale between 500 and 1000 bars.

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[CONTRIBUTION FROM THE DEPARTMENT OF PHYSIOLOGY, SCHOOL OF PUBLIC HEALTH, HARVARD UNIVERSITY]

The Effect of Acetic Acid upon Traces of Lead Chromate

BY LAWRENCE T. FAIRHALL AND KEIJI AKATSUKA

In estimating small amounts of lead in biological material by means of the chromate method,[1] the lead chromate is precipitated in a solution slightly acidified with acetic acid, *i. e.*, 1 drop excess of glacial acetic acid to 50 cc. of solution. As little as 0.01 mg. of lead in 50 cc. of such a solution gives a clearly visible Tyndall beam when thus precipitated. When, however, the quantity of acetic acid is largely increased no Tyndall effect is apparent even though the amount of lead is as much as 0.1 mg. Similarly from a very slightly acidified solution, 0.1 mg. of lead as chromate is clearly visible on the filter paper as a light yellow precipitate, while from a 2% acetic acid solution no precipitation can be seen and furthermore with the average quantitative filter paper and large amounts of lead there is loss of lead chromate. In spite of results showing that acetic acid does not interfere with the quantitative determination of lead as chromate,[2] it is not surprising that occasional tests have been reported as negative when based upon visual evidence.

The following experiments, however, show that lead chromate is not appreciably soluble in acetic acid. The apparent disappearance of a trace of lead chromate when precipitated in an excess of acetic acid is at once accounted for if it is centrifuged and examined microscopically. Figure 1 shows the typical amicron material aggregated in clumps as usually obtained in neutral or slightly acid solution. Figures 2 and 3 show the type of precipitate formed in 2 and 50% acetic acid, respectively. In the latter it is evident that the initial condensation of solid from the highly dis-

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(1) Fairhall, *J. Ind. Hyg.*, **4**, 9 (1922).

(2) Patten, *J. Assn. Off. Agr. Chem.*, **4**, 217 (1920).

TABLE I

	Amount of lead, mg.											
	0.3				0.2				0.1			
	First recov.		Second recov.		First recov.		Second recov.		First recov.		Second recov.	
HAc, %	Av., mg.	Dev. of triplicates from av.	Av., mg.	Dev. of triplicates from av.	Av., mg.	Dev. of triplicates from av.	Av., mg.	Dev. of triplicates from av.	Av., mg.	Dev. of triplicates from av.	Av., mg.	Dev. of triplicates from av.
0.15	0.309	±0.000	0.303	±0.007	0.212	±0.004	0.183	±0.005	0.095	±0.007	0.082	±0.008
7.69	.289	± .009	.287	± .013	.208	± .016	.190	± .002	.102	± .001	.080	± .010
15.38	.299	± .006	.278	± .015	.211	± .014	.170	± .008	.106	± .002	.084	± .010
38.46	.304	± .001	.290	± .010	.215	± .011	.180	± .022	.108	± .003	.075	± .004
57.69	.311	± .009	.285	± .014	.230	± .001	.175	± .015	.113	± .004	.075	± .008
Mean all acid concns., mg.	.302		.289		.215		.180		.105		.079	
Av. of 1st and 2d recov., mg.	.295				.197				0.092			

perse phase is sufficiently retarded so that particle orientation becomes more perfect with increasingly acid solution. Thus, the higher the concentration of acetic acid the less evidence of strain is apparent in crystal form (Fig. 3).

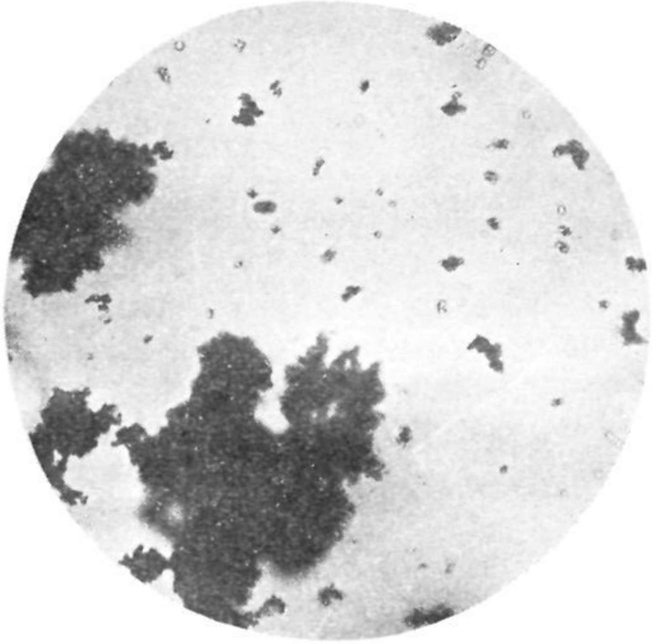

Fig. 1.—Typical amorphous lead chromate precipitated from neutral or slightly acid solution (× 400).

