INVESTIGATION OF THE MAGNETIC SUSCEPTIBILITY AND OTHER PHYSICAL PROPERTIES OF BINARY MIXTURES OF ORGANIC LIQUIDS.

ABSTRACT.

The work described in this thesis consists of an examination of various physical properties of complete series of binary mixtures of aromatic liquids.

The investigation was undertaken with a dual object in view:

(1) To ascertain the nature of the physical or chemical changes occuring in the liquids on mixing and

(2) To gain an insight into the relative suitability of the various physical properties for shewing the chemical changes which may have occured.

The binary mixtures named below have been examined:-

(1) Toluene and m-Cresol.

(2) Aniline and m-Cresol.

(3) Aniline and Nitrobenzene.

(4) m-Cresol and Benzene.

(5) Toluene and benzene.

(6) Nitrobenzene and m-Cresol.

In each case the following five physical properties have been investigated:-

(1) Specific Gravity.

(2) Refractive Index.

(3) Heat of Mixing.

(4) Specific Heat.

(5) Magnetic Susceptibility.

The liquids were purified very carefully, (constant boiling point and specific gravity being the criterion of purity) and mixtures were prepared covering the whole concentration range, from one pure component to the other.

Specific gravities were measured with a 2 cc. pyknometer, refractive indices with a Pulfrich refractometer used with a temperature control, heats of mixing and specific heats by the method of mixtures, and magnetic susceptibilities with a modified form of Curie balance.

From the refractive indices, specific and molecular refractivity, dispersion, molecular dispersion, and dispersive power were calculated.

In all cases the results are tabulated and from the tables, curves are drawn in which the value of the physical property as ordinate is plotted against the composition expressed in moles % as abscissa.

It was found that (1) none of the mixtures was ideal, i.e. in all cases there was a change on mixing; and (2) the best properties for detecting changes are dispersion, heat of mixing, and magnetic susceptibility, the other properties examined not shewing very marked changes with the changes occuring on mixing.

INVESTIGATION OF THE MAGNETIC SUSCEPTIBILITY AND OTHER PHYSICAL PROPERTIES OF BINARY MIXTURES OF ORGANIC LIQUIDS.

J.Cattermole. B.Sc.

June 1930.

CONTENTS.

OBJECT OF THE INVESTIGATION.

The work described in this thesis consists of an examination of various physical properties of complete series of binary mixtures of aromatic liquids.

The investigation was undertaken with a dual object in view

(1) To ascertain the nature of the physical or chemical changes occuring in the liquids on mixing and

(2) To gain an insight into the relative suitability of the various physical properties for shewing the chemical changes which may have occured.

The binary mixtures named below have been examined:-

(i) Toluene and meta-cresol.

(ii) meta-Cresol and aniline.

(iii) Aniline and nitrobenzene.

(iv) meta-Cresol and benzene.

(v) Toluene and benzene.

(vi) Nitrobenzene and meta-cresol.

In each case the following five physical properties have been investigated:-

(1) Specific gravity.

(2) Refractive index.

(3) Heat of mixing.

(4) Specific heat.

(5) Magnetic susceptibility.

PURIFICATION OF MATERIALS.

Before any mixtures could be prepared and examined, it was necessary (since small amounts of impurity may seriously change the value of the physical property) to purify very carefully the liquids from which the mixtures were to be made. Each liquid was purchased in a state as pure as possible, and was submitted to careful fractional distillation. The middle portion only of each fractionation was retained, and the product when almost pure was submitted to distillation in a vacuum, until a product was obtained which did not change appreciably in density on re-distillation. Constant density, together with constant boiling point, was taken as the criterion of purity.

The boiling points of the specimens used in the preparation of the binary mixtures are given in columns 2 & 3 of Table I and these are compared in columns 3 & 4 with the values quoted in the literature for these substances.

TABLE I.

