of the laws which have so much value in throwing light on chemical reactions in other lines of work could be employed advantageously in the study of steel. The influence of temperature, pressure, concentration, mass action, velocity of reaction and many other questions could then be studied from the physico-chemical view point; and the influence of elements other than iron and carbon on the constitution of solvent or of the solute might be studied with some hope of obtaining reasonable explanations for their influence. The art of controlling the physical properties of steel has usually been in advance of scientific explanation of the reason for the properties of the metal, this being especially true of the properties of the modern alloy steels. Any conception of the constitution of steel to be at all satisfactory must be broad enough to include a possible explanation for the facts now known concerning the properties of this really wonderful metal and should serve as a basis for the further scientific development of the arts.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF NEW HAMPSHIRE COLLEGE.]

HYDRATES OF LANTHANUM OXALATE.

BY C. JAMES AND C. F. WHITTEMORE.

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This work was undertaken in order to ascertain whether the oxalonitrate of lanthanum exists at 25°. For this purpose a careful study of the system, lanthanum oxalate, lanthanum nitrate and water, was carried out, in the usual manner, by adding varying amounts of lanthanum

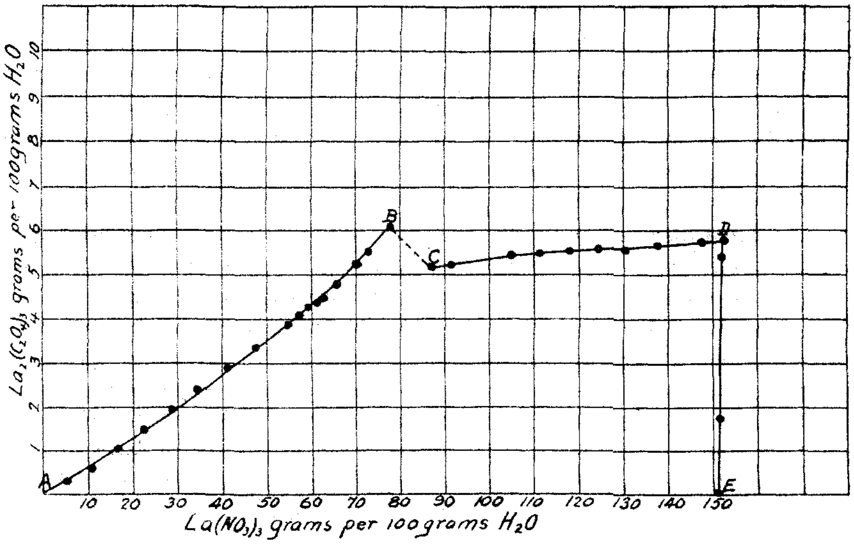

Fig. 1.

oxalate and lanthanum nitrate to sufficient water to make 50 cc. The oxalate was prepared at a fairly low temperature, since that obtained at 100°, which was composed of a lower hydrate, could remain in contact with the solutions for a long time without reaching equilibrium. The bottles containing the mixtures were rotated in a thermostat at 25° until equilibrium was reached. They were then allowed to stand at this same temperature until the solid had settled, when portions of the clear supernatant liquids were withdrawn for analysis.

In each of these samples, the lanthanum oxide and C_2O_3 were determined. The lanthanum was precipitated with a slight excess of oxalic acid, allowed to stand for half an hour, filtered off and ignited to the oxide. The C_2O_3 was determined by titration with standard potassium permanganate solution.

The resulting data are given in Table I and plotted in Fig. 1:

TABLE I.

Bottle No.	Per cent $La_2(C_2O_4)_3$.	Per cent $La(NO_3)_3$.	Gms. $La_2(C_2O_4)_3$ per 100 grams H_2O.	Gms. $La(NO_3)_3$ per 100 grams H_2O.
1	0.28	5.06	0.29	5.35
2	0.50	9.89	0.56	11.04
3	0.88	14.04	1.03	16.50
4	1.18	17.99	1.46	22.25
5	1.46	22.15	1.91	29.00
6	1.73	25.17	2.37	34.43
7	2.01	28.63	2.89	41.28
8	2.21	31.53	3.33	47.56
9	2.41	34.61	3.83	54.94
10	2.51	35.57	4.05	57.45
11	2.59	36.24	4.23	59.27
12	2.63	37.18	4.37	61.79
13	2.67	37.42	4.46	62.46
14	2.80	38.50	4.76	65.60
15	3.00	39.89	5.25	69.85
16	3.09	40.83	5.50	72.81
17	3.32	42.27	6.10	77.67
18	2.68	45.26	5.14	86.94
19	2.68	45.06	5.14	86.82
20	2.64	46.39	5.18	91.03
21	2.59	49.84	5.44	104.80
22	2.52	51.30	5.46	111.10
23	2.47	52.74	5.50	117.80
24	2.41	54.11	5.54	124.50
25	2.34	55.20	5.51	130.00
26	2.32	56.54	5.63	137.50
27	2.26	58.22	5.71	147.30
28	2.23	59.03	5.76	152.40
29	2.10	59.03	5.39	151.90
30	0.67	59.91	1.70	152.00
31	0.00	60.17	0.00	151.10

Bottle 31 was employed for the determination of the solubility of lanthanum nitrate.

