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LVI. *The Temperature Variations of the Specific Molecular Conductivity and of the Fluidity of Sodium Chloride Solutions.* By Prof. THOMAS R. LYLE and Mr. RICHARD HOSKING, *University of Melbourne*.*

[Plates XI. & XII.]

THE statement has often been made that the temperature variations of electrical conductivity and fluidity (the inverse of viscosity) are identical for a given electrolytic solution. In order partly to test the accuracy of the statement in a particular case, and generally to obtain a set of accurate values for the two quantities mentioned, the experiments which yielded the following results were undertaken by us.

Previously one of us had obtained values of the Viscosity of Sodium Chloride solutions over a considerable range of temperature (*Phil. Mag.* March 1900, p. 274); but the effect of change of density and temperature on the viscosity is so great that it was determined that portions of the solution to be experimented upon should be run into suitable instruments fixed in the same bath, and that the observations necessary for calculating the density, fluidity, and electrical resistance should be made at the same time, the temperature being kept constant until all the readings had been taken for that particular temperature.

From the results so obtained, we are able, by interpolation, to compare the electric conductivity and the fluidity over the range of temperature between 0°C. and 100°C. of solutions of constant concentration; that is, we compare the conductivity and the fluidity at different temperatures of such solutions as contain, say, 1 gram molecule per litre at each of these temperatures. This we are enabled to do by means of the values of the density at the different temperatures of any particular solution experimented with, which we determine simultaneously with its electric resistance and viscosity.

The bath was a large beaker of water, contained in the upper compartment of an iron jacket provided at the front and back with glass windows, and inclosed at the top by a thick wooden cover. The two compartments were separated by a plate of asbestos on which the beaker rested, and the lower one contained the gas-jet used for heating the bath and the very small controlling flame which was used for keeping the bath from cooling while readings were being taken. The cover was pierced with the holes necessary for holding the

* Communicated by the Authors.

various instruments in position in the bath, namely: the glischrometer, dilatometer, electrolytic cell, thermometer, and siphon. The stirring was managed by a swiftly rotating propeller. The thermometers were standardized before being used. They were graduated in tenths, and their readings were observed through a cathetometer. The sample of sodium chloride used in the solutions was specially purified for the purpose by David Avery, Esq., M.Sc., Instructor in Chemistry at the Working Men's College, Melbourne.

Figures 1, 2, and 3 are drawings of the glischrometer, dilatometer, and electrolytic cell used. The formula used in determining the viscosity was

$$\eta = A\rho T - \frac{B}{T}\rho,$$

where A and B are constants, ρ is the density and T the transpiration time of the solution. The constants A and B were obtained from known values of η supplied from the original curves at two temperatures for which T had been observed with the new glischrometer, the liquid used being water. The values obtained were

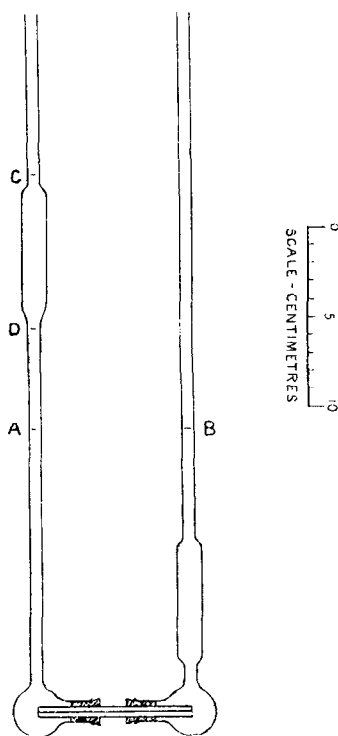
$$A = 0.00002834, \quad B = 0.0360 ;$$

and the new determinations of the viscosity of water were identical with the old ones up to 70° C. Above that there were very slight variations. With the new form of glischrometer the liquid flowed through the capillary-tube under a pressure due to the difference of level of its two surfaces only. No external pressure was used. Moreover, measurements could only be made with the liquid flowing in the one direction through the capillary-tube, so that we could not eliminate errors due to this tube not being quite horizontal. For these reasons the new values obtained as absolute values are not quite so reliable as the original ones. However, we took all precautions to get as accurate values as possible. The amount of solution before each reading was adjusted so that the two surfaces were at the marks A and B in the same horizontal line. The solution was then forced up into the left limb until its surface was just above C. The time of flow when the meniscus passed from C to D gave the transpiration time (T), usually from 2 to 6 minutes.