	PRESSURE.	BOILING POINT.	PRESSURE.	BOILING POINT.
Benzene.	758mm.	80.5 $^\circ$C.	760mm.	80.18 $^\circ$C,[1] 80.20 $^\circ$C,[2] 80.36 $^\circ$C.[3]
Toluene.	753mm.	111.0 $^\circ$C.	760mm.	110.8 $^\circ$C.[4]
Aniline.	760mm.	184.0 $^\circ$C.	760mm.	183.8 $^\circ$C.[5]
	18mm.	82.0 $^\circ$C.	20mm.	82.8 $^\circ$C.[5]
Nitrobenzene.	762mm.	210.6 $^\circ$C.	760mm.	210.8 $^\circ$C,[6] 210.6 $^\circ$C.[7]
	14mm.	94 $^\circ$ - 95 $^\circ$C.	10mm.	85.4 $^\circ$C.[8]
meta-Cresol.	760mm.	202.4 $^\circ$ - 202.6 $^\circ$C.	760mm.	201.0 $^\circ$C,[9] 202.8 $^\circ$C.[10]
	20mm.	100 $^\circ$ - 101 $^\circ$C.		

Table II gives (in columns 2 & 3) the specific gravities of the pure liquids and these are compared in columns 4 & 5 with the most probable values of earlier investigations.

TABLE II.

	TEMPERATURE.	SPECIFIC GRAVITY.	TEMPERATURE.	SPECIFIC GRAVITY.
Benzene.	28°C.	0.8708	25°C.	0.87255 (11)
			30°C.	0.86718 (12)
Toluene.	28°C.	0.8565	20°C.	0.8656 (13)
			31.92°C.	0.85263 (14)
Aniline.	28°C.	1.0148	20°C.	1.0216 (15)
Nitrobenzene.	28°C.	1.1937	28°C.	1.1931 (16)
meta-Cresol.	28°C.	1.0292	20°C.	1.0341 (17)

PREPARATION OF A SET OF MIXTURES FOR INVESTIGATION.

A set of nine mixtures of two liquids A & B were made up as follows so that their composition was accurately known and was approximately:-

I.	10 % A.	90 % B.
II.	20 % A.	80 % B.
III.	30 % A.	70 % B.
IV.	40 % A.	60 % B.
V.	50 % A.	50 % B.
VI.	60 % A.	40 % B.
VII.	70 % A.	30 % B.
VIII.	80 % A.	20 % B.
IX.	90 % A.	10 % B.

Nine glass bottles, fitted with ground glass stoppers, were steamed out to remove soluble impurities before use. They were inverted over a jet of steam, and left for one to two hours; they were then removed and dried. Each bottle was weighed empty, and the calculated volumes of liquid A were run in to each bottle in turn from a burette. Each bottle was again weighed, so that the weight of liquid A in every bottle was accurately known. The calculated volumes of liquid B were then run in, and the bottles were again weighed. The weights of liquids A & B being accurately known, the composition in moles % of every mixture was calculated from the formula:-

$$\frac{W_a}{M_a} \Big/ \frac{W_a}{M_a} + \frac{W_b}{M_b} = \text{moles \% of A.}$$

where

W_a = weight of liquid A.

W_b = weight of liquid B.

M_a = molecular weight of liquid A.

M_b = molecular weight of liquid B.

or:-

$$\frac{W_b}{M_b} \Big/ \frac{W_a}{M_a} + \frac{W_b}{M_b} = \text{moles \% of B.}$$

which was used as a check, for

moles % A +moles % B = 100.

The physical properties of each series of binary mixtures have been examined, together with the physical properties of the pure liquids from which the mixtures were made.

METHODS OF MEASUREMENT OF THE DIFFERENT PHYSICAL PROPERTIES.

(1) SPECIFIC GRAVITY.

Specific gravities were measured with a 2cc. pyknometer shaped as in figure I. The pyknometer was cleaned, dried, and weighed. It was filled with boiled distilled water, and put in a thermostat at 28°C. When the pyknometer and its contents had taken on the temperature of the bath, the level of the liquid was adjusted, the pyknometer removed, dried, and weighed. This was repeated with the liquid of which the specific gravity was required. The specific gravity was calculated from the above data as follows:-

FIGURE I.

$$D_4^t = (W_s^t \times D_w^t) / W_w^t .$$

where:- D_4^t = specific gravity of liquid at 28°C.

