Double Salts in Solution.

By P. N. Evans.

In a paper presented to this Academy four years ago, the author called attention to numerous apparent exceptions to the rule that an electrolyte is less soluble in a solution of another electrolyte with an ion in common with the first than in water alone. The evidence presented at that time was that many saturated solutions fail to give precipitates on addition of second electrolytes having ions in common with those already in the solutions.

Since that time some of the cases then noted have been further investigated, and it has been proved, as then suspected, that in these cases the electrolyte is more instead of less soluble in a solution of a second electrolyte with a common ion than in water alone.

The substances chosen were lead chloride and nitrate, and barium chloride and nitrate. The method of investigation was the determination of the solubility at zero centigrade of one compound in solutions of the other of varying concentrations up to saturation, one hundred cubic centimeters of the solution being used in each case for analysis.

Lead chloride was estimated by determining chlorine in the solution volumetrically, beginning with pure water and ending with a saturated solution of lead nitrate, after saturating with lead chloride. It was found that the solubility of the chloride increased with the concentration of the nitrate, the curve being a straight line within the limits of experimental error. The solubility of lead chloride in water was found to be 0.5426 grams in one hundred cubic centimeters of the solution; in saturated lead nitrate solution, 1.83 grams.

The solubility of lead nitrate in solutions of lead chloride was not determined, on account of the very limited solubility of the latter.

Barium chloride was estimated by determining chlorine in the solution. It was found in this case also that the solubility of the chloride increased with the concentration of the nitrate, the curve again being a straight line. The solubility of barium chloride in water was found to be 33.89 grams in one hundred cubic centimeters of the solution; in saturated barium nitrate solution, 37.42 grams.

Barium nitrate was estimated by determining barium in the pure water solution, barium and chlorine in the solutions containing chloride, and considering the excess of barium over chlorine to be present as nitrate. Again the curve was a straight line, showing an increasing solubility of nitrate with higher concentrations of chloride. The solubility of barium chloride (anhydrous) in water was found to be 5.11 grams in one hundred cubic centimeters of the solution; in saturated barium chloride solution, 9.38 grams.

These results all agree with the assumption that double salts are formed when these salts are mixed in solution, as lead chloride-nitrate and barium chloride-nitrate.

A single instance of this kind has been noticed by other observers, potassium nitrate and lead nitrate by LeBlanc and Noyes. In this instance it is interesting to note that the common ion is the anion, while in the new cases here presented it is the kathion.

These exceptions to the general rule are apparently not uncommon and deserve more consideration in the text-books on physical chemistry, where they are rarely mentioned at all.

In conclusion, the author desires to express his appreciation of the careful experimental work performed by Mr. R. W. Duncan, B.S., at that time a student in Purdue University.

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