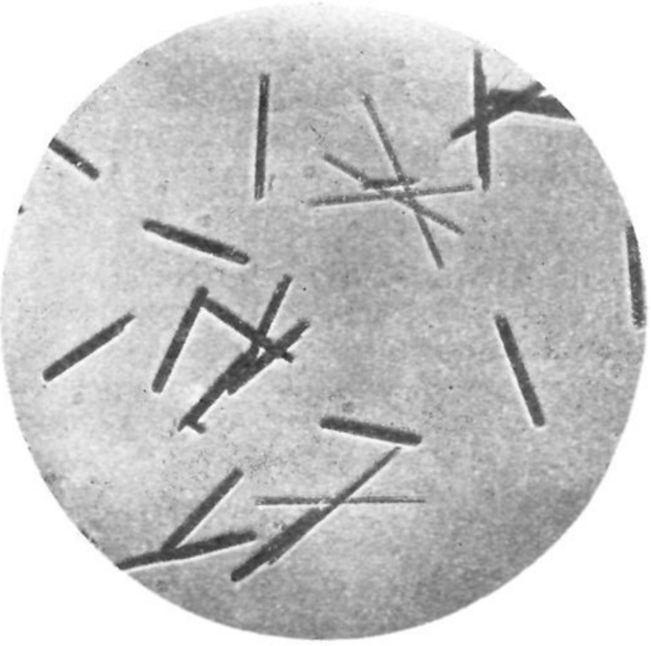

Fig. 2.—Crystalline lead chromate formed in two per cent. acetic acid solution (× 400).

That the quantitative separation of lead as chromate is not affected by the quantity of acetic acid is shown by the following analyses. The precipitation and subsequent manipulation including titration were carried out in 15-cc. centrifuge tubes. Whatman No. 42 filter paper was found sufficiently retentive for the precipitate. Microfunnels and an accurately calibrated microburet were used. In order to remove any doubt of adequate recovery of lead the titration mixture was oxidized, the lead successively precipitated as sulfide and chromate and again titrated. Needless to say the quantitative steps for such a small amount as 0.1 mg. of lead require great care. All analyses were made in triplicate and the average figures are given.

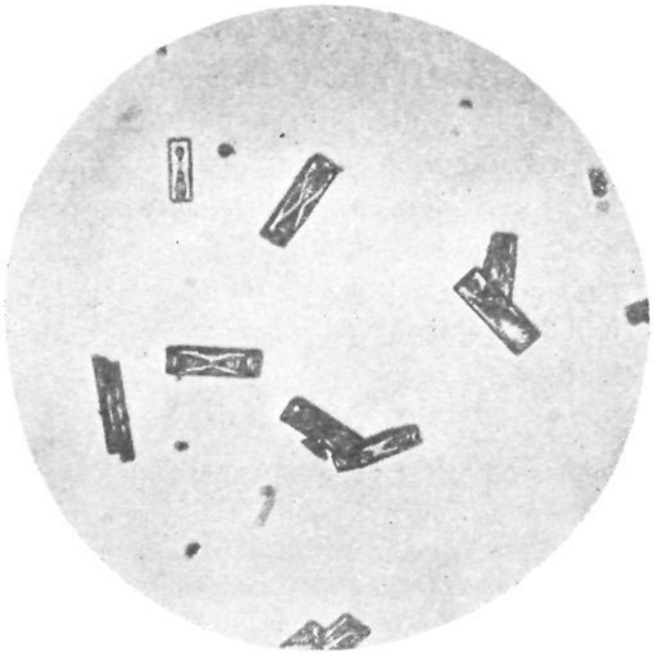

Fig. 3.—Larger and more perfect lead chromate crystals formed in 50 per cent. acetic acid solution (× 400).

Summary

Lead chromate is precipitated as a crystalline rather than amorphous precipitate in the presence of acetic acid. The latter has no appreciable solubility effect on the precipitate.

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