W_s^t = weight of liquid filling pyknometer at 28°C.

W_w^t = weight of water filling pyknometer at 28°C.

D_w^t = density of water at 28°C.

(2) REFRACTIVE INDEX.

Refractive index was measured with a Pulfrich refractometer, used with a device for maintaining the prism and the liquid under observation at constant temperature. Water at constant temperature was continuously flowing through a metal heater, which was immersed in the liquid in the cell, and round the prism of the instrument. The temperature was read from a thermometer placed in the heater. As in the case of the other properties, observations were made at 28°C., and refractive indices for the sodium D line, and for the C & F (red and blue) lines of the hydrogen spectrum were measured. The sodium D line was obtained by using an ordinary sodium flame, and the hydrogen spectrum was produced by discharging an induction coil across the electrodes of a hydrogen bulb. The angles of refraction could be read to 1', and the refractive indices were calculated from them by means of tables provided with the instrument.

From the refractive indices, the following derived optical properties were calculated.

SPECIFIC REFRACTIVITY.

given by:- $(n^2-1)/(n^2+2)d$

where n = refractive index for a definite wave length at a definite temperature. (28°)

d = specific gravity of the liquid at that temperature.

MOLECULAR REFRACTIVITY.

given by:-

$$\frac{n^2-1}{n^2+2}\cdot\left(\frac{M}{d}\right)$$

where n & d have the same significance as in the previous formula.

M = mean molecular weight in the case of a mixture, or molecular weight in the case of a pure liquid.

(in the case of a mixture, M was calculated as

$$1/100.(\text{moles \% A x } M_a)+(\text{moles \% B x } M_b)$$

where M_a, and M_b, are the molecular weights of A and B.)

DISPERSION.

given by:-

$$n_F - n_C$$

where n_F = refractive index at 28° for F light.

n_C = ... C ..

MOLECULAR DISPERSION.

given by:-

$$M(n_F - n_C)/d$$

where n_F, n_C, M, d, have the meaning previously defined.

DISPERSIVE POWER.

given by:-

$$(n_F - n_C) / (n_D - 1)$$

where

n_D = refractive index at 28° for D light.

n_F & n_C as previously defined.

Table IIA gives in columns 2 3 & 4 the values of the refractive indices for the pure liquids, which are compared, in columns 5,6,&7, with those in the literature.[18] (The refractive indices in the literature were quoted for 20°C., and these are extrapolated in the following table to 28° by use of the temperature corrections given)

TABLE IIA. REFRACTIVE INDICES AT 28°C.

	REFRACTIVE INDEX.			REFRACTIVE INDEX.		
	C.	D.	F.	C.	D.	F.
Benzene.	1.49140	1.49591	1.50764	1.49136	1.49595	1.50826
Toluene.	1.48580	1.49030	1.50137	-	-	-
m-Cresol.	1.53275	1.53812	1.55097	-	-	-
Aniline.	1.57502	1.58170	1.59948	1.57508	1.58218	1.59974
Nitro-benzene.	1.54260	1.54928	1.56729	1.54235	1.54913	1.56759

Table IIB. gives, in columns 2,3,& 4, the molecular refractivities of the pure liquids, and these are compared in columns 5,6, & 7, with those found in the literature.(18)

TABLE IIB. MOLECULAR REFRACTIVITIES.

	MOLECULAR REFRACTIVITY.			MOLECULAR REFRACTIVITY.		
	C.	D.	F.	C.	D.	F.
Benzene.	25.96	26.16	26.69	25.96	26.18	26.70
Toluene.	30.81	31.07	31.66	30.80	31.06	31.64
m-Cresol.	32.57	32.84	33.49	-	-	-
Aniline.	30.28	30.57	31.33	30.29	30.58	31.34
Nitrobenzene.	32.45	32.73	33.67	32.41	32.74	33.64

(3) HEAT OF MIXING.

