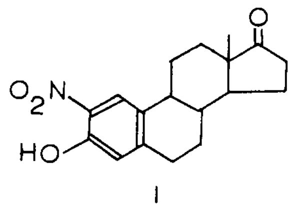
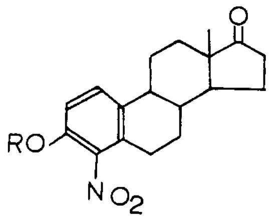
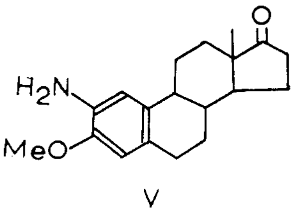


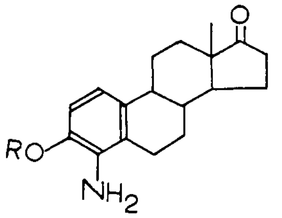
I



Compound	R
II	H
III	CH_3
IV	Benzyl



V



Compound	R
VI	CH_3
VII	Benzyl

2-nitroestrone (I) (*4, 6*) (m.p. 172–175° C.), has two protons in the aromatic region of the NMR spectrum centered at 2.16 and 3.06τ. These protons showed little coupling (J = 0.5 c.p.s.). Since the two protons on the aromatic ring of 2-nitroestrone are para to each other, coupling should be small. Therefore, this compound is confirmed as 2-nitroestrone (I). The 1 proton of 2-nitroestrone is deshielded by the nitro group and is shifted downfield to 2.16τ.

The mononitroestrone, which was assigned as 4-nitroestrone (II) (*4, 6*) (m.p. 272–276° C.), was found to have two protons in the aromatic region of the NMR spectrum centered at 2.60 and 3.03τ. Each of these protons show strong coupling (J = 9.0 c.p.s.). Since the two protons on the aromatic ring of 4-nitroestrone are ortho to each other, they should show strong coupling. Therefore, this compound is confirmed as 4-nitroestrone (II).

The chemical shifts of the 1 and 2 protons of 4-aminoestrone, 3-methyl ether (VI) in the NMR spectrum, appeared to be identical. As two protons with identical chemical shifts do not show any visible evidence of coupling they appear as a sharp single peak. This peak is centered at 3.18τ. This was rather unexpected, but in fact a precedent for this does exist (*7*), insofar as the four aromatic protons of *o*-amino anisole appear as a single peak.

When the hydrochloride of 4-aminoestrone, 3-methyl ether was prepared by adding DCl and D_2O to the $CDCl_3$ solution, the NMR spectrum showed the 1 and 2 protons as two doublets centered at 2.52 and 3.02τ (J = 9.0 c.p.s.). Again, the positions of these two doublets are very similar, if not identical, to those of the doublets produced by the 1 and 2 protons of 4-nitroestrone, 3-methyl ether (III). This would indicate that the electronic influence exerted by the 4-amino hydrochloride upon the aromatic ring is much the same as that of the 4-nitro group.

4-Nitroestrone, 3-benzyl ether (IV) and 4-aminoestrone, 3-benzyl ether (VII) were prepared (*3*) so that the NMR spectra of these compounds could be compared with those of the corresponding methoxyl compounds.

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Solubilities of the Cyclohexylamine Salts of the Odd and Even Normal C_{10} to C_{20} Fatty Acids in Benzene, Methanol, and Acetone

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Experimental solubility data are reported for the cyclohexylamine salts of decanoic, dodecanoic, tridecanoic, tetradecanoic, hexadecanoic, heptadecanoic, and octadecanoic acids in benzene, methanol, and acetone. These data have been used to calculate the solubilities of the cyclohexylamine salts of undecanoic, pentadecanoic, nonodecanoic, and eicosanoic acids by means of the isopleth and isotherm methods of graphical interpolation and extrapolation.