The cylindrical bulb of the dilatometer (figure 2) was about 5 c.c. in capacity, and the remaining portion had an internal diameter of 2 mm. approximately. Between A and C were graduations etched in the glass. The graduations above B in the other limb were much further apart, and were

only used for setting the surface of the solution at a definite level in that limb, while readings in the other limb were being made. Sufficient of the solution was first run in to fill the bulb and tubes just above A and B. Its weight was obtained, and the pressure of a screw-clip on an air-reservoir attached to D was so adjusted that the level was exactly at the mark B. The reading in A C was then noted and the

Fig. 1.—Glischrometer.

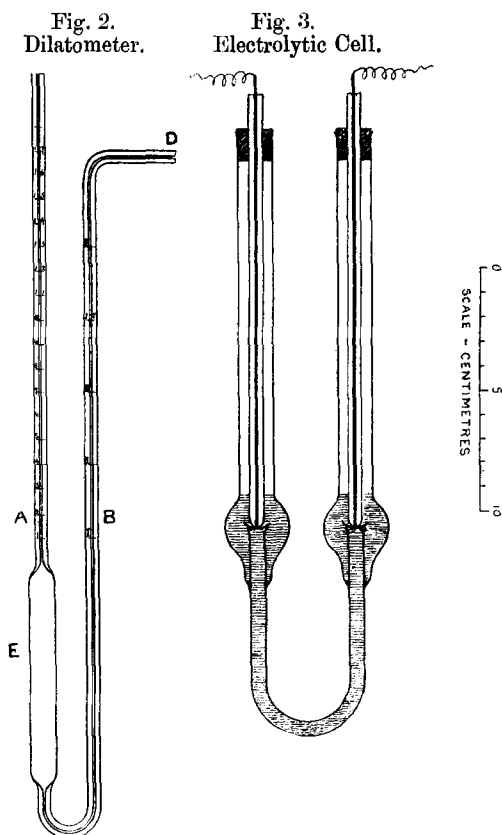


temperature and the volume of the solution could be calculated, and the density at that temperature deduced. At higher temperatures, the mark II. in B D was used instead of mark I., and at still higher temperatures, marks III. and IV. The actual values in scale-divisions of these intervals had been previously calculated, and the coefficient of expansion of the glass in the dilatometer was also determined. The volume between B and A was also found, and the absolute value of the scale-divisions in A C.

The volume of solution in the dilatometer at any temperature $t^{\circ}\text{C}$. was given by

$$V_t = (5.030 + n \times .001296) (1 + 0.0000287t) \text{ c.c.},$$

where n was the scale-reading. With this instrument, values for the density of water were obtained agreeing with the true values to within .01 per cent. between temperatures 0° and 90°C . which was sufficiently accurate for our purpose.



The electrolytic cell was constructed wholly of glass (fig. 3), and the electrodes could always be fixed at exactly the same place, for when they were in position they rested on the open ends of the tube containing the solution, these ends being in the centre of pear-shaped bulbs which connected with wide tubes passing through the cover of the bath, and supported by it. Sufficient solution was used to fill the cell to the top of the bulbs. The wires leading to the electrodes

passed down narrow glass tubes, and were sealed through the ends to the platinum electrodes which were cup-shaped and had been coated with platinum-black. The tubes were kept in position by passing through corks which fitted into the open ends of the wide tubes.