Measurement of temperature changes on mixing the two liquids under investigation, in varying proportions, was made in a vessel designed to hinder loss of heat by radiation, shewn in section in figure III. The calorimeter used for the measuremant was of glass, as a copper vessel would have become corroded by the organic liquids in use. Temperatures were measured to 1/100 of a degree, on a thermometer graduated in tenths of a degree, and an experiment was carried out previously to determine the water equivalent of the glass calorimeter, and thermometer. Owing to the fact that glass is a bad conductor of heat, some difficulty was found at first in obtaining concordant results, but it was found that if the calorimeter always contained the same volume of liquid, so that the surface of the glass in contact with the liquid was always the same, results were obtained which agreed within the other limits of experimental error. Temperatures were measured at minute, or half minute intervals, and on plotting temperature as ordinate against time as abscissa, lines were obtained, which, on producing to meet the ordinate drawn at the time of mixing, gave the temperature at the time of mixing.

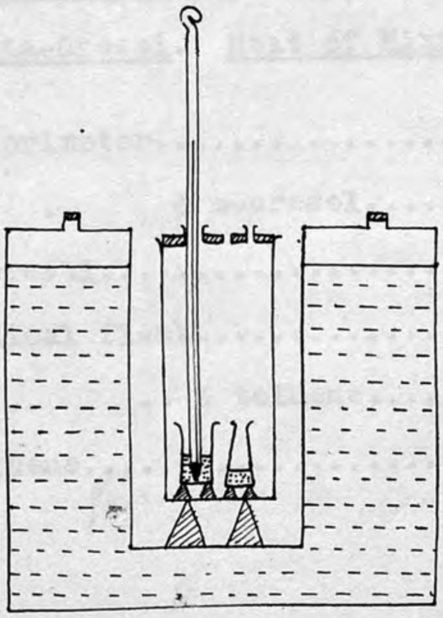


FIGURE III.

The formula

$$H = (t_m - t)\left[s_m (m_c + m_t) + W\right] / (m_c + m_t)$$

was used to calculate the heat of mixing from the data.

where

H = heat of mixing in calories per gram.

t_m = final temperature.

t = initial temperature.

s_m = specific heat of mixture.

m_c = weight of one substance.

m_t = ... the other substance.

W = water equivalent of the calorimeter and thermometer.

Example of Calculation.

Toluene and meta-Cresol. Heat of Mixing. Mixture A.

Weight of calorimeter	35.87	grams.
.. .. .. & m-cresol	65.68	..
.. .. m-cresol	29.81	..
Weight of conical flask	15.47	..
.. .. & toluene	20.66	..
.. .. toluene	5.19	..

TEMPERATURES.

Initial.		Final.	
Time. (in minutes)	Temperature.	Time. (in minutes)	Temperature.
0.	23.36°C.	4.	22.00°C.
1.	23.36°C.	5.	22.00°C.
2.	23.36°C.	6.	22.05°C.
3.	23.36°C.	7.	22.10°C.
3.5 liquids mixed.		8.	22.20°C.
		9.	22.25°C.
		10.	22.30°C.
		11.	22.35°C.

From graph shewn in figure IV.

Initial temperature. (t) = 23.36°C.

Final temperature. (t_m) = 21.98°C.

Water equivalent of calorimeter and thermometer. (W) = 4.44 grams.

Specific heat of mixture (from separate determinations) (s_m) = 0.456 cals/gm.