SOLUBILITY tables have been constructed for the cyclohexylamine salts of the normal fatty acids containing 10 to 20 carbon atoms in benzene, methanol, and acetone. The data are based on experimental solubility measurements of the salts of the C_{10} to C_{18} even carbon acids and of the C_{13} and C_{17} members of the odd carbon acid series. These data were used to calculate the supplementary solubility data for the series by means of the isopleth (*3*) and the isotherm (*4*) methods of graphical interpolation and extrapolation.

Table I. Solubilities of the Cyclohexylamine Salts of the Normal C_{10} to C_{20} Fatty Acids in Benzene, Methanol, and Acetone[a]

(Composition in Mole %)

C_{10}		C_{11}		C_{12}		C_{13}		C_{14}		C_{15}		C_{16}		C_{17}		C_{18}		C_{19}		C_{20}	
%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.	%	° C.
										In Benzene											
2.35	5.1	4.00	12.3	1.09	10.5	0.261	8.5	0.38	14.1	0.10	14.0	0.40	24.0	0.017	14.9	0.016	17.7	0.10	30.5	0.40	38.6
4.74	10.8	10.00	20.1	3.89	19.3	0.94	14.7	0.80	18.2	0.25	18.1	1.00	27.9	0.050	20.0	0.050	23.7	0.25	34.2	1.00	41.0
9.92	19.1	20.00	28.4	7.15	25.1	2.84	20.9	3.97	28.6	0.50	21.1	2.00	31.2	0.50	29.7	1.30	36.3	0.50	36.8	2.00	43.1
14.89	25.1	30.00	34.7	14.99	34.6	7.57	28.1	6.69	33.1	1.00	24.3	3.00	33.7	0.98	32.6	5.04	43.5	1.00	39.5	3.00	45.1
19.90	29.9	40.00	41.3	18.80	38.4	10.00	30.7	9.09	36.6	4.00	32.1	5.14	38.3	4.70	41.0	10.52	50.8	4.00	46.7	5.00	48.3
29.94	37.2	50.00	48.4	27.40	44.8	19.07	38.3	15.00	42.9	10.00	39.5	10.03	44.8	9.85	47.2	21.32	61.4	10.00	53.8	7.00	51.3
40.14	44.3	60.00	55.6	44.88	56.4	30.00	45.3	24.19	51.0	20.00	47.4	19.38	54.3	20.72	55.8	31.17	68.2	20.00	61.3	10.00	55.0
50.92	51.7	70.00	62.3	53.97	62.1	38.31	50.4	34.77	58.0	30.00	53.8	29.37	61.6	29.65	61.1	41.97	73.8	30.00	67.9	15.00	60.5
59.18	57.4			66.78	69.3	50.00	57.6	45.11	63.9	40.00	59.7	39.65	67.5	41.33	68.1	50.00	77.4	40.00	73.2	20.00	64.9
71.01	64.9			69.95	70.8	60.00	63.8	45.45	64.1	50.00	65.4	45.25	70.5	45.32	70.1	58.76	80.8	50.00	77.7	30.00	71.9
80.08	70.0			80.00[b]	75.8	70.00	69.5	60.15	71.8	60.00	70.7	50.00	72.9	55.49	74.9	60.00	81.2			40.00	77.2
89.49	75.1							74.42	77.9	70.00	75.5	60.00	77.2	60.00	76.7					50.00	81.4
														69.45	80.6						
										In Methanol											
10.00	-5.8	3.00	-23.9	5.00	-1.5	4.56	4.4	1.00	-7.2	3.00	14.6	0.99	9.3	0.320	0.7	0.10	-7.4	3.00	41.6	1.00	36.6
15.00	4.4	6.00	-9.3	7.00	5.6	5.94	8.9	3.00	8.0	6.00	24.5	3.00	22.2	0.887	16.1	0.69	19.8	6.00	47.9	3.00	45.5
20.02	11.4	10.00	1.6	10.00	12.4	6.87	11.6	4.89	14.6	10.00	31.9	5.00	28.7	3.10	29.9	3.04	34.9	10.00	53.3	4.00	47.6
24.75	18.5	20.00	17.0	14.56	20.5	9.39	17.3	9.48	26.0	20.00	43.6	9.65	38.5	6.30	37.7	5.94	41.7	20.00	61.3	5.00	49.2
30.42	26.4	30.00	26.1	20.00	28.0	13.45	24.4	17.53	38.4	30.00	51.0	15.00	46.1	9.89	43.2	9.49	46.9			7.00	52.6
39.53	36.1			30.00	39.1	14.84	26.1	24.34	45.7	40.00[b]	57.6	22.72	54.1	15.32	49.3	20.22	58.9			10.00	56.4
49.99	45.4			34.34	43.5	25.77	37.0	38.74	57.2			30.00	59.8	20.07	53.2	25.00	62.5			15.00	61.6
60.00	53.7			40.00	48.4	37.78	45.2							30.97	60.3					20.00	65.9
74.86	64.6			50.00[b]	56.3	68.68	67.8														
										In Acetone											
0.58	17.4	0.10	-6.4	0.10	-0.7	0.10	4.3	0.034	-6.6	0.10	13.0	0.04	3.8	0.051	9.6	0.039	10.5	0.10	26.2	0.04	17.0
0.86	22.1	0.50	14.9	0.50	25.7	0.20	13.7	0.12	12.0	0.50	36.5	0.10	17.7	0.097	20.0	0.09	22.8	0.50	51.1	0.10	30.8
0.99	23.1	1.00	24.6	0.69	29.6	0.52	27.4	0.56	35.0	1.00	44.4	0.50	40.9	0.28	35.1	0.22	35.5	1.00	57.6	0.50	51.5
2.18	29.6	2.00	27.9	1.04	34.1	0.92	34.4	0.93	40.9	2.00	49.0	0.70	45.0	0.53	43.1	0.32	40.7	2.00	62.8	0.70	55.7
3.71	32.6			2.08	40.4	4.63	44.3	1.07	43.1			1.00	49.2	0.68	46.5	0.54	47.8			1.00	59.8
5.08	33.2			5.42	45.1	9.14	46.4	2.47	50.0			1.50	53.0	0.76	47.3	1.05	55.6				
5.10	33.4			10.00	46.7	29.14	50.1	5.62	53.6			2.10	55.6	1.04	51.4	1.50	58.6				
20.43	39.5			20.68	49.0	49.28	58.4	9.33	54.7			3.22	58.1	2.01	56.4						
33.00	44.4			24.75	50.2			14.81	56.4												
40.00	47.6			41.70	55.6																
51.57	51.3																				