When all the instruments had been thoroughly cleaned, and had been fixed in position in the bath, the solution, which had been made up by weight according to Bender's (*Wied. Ann.* xxii.) values for the density, was distributed among the three instruments in the proper proportions. After any excess had been removed, and the dilatometer had been weighed and replaced, the experiments on that solution were begun at 0° and the readings were taken at intervals of 10° C. up to a degree or two below the boiling-point of water. Everything was then allowed to cool, and final readings were taken at the temperature of the room in order to see whether there was any appreciable variation in any of the quantities observed on account of evaporation. During all this time the instruments remained untouched and unaltered in position. The electrical resistances were measured by a modification of Kohlrausch's method.

The alternating current was derived from a small magneto-alternator driven by a water-motor, and a Wheatstone's bridge was connected up in the ordinary way. A telephone, however, was not used as an indicator, but a reflecting D'Arsonval galvanometer; the alternating current in this portion of the circuit having been transformed into a direct one by passing from the bridge to a commutator attached to the axle of the alternator and rotating with it. The galvanometer connexions were in this way reversed as often as the direction of the current from the alternator changed, and so the usual deflexion of the galvanometer could be readily detected, and the resistances adjusted to give no deflexion.

Owing to the shape of the vessel containing the electrolyte, relative measurements of the resistance were obtained. These were, however, standardized by using Kohlrausch's recent values (*Journal of Chemical Society*, February 1900) for the specific molecular conductivity of 1.0 gramme-molecule and of 0.5 gramme-molecule solutions of sodium chloride at 18° C.

The strengths of the solutions used were very approximately 0.1, 0.2, 0.5, 1.0, 2.0, and 4.0 gramme-molecule equivalents per litre at 15° C., the exact strengths at the various temperatures being determined as the experiments proceeded. In the accompanying Table, specimen observations are given, with the results deduced from them.

Specimen Observations.

Fluidity Data.				Density Data.				Conductivity Data.	
Strength of Soln. <i>n</i> .	Temp. °C.	Time (secs.).	Viscosity (Calc.).	Temp. °C.	Weight of Soln. (gms.)	Scale-Reading.	Density (Calc.).	Temp. °C.	Resistance (Legal Ohms.)
0·1	10·96	452·0	·01278	10·90	5·0660	9·9	1·0043	11·00	17760
0·1	90·05	124·8	·00315	90·05	„	137·4	0·97022	90·05	5250
0·2	20·85	351·2	·00992	20·90	5·0881	16·0	1·0069	20·80	7507
0·2	80·50	137·4	·00356	80·50	„	114·8	0·9802	80·45	3160
0·5	70·52	158·2	·00424	70·53	5·1521	97·7	0·9972	70·70	1570
0·5	35·72	265·6	·00749	35·74	„	35·5	1·0140	35·70	2500
1·0	41·05	246·0	·00704	41·10	5·255	44·4	1·0317	41·00	1261
1·0	60·95	182·4	·00508	61·00	„	79·7	1·0220	61·00	951
2·0	51·20	223·4	·00656	51·20	5·446	63·8	1·0636	51·15	843
4·0	0·15	809·6	·02656	0·15	5·8423	5·0	1·1600	0·15	1087
4·0	98·35	156·0	·00463	98·30	„	183·3	1·1060	93·70	247

Curves were drawn to represent the changes in the density, viscosity, and electrical resistance of the different solutions with change of temperature, and the values obtained from these curves for every 10° C. are contained in Tables I., II., and III. These curves, and others obtained from interpolated values, were plotted with extreme care on very large sheets of squared paper in order to keep the required degree of accuracy throughout.

In the experiments, the extreme temperatures of the bath were 0°·15 C. and 98°·70 C., and the transpiration times varied between 809 secs. and 118 secs.

TABLE I.—Density of NaCl Solutions.