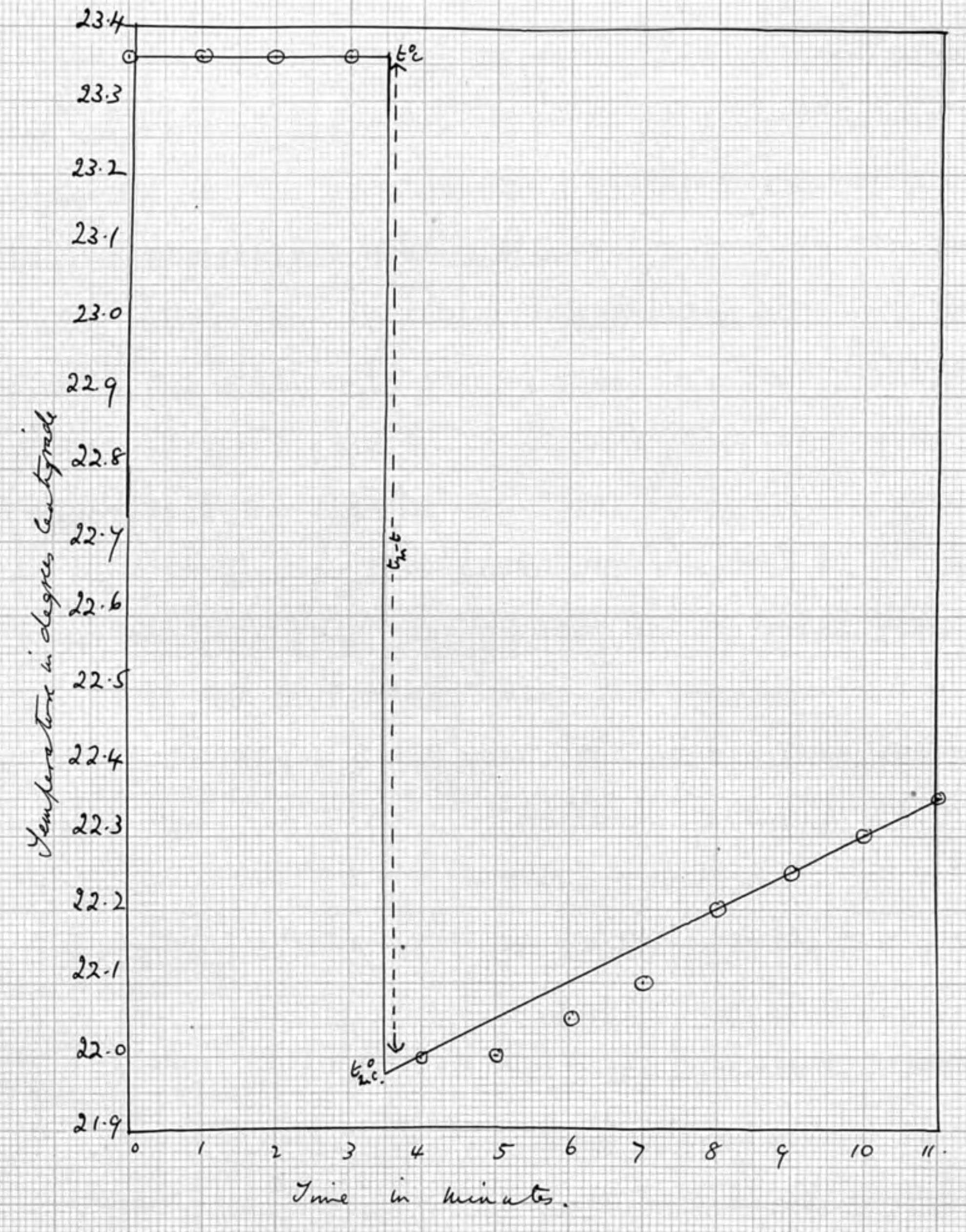
Weight of mixture. $(m_c + m_t)$ = 35.00 grams.

$$\text{Heat of mixing} = \frac{(21.98 - 23.36) \times [(0.456 \times 35.00) + 4.44]}{35.00}$$

$$= -0.80 \text{ cals/gm.}$$

Toluene and m-Cresol.

Temperature change on mixing   Figure IV.



(4) SPECIFIC HEAT.

The specific heat of each pure substance and each mixture in the glass calorimeter left from the heat of mixing determination, were measured by the method of mixtures. Pure silver, of specific heat 0.056, was heated to the temperature of boiling toluene, (or in some cases boiling benzene) and was then poured into the mixture in the calorimeter. Time readings of the temperature of the liquid in the calorimeter were taken before and after mixing, and the initial and final temperatures were read off from a graph similar to that drawn for the heat of mixing. The silver was shielded from loss of heat during transference to the calorimeter by the following device. A double walled glass vessel shewn in figure V was used. The pure silver was placed in the inner vessel A and a thermometer T was placed with its bulb well immersed in the silver. The outer vessel contained the liquid, the vapour of which surrounded the vessel containing the silver. This liquid was heated to boiling over a small flame. The temperature of the silver gradually rose, and when the thermometer reading was steady, the temperature was read, and the thermometer removed. The silver was then poured quickly into