[a] Interpolated and extrapolated values are underscored. [b] By isotherm method.

EXPERIMENTAL

The salts were prepared from Eastman Kodak Co. White Label acids and amine and purified by repeated solvent recrystallization as previously described (*2*). The freezing points of the cyclohexylamine salts were as follows: decanoic, 80.5°; dodecanoic, 84.5°; tridecanoic, 83.8°; tetradecanoic, 87.6°; hexadecanoic, 90.6°; heptadecanoic, 90.8°; and octadecanoic, 93.0° C.

The methanol used was J. T. Baker, 99.8% minimum purity, containing less than 0.09% water. Benzene, C. P. grade, was purified by refluxing with metallic sodium followed by distillation. The acetone was purified by treating the C. P. grade reagent with potassium permanganate, drying over anhydrous sodium carbonate, and then distilling.

The freezing points were determined by the thermostatic, sealed-tube method (*1*), which gives the true equilibrium temperature between the crystals and the liquid of the given composition with a precision and accuracy of ±0.1 to 0.2° C. For each composition, weighed amounts of the cyclohexylamine salt and the solvent were sealed in a glass tube. A glass bead was included to ensure efficient stirring as the sample tubes were turned end-over-end in a constant temperature bath. Two temperatures about 0.2° C. apart were found, one at which the last crystals disappeared and the other at which a few crystals remained undissolved after prolonged agitation. The freezing point was taken as the mean of these two temperatures, corrected for both thermometer calibration and emergent stem.