Temp.	Water.	NaCl Solutions.					
		$n_{15}=0\cdot1$	0·2	0·5	1·0	2·0	4·0
0°C.	0·9999	1·0049	1·0095	1·0220	1·0442	1·0841	1·1600
10	0·9997	1·0043	1·0087	1·0210	1·0421	1·0809	1·1554
15	0·9992	1·0036	1·0080	1·0201	1·0408	1·0792	1·1530
18	0·9986	1·0032	1·0075	1·0195	1·0401	1·0782	1·1517
20	0·9983	1·0028	1·0071	1·0190	1·0394	1·0774	1·1507
30	0·9958	1·0002	1·0044	1·0160	1·0361	1·0734	1·1457
40	0·9923	0·9966	1·0005	1·0123	1·0320	1·0690	1·1405
50	0·9882	0·9924	0·9962	1·0079	1·0275	1·0643	1·1351
60	0·9834	0·9876	0·9915	1·0029	1·0224	1·0588	1·1295
70	0·9779	0·9821	0·9862	0·9975	1·0170	1·0533	1·1236
80	0·9719	0·9763	0·9805	0·9916	1·0111	1·0474	1·1176
90	0·9656	0·9700	0·9742	0·9854	1·0049	1·0414	1·1113
100	0·9586	0·9632	0·9675	0·9792	0·9983	1·0353	1·1049

TABLE II.—Viscosity of NaCl Solutions.

Temp.	Water.	NaCl Solutions.					
	$n_{15}=0\cdot0$	$n_{15}=0\cdot1$	0·2	0·5	1·0	2·0	4·0
0°C.	·01794	·01805	·01805	·01820	·01851	·02039	·02676
10	·01309	·01312	·01312	·01342	·01392	·01506	·02014
15	·01143	·01147	·01147	·01177	·01223	·01328	·01762
18	·01060	·01063	·01063	·01092	·01135	·01237	·01636
20	·01009	·01013	·01013	·01041	·01082	·01182	·01557
30	·00802	·00805	·00805	·00837	·00869	·00956	·01254
40	·00657	·00657	·00657	·00685	·00715	·00788	·01034
50	·00553	·00553	·00553	·00579	·00599	·00668	·00873
60	·00472	·00472	·00472	·00493	·00515	·00578	·00746
70	·00407	·00407	·00407	·00427	·00447	·00502	·00647
80	·00358	·00358	·00358	·00375	·00394	·00442	·00569
90	·00316	·00316	·00316	·00333	·00349	·00397	·00506
100	·00285	·00285	·00285	·00300	·00314	·00355	·00456

TABLE III.—Resistance between the Electrodes of NaCl Solutions.

Temp.	NaCl Solutions.					
	$n_{15}=0\cdot1$	0·2	0·5	1·0	2·0	4·0
0° C.	24000	12500	5300	2970	1785	1097
10	18170	9670	4110	2325	1316	864
15	16120	8580	3670	2062	1177	777
18	15070	8000	3450	1925	1108	729
20	14420	7625	3300	1841	1065	701
30	11720	6250	2700	1512	893	575
40	9850	5270	2300	1279	762	485
50	8420	4550	2000	1103	653	419
60	7330	3955	1762	963	562	367
70	6500	3525	1581	853	492	329
80	5810	3155	1425	768	440	297
90	5250	2850	1280	702	403	270
100	4730	2560	1154	649	375	250

From Table I. the Molecular Concentrations of the solutions were obtained by using the formula

$$N_t = N_{15} \times \frac{\rho_t}{\rho_{15}} = \frac{N}{\rho} \cdot \rho_t,$$

where N_{15} = number of gramme-molecules per litre at 15° C.,
 ρ_{15} = density of solution at 15° C.,
and t is the temperature.

Also ρ is the density at 15° C. given by Bender (Wied. Ann. xxii.) for solutions containing N gramme-molecules
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per litre at that temperature. The results are collected in Table IV.

Table V. contains the Fluidities, the reciprocals of the Viscosities, and Table VI. the Specific Molecular Conductivities. To obtain the latter the formula $C_t = \frac{x(1-gt)}{N_t R_t}$ was employed; where x was the constant of the cell used (1427.0), g was the coefficient of linear expansion of the glass, N_t was the concentration and R_t the resistance of the solution used at the temperature t° C.

TABLE IV.—Molecular Concentrations.
NaCl Solutions.

