CONTRACTION PRODUCED BY SOLUTION OF SALTS.*

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The paper briefly summarizes the conclusions of experimenters on volume changes, produced by the solution of salts. The table accompanying shows the contraction values of some in solution of various strengths.

It is a well-known fact that when solvent and solute are brought together to form a solution a contraction in volume is usually produced. Many workers have made investigations on these volume changes, and much has been learned regarding their nature. Tyrer accepts the following possibilities as influences to volume change:

1. Ionization.
2. Association of molecules of solute.
3. Association of molecules of solvent.
4. Hydration of undissociated solute.
5. Hydration of ions.

The method for investigating the causes of volume changes seems to have been one depending upon the use of optically active substances. This method indicated by Winther makes possible the determination of the actual volume of both solute and solvent.

Tyrer states "that no generalizations of importance have resulted, due no doubt to the complexity of the factors which come into play, all of which may vary with concentration." It may be interesting, however, to summarize some of his conclusions:

1. "In solutions in which no chemical changes of any kind occur, the specific volume of the solute is constant, independent of the concentration."
2. "The volume of an electrolyte in solution shows no tendency to assume a constant value, but goes on decreasing as the dilution increases, and in many cases becomes negative."
3. "Molecular association of the solute in solution is without influence on the apparent volume of the solute. The behavior is the same as if the molecules were normal."
4. "Solvate formation,—that is, combination of the solvent and solute,—generally causes a contraction in the apparent volume of the solute, and, further, the volume of the solute in solution generally decreases with decrease of concentration. But in some of the cases investigated the formation of a solvate appears to be without influence on the solution volume of the solute."
5. "With aqueous solutions of electrolytes it is probable that in strong solutions the undissociated molecules are hydrated, and in dilute solutions the ions are hydrated."

The following table has been compiled showing contraction values for six of the more common salts in various solution strengths:

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Grammes of salt in 100 of water	Observed volume	Calculated volume	Percent of contraction
	NaCl		
	Density—2.150 (Clarke)		
	(Gerlach)		
5	101.4	102.33	0.90
10	103.2	104.65	1.48
20	106.7	109.30	2.38
30	110.4	113.95	3.11
	KI		
	Density—3.07 (Clarke)		
	(Kremers)		
15	104.0	104.88	0.84
50	114.2	116.29	1.70
85	124.5	127.68	2.49
	$KC_2H_3O_2$		
	Density—1.472 (Gerlach)		
	(Gerlach)		
20	110.7	113.59	2.54
50	127.9	133.97	4.53
100	157.6	167.95	6.16
	$CaCl_2$		
	Density—2.216 (Schroeder)		
	(Gerlach)		
10	102.0	104.51	2.40
30	107.0	113.53	5.75
60	116.8	127.06	8.07
	$MgSO_4$		
	Density—2.65 (Clarke)		
5	100.10	101.89	1.79
10	100.33	103.77	3.31
20	101.75	107.55	5.39
	$Pb(C_2H_3O_2)_2$		
	Density—3.251 (Schroeder)		
	(Gerlach)		
15	104.3	104.61	0.28
30	108.8	109.23	0.39
80	124.3	124.61	0.24

REFERENCES.

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* These tables were compiled from values found in Smithsonian Physical Tables, 1904, pp. 131–134.