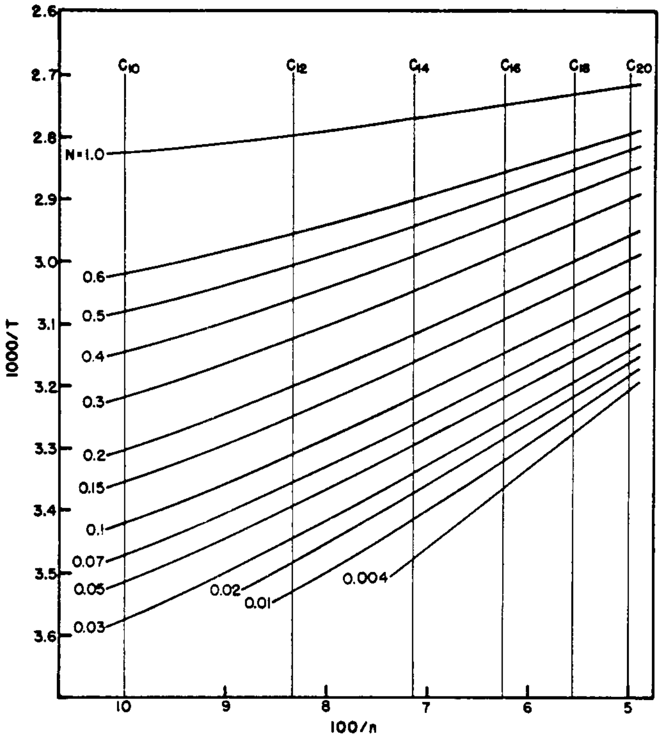

Figure 1. Isopleth plots for the solubilities of the even-carbon fatty acid salts in benzene

RESULTS

The results are given in Table I. The predicted data, most of which were obtained from the isopleth plots, are underscored. In a few instances, as indicated, predictions were made from isotherm plots.

Separate large-scale log *N vs.* 1000/*T* plots were constructed from the experimental data for the odd and for the even members of the homologous series in each solvent, *N* being the solubility in mole per cent at *T*, the absolute temperature. The values of 1000/*T* at selected values of *N* were then read from these curves and plotted against 100/*n*, where *n* is the number of carbon atoms in the acid.

A typical isopleth correlation plot representing the solubilities of the seven homologs in benzene, is shown in Figure 1. The isopleth plots for the solubilities of the even homologs, C_{10} to C_{18}, in methanol were straight lines. The values for the salts of the C_{20} acid could therefore be obtained by extrapolation. The isopleths for the odd members of the series also will be linear over this range (*3, 4*). Thus, the isopleths for the odd series in methanol were constructed by drawing straight lines through the plotted 1000/*T vs.* 100/*n* points read from the log *N vs.* 1000/*T* plots for the C_{13} and C_{17} experimental data. These isopleths were then used to predict the solubilities of the C_{11}, C_{15}, and C_{19} members. The isopleths for the even homologs in benzene and acetone were slightly concave upward below C_{12}, so that the departure of the C_{10} salt from linearity was 1.7° C. in benzene and 0.7° C. in acetone over the whole range of concentrations. A similar curvature, therefore, was used in drawing the odd isopleths between C_{13} and C_{11}.

The experimental solubility temperatures read from the experimental log *N vs.* 1000/*T* plots showed standard deviations from the isopleth plots of 0.25°, 0.26°, and 0.14° C. for the benzene, methanol, and acetone systems, respectively. The corresponding values for the individual salts were all between 0.06° and 0.26° C., except that for palmitic acid in methanol, which was 0.48° C.

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