Temp.	$\rho_{15}=1.0035$	1.0075	1.0200	1.0400	1.0788	1.1522
	$n_{15}=0.1$	0.2	0.5	1.0	2.0	4.0
0° C.	.10014	.20040	.50095	1.0042	2.0100	4.0275
10	.10008	.20024	.5005	1.0021	2.0040	4.012
15	.10001	.20010	.5000	1.0008	2.0007	4.003
18	.09997	.20000	.4998	1.0001	1.9990	3.999
20	.09993	.19993	.4995	0.9994	1.9974	3.995
30	.09966	.19940	.4980	.9962	1.9900	3.978
40	.09932	.19861	.4962	.9923	1.9817	3.960
50	.09890	.19780	.4941	.9879	1.9730	3.941
60	.09842	.19683	.4916	.9832	1.9630	3.922
70	.09788	.19580	.4890	.9778	1.9523	3.902
80	.09728	.19470	.4861	.9722	1.9419	3.881
90	.09666	.19340	.4831	.9663	1.9308	3.859
100	.09598	.19206	.4800	.9609	1.9194	3.836

TABLE V.—Fluidity of NaCl Solutions.

Temp.	Water.	NaCl Solutions.					
		$n_{15}=0.1$	0.2	0.5	1.0	2.0	4.0
0° C.	55.75	55.40	55.40	54.95	54.03	49.05	37.37
10	76.40	76.22	76.22	74.52	71.84	66.40	49.65
15	87.49	87.19	87.19	84.97	81.78	75.30	56.75
18	94.34	94.08	94.08	91.58	88.11	80.85	61.13
20	99.11	98.72	98.72	96.06	92.43	84.61	64.23
30	124.7	124.2	124.2	119.5	115.1	104.6	79.74
40	152.2	152.2	152.2	146.0	139.9	126.9	96.72
50	180.8	180.8	180.8	172.7	167.0	149.7	114.5
60	211.9	211.9	211.9	202.8	194.2	173.0	134.1
70	245.7	245.7	245.7	234.2	223.7	199.3	154.6
80	279.4	279.4	279.4	266.7	253.8	226.3	175.8
90	316.5	316.5	316.5	300.3	286.5	252.0	197.6
100	350.9	350.9	350.9	333.3	318.5	281.7	219.3

TABLE VI.—Specific Molecular Conductivities.
NaCl Solutions.

Temp.	NaCl Solutions.					
	$n_{15}=0.1$	0.2	0.5	1.0	2.0	4.0
0° C.	59.38	56.97	53.75	47.85	39.78	32.30
10	78.48	73.70	69.37	61.25	54.11	41.36
15	88.54	83.12	77.78	69.16	60.60	45.88
18	94.76	89.20	82.76	74.06	64.43	48.95
20	98.88	93.60	86.56	77.55	67.10	50.95
30	122.15	114.47	106.10	94.71	80.28	62.37
40	145.8	136.3	125.0	112.4	94.47	74.28
50	171.3	158.5	144.3	130.9	110.7	86.36
60	197.7	183.2	164.6	150.6	129.3	99.06
70	224.2	206.6	184.5	171.0	148.5	111.1
80	252.3	232.2	205.9	191.0	166.9	123.7
90	281.0	258.7	230.6	210.2	183.3	133.4
100	314.1	290.0	257.4	228.8	198.1	148.7

Using now the figures contained in Tables IV., V., and VI., two sets of isothermal curves were drawn, one set having fluidity as ordinates and absolute concentration as abscissæ, and the other set having specific molecular conductivity as ordinates and absolute concentration as abscissæ.

The fluidity-concentration isothermals are, with a slight deviation for weak solutions near the freezing- and boiling-points, straight lines meeting very approximately in a point on the axis of abscissæ for which the concentration c is 10.74.

Hence these isothermals can be expressed by the formula

$$F = \lambda (10.74 - c),$$

where λ is a function of the temperature only.

The actual deviations of the experimental results from this empirical formula only occur, as already mentioned, in the case of weak solutions near 0° C. and 100° C., F being slightly greater near 100° C. and being slightly less near 0° C. than the formula indicates.