Samples of the solid phases were withdrawn by means of a platinum spoon and freed as much as possible from the mother liquor by pressing between filter papers in a screw press. The pressed solid was quickly transferred to a weighing bottle and thoroughly mixed. In order to estimate the C_2O_3 by titration with potassium permanganate, it was found advizable to add the solid to the dilute sulfuric acid since under these conditions the substance disintegrated and dissolved rapidly upon heating. The La_2O_3 was determined by simple ignition.

The data are given in Table II and plotted in the triangular diagram, Fig. 2:

TABLE II.

	Liquid.		Solid.	
Bottle No.	Per cent $La_2(C_2O_4)_3$.	Per cent $La(NO_3)_3$.	Per cent $La_2(C_2O_4)_3$.	Per cent $La(NO_3)_3$.
2	0.50	9.89	59.09	2.43
5	1.46	22.15	52.18	7.74
8	2.21	31.53	55.85	9.19
	2.15	39.57	64.86	9.85
	2.35	44.27	59.55	13.88
	2.60	48.31	60.06	15.27
25	2.34	55.20	51.71	24.58
26	2.32	56.54	44.43	29.85
27	2.26	58.22	41.85	32.22

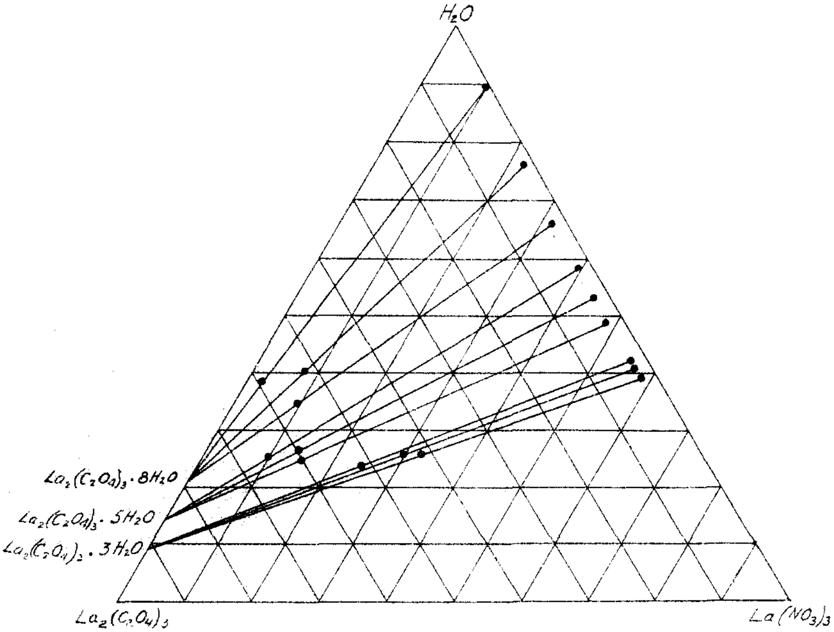

Fig. 2.

The solubility curve shows three distinct breaks, at B, C, and D. The solid along the portion A B was shown by the triangular diagram to consist of the hydrate $La(C_2O_4)_3.8H_2O$. Under slightly different conditions, the length of that portion of the curve B C was increased and the lanthanum oxalate along this branch was found to contain five molecules of water of crystallization. The dotted line does not represent the true direction of the curve of this hydrate. From C to D, the lanthanum compound was found to be in a still lower state of hydration, *viz.*, $La_2(C_2O_4)_3.3H_2O$. It was observed that along D E, the curve showed a slight increase in the solubility of lanthanum nitrate.

Summary.

The above work indicates that at 25°:

1. $La_2(C_2O_4)_3.11H_2O$ is not stable in contact with lanthanum nitrate solution.

2. The following hydrates also exist:
$La_2(C_2O_4)_3.8H_2O$, $La_2(C_2O_4)_3.5H_2O$ and $La_2(C_2O_4)_3.3H_2O$.

3. No oxalo-nitrate exists, although it may possibly be found at higher temperatures.

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THE QUANTITATIVE SEPARATION OF LANTHANUM FROM YTTRIUM.

BY C. JAMES AND T. O. SMITH.

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Hitherto the only method employed for the separation of the cerium earths from the yttrium earths has been the potassium sulfate treatment. This separation is based upon the fact that lanthanum forms a double sulfate with potassium which is insoluble in saturated potassium sulfate solution, while the corresponding yttrium compound is fairly soluble.

In addition to the above, Urbain has shown that by fractionally crystallizing the rare earth magnesium nitrates in the presence of bismuth magnesium nitrate the latter inserts itself between samarium magnesium nitrate and europium magnesium nitrate, dividing these elements quantitatively at this point.

He also states that by treating yttrium earth nitrates containing some cerium earth nitrates with magnesium nitrate and bismuth magnesium nitrate the separation of the two groups was effected.

Among other compounds which show diverging solubilities for these two groups are the sodium double sulfates, the formates, and the cacodylates.

For the quantitative study it was considered that the completeness of the separation could be better shown by employing lanthanum and yttrium which approach the extremes of the series.