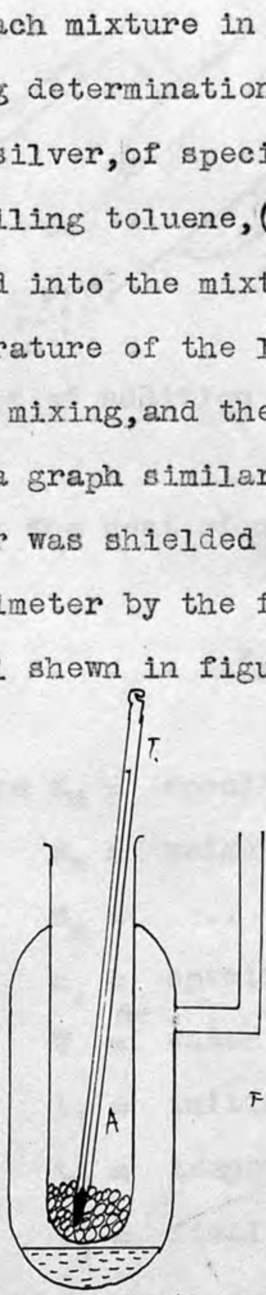


FIGURE V.

the calorimeter by inverting the heater as shewn in figure VI.

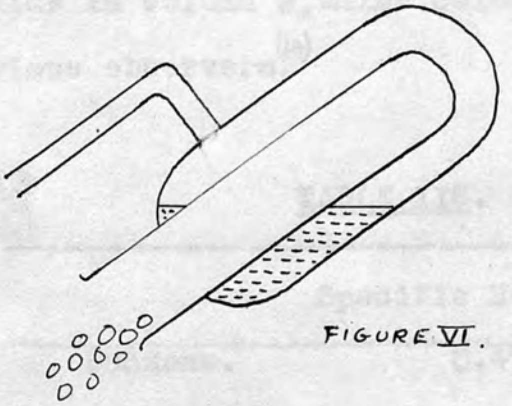


FIGURE VI.

The position of the limb L prevented the spilling of the heating liquid, and the whole arrangement ensures that the silver is surrounded by the vapour and liquid at the constant temperature read on the thermometer until the moment of addition to the liquid in the calorimeter.

The heat of mixing was calculated by means of the formula:-

$$s_m = \frac{1}{w_m}\left[\frac{w_s s_s (t_2 - t_3)}{t_3 - t_1} - W\right]$$

where s_m = specific heat of mixture.

w_m = weight of mixture.

w_s = ... silver.

s_s = specific heat of silver.

W = water equivalent of calorimeter and thermometer.

t_1 = initial temperature.

t_2 = temperature of silver.

t_3 = final temperature.

Table IIC shews the values for the specific heats of the pure liquids in column 2, while column 3 gives values obtained by previous observers.[19]

TABLE IIC. SPECIFIC HEATS.

	Specific Heat.	Specific Heat.
Benzene.	0.474	0.41 to 0.42
Toluene.	0.383	0.40 .. 0.42
Aniline.	0.448	0.49 .. 0.51
m-Cresol.	0.515	0.55
Nitrobenzene.	0.355	0.34 to 0.39

(5) MAGNETIC SUSCEPTIBILITY.

The magnetic susceptibility was measured by observations of the oscillations executed by the substance contained in a tube suspended in a variable field. The instrument used was a modified form of Curie balance shewn in figure VII. This consisted of a balance beam TT of soft copper, suspended by an annealed platinum wire of 0.01 mm. diameter. The wire was held in the grip shewn in figure VIII[20], which prevented any chance of a slip in the suspension. The beam had three arms, one C on one side to support the tube t, and two S and E on the other. S was a copper vane, which passed between the poles of the damping magnet A, and E was an arm upon which riders were placed to counterbalance the tube t. NS was a permanent annular magnet (producing a field of about 640 gauss) pivoted at O so that it could be turned toward the front, or toward the back of the case in which the instrument was enclosed. Two stops were placed so