The sp. mol. conductivity-concentration isothermals were not so simple. For concentrations greater than 1 gr.-mol. they were approximately straight lines apparently meeting at the same point on the axis of abscissæ as the fluidity-concentration isothermals, but sufficient experiments have not been carried out to properly test this. For concentrations less than 1 gr.-mol. these isothermals curve up, showing as they ought an accelerated increase in sp.-mol. conductivity as the solution becomes more dilute.

If, however, we admit that both sets of isothermals meet the axis of abscissæ at a point corresponding to a concentration of 10.74 gr.-mol. per litre, it would indicate obviously that such a solution, if physically possible, would at all temperatures have zero fluidity and zero sp.-mol. conductivity.

From these isothermal curves values were obtained at different temperatures of the fluidity and the sp.-mol. conductivity for solutions of constant concentration throughout, namely, for 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 4.0 gr.-mol. per litre. From the same curves also, by extrapolation, we obtained the values of the fluidity and the sp.-mol. conductivity at infinite dilution for all temperatures between 0° C. and 100° C.

These results are collected in Tables VII. and VIII., and plotted on Plate XI. The curves so arrived at are remarkable in that they indicate that for solutions of the strengths experimented with, both the fluidity and the sp.-mol. conductivity vanish at a temperature of $-35^{\circ}.5$ C.

It is obvious at once from these constant-concentration curves that the temperature-coefficients of fluidity and sp.-mol. conductivity are not identical, though the two sets of curves possess considerable similarity.

The values of the ratio of the sp.-mol. conductivity (C) to fluidity (F) were now calculated for solutions of constant concentration at different temperatures, and the results are collected in Table IX., and plotted in Plate XII., where the values of C/F are abscissæ with the corresponding temperatures as ordinates.

TABLE VII.—Fluidity (F) at Constant Concentration.

Temp.	Infinite Dilution.	$n=0.1$	$n=0.2$	$n=0.5$	$n=1.0$	$n=2.0$	$n=3.0$	$n=4.0$
0° C.	55.7	55.4	55.2	55.0	54.0	49.4	43.9	37.7
10	76.4	76.3	76.0	74.6	71.8	66.4	58.8	49.9
18	94.35	94.0	93.2	91.6	88.1	80.8	71.4	61.1
20	99.1	98.6	98.0	96.0	92.4	84.6	74.4	64.2
30	124.7	123.2	122.5	120.0	115.0	104.5	92.1	79.1
40	152.2	151.0	149.8	146.1	140.0	126.7	112.0	96.2
50	180.8	179.4	178.0	173.9	166.4	149.3	131.4	113.7
60	211.9	210.0	208.0	202.0	192.0	172.6	152.8	132.9
70	245.7	243.2	241.0	234.0	222.4	198.9	175.7	152.2
80	279.4	276.8	274.0	266.1	252.8	226.0	192.2	172.6
90	316.5	313.3	310.0	300.0	283.9	251.7	221.7	193.4
100	350.9	347.1	343.4	332.5	314.2	278.4	245.4	217.0

TABLE VIII.—Specific Molecular Conductivity (\bar{C}) at Constant Concentration.

Temp.	Infinite Dilution.	$n=0.1$	$n=0.2$	$n=0.5$	$n=1.0$	$n=2.0$	$n=3.0$	$n=4.0$
0° C.	66.2	59.4	55.0	50.5	47.9	42.4	37.4	32.65
10	88.0	78.5	73.7	66.6	61.25	54.0	47.0	41.4
18	107.5	94.75	89.2	80.9	74.06	64.4	56.1	48.9
20	112.5	98.9	93.6	84.6	77.55	67.1	58.1	50.9
30	140.0	122.1	114.5	104.1	94.7	80.2	70.0	62.0
40	166.0	145.8	135.4	123.9	112.2	94.2	82.4	74.0
50	194.0	171.3	158.5	143.4	130.5	110.0	96.1	85.9
60	225.0	197.7	183.2	164.0	150.1	128.8	111.7	98.1
70	252.0	224.2	206.3	184.0	170.1	147.2	127.1	109.6
80	283.0	251.7	231.8	205.3	190.0	165.8	142.9	121.5
90	311.0	279.4	257.0	229.3	209.4	181.9	155.4	133.0
100	350.0	312.6	288.5	253.0	227.6	196.0	168.7	144.9

TABLE IX.—Ratio $\frac{C}{F}$ at Constant Concentration.

Temp.	Infinite Dilution.	$n=0.1$	$n=0.2$	$n=0.5$	$n=1.0$	$n=2.0$	$n=3.0$	$n=4.0$
0° C.	1.189	1.072	0.996	0.918	0.887	0.858	0.852	0.866
10	1.152	1.029	.970	.893	.853	.813	.799	.830
18	1.139	1.008	.957	.883	.841	.797	.786	.800
20	1.135	1.003	.955	.881	.839	.793	.782	.793
30	1.123	.991	.935	.867	.823	.768	.760	.784
40	1.091	.966	.904	.848	.801	.744	.736	.769
50	1.073	.955	.890	.825	.784	.737	.731	.755
60	1.062	.942	.881	.812	.781	.746	.731	.738
70	1.026	.922	.856	.786	.765	.740	.723	.720
80	1.013	.909	.846	.772	.752	.734	.717	.704
90	.983	.892	.829	.764	.738	.723	.701	.688
100	.998	.901	.840	.761	.724	.704	.687	.668

The plots come out as parallel straight lines to a very close approximation, which shows that the ratio C/F for solutions of constant concentration decreases proportionally to rise of temperature, and that for solutions of all strengths the temperature-coefficient involved is the same. Its value may be taken as .00174; hence we may express the relations shown on Plate XII. by the formula

$$\frac{C}{F} = u(1 - .00174 t),$$

where u depends only on the concentration and t is the temperature.

For infinite dilution $u=1.177$, and for solutions of different strengths n we get the following values of u :—

n	0.1	0.2	0.5	1.0	2.0	3.0	4.0
u	1.048	.982	.906	.869	.827	.816	.825

If these values of u be substituted in the above formula for C/F, and the latter quantity calculated for different states of temperature and concentration, it will be found that the values so obtained agree very closely with those contained in Table X. The average difference is 1 per cent., and the largest deviations occur for the temperatures 0° C. and 100° C.

The degree of dissociation at different temperatures for solutions of constant concentration is given in Table X. ; and it is interesting to note that for the stronger solutions at least there is a well-marked diminution of the degree of dissociation with rise of temperature.

TABLE X.—Degree of Dissociation at Different Temperatures of Solutions of Constant Concentration.

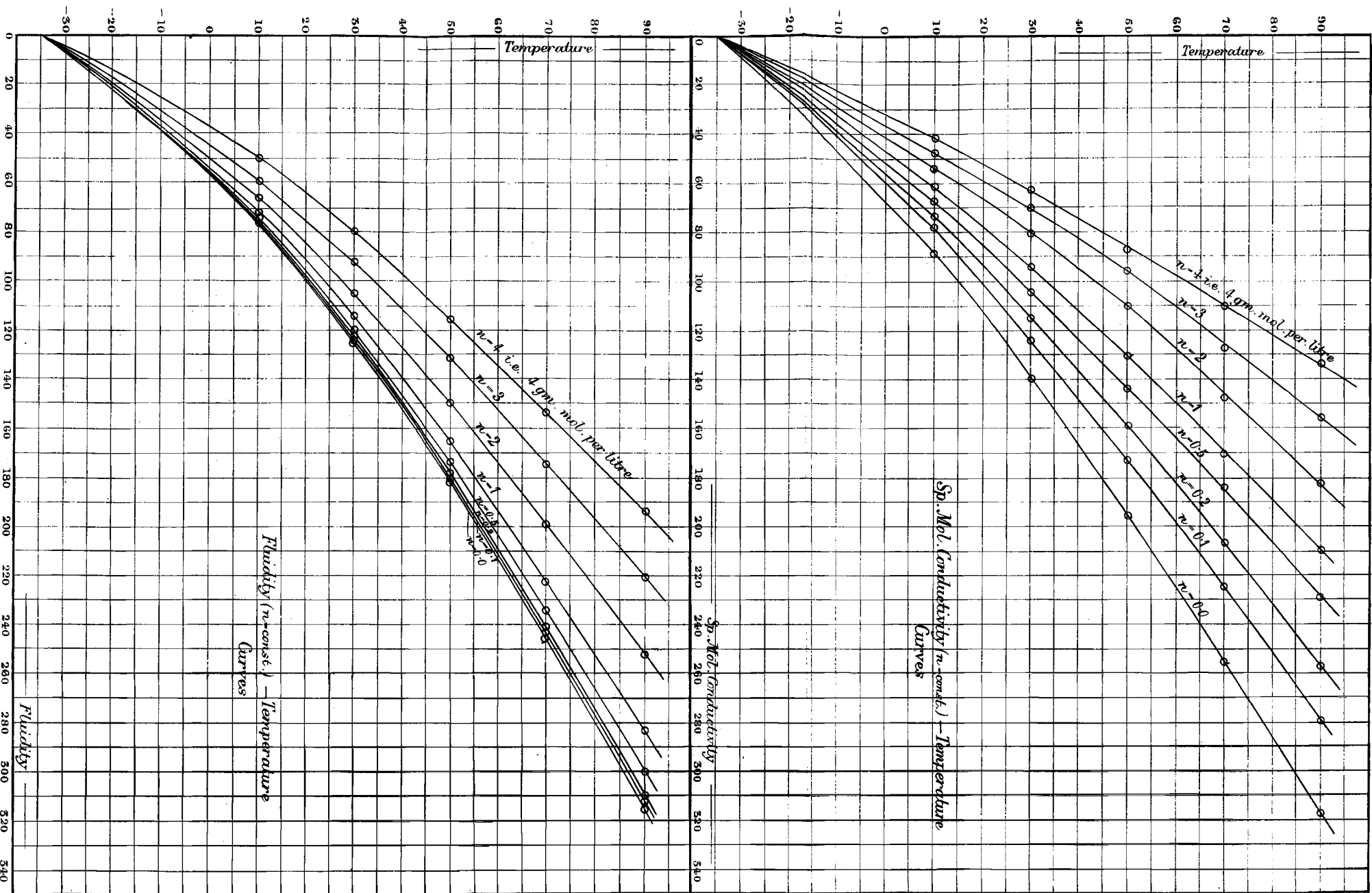
Temp.	NaCl Solutions.						
	$n=0.1$	$n=0.2$	$n=0.5$	$n=1.0$	$n=2$	$n=3$	$n=4$
0° C.	.897	.830	.763	.723	.640	.565	.493
10	.892	.838	.756	.696	.614	.535	.470
18	.882	.830	.753	.689	.599	.522	.454
20	.879	.832	.752	.689	.596	.517	.451
30	.872	.818	.744	.677	.573	.501	.443
40	.876	.813	.744	.674	.566	.495	.444
50	.882	.816	.738	.672	.566	.495	.442
60	.879	.814	.729	.669	.573	.496	.437
70	.890	.820	.731	.675	.585	.505	.435
80	.889	.819	.725	.671	.586	.505	.429
90	.899	.826	.737	.673	.585	.500	.428
100	.893	.824	.723	.650	.560	.482	.414

LVII. *On the Physical Peculiarities of Solutions of Gases in Liquids.* No. 2. By J. ALFRED WANKLYN, Corresponding Member of the Royal Bavarian Academy of Sciences*.

THE solubility of ammonia in water at ordinary pressures and temperatures is seven hundred times as great as the solubility of carbonic acid. There is, therefore, great interest in ascertaining whether a corresponding retardation of the act of solution of the ammonia is possible. The following experiments answer this question in the affirmative.

The same tube as was employed in the experiments upon

* Communicated by the Author.



The Temperature variations of the Specific Molecular Conductivity and the Fluidity of Sodium Chloride Solutions.

$\frac{1}{F} (n - \text{const.}) - \text{Temperature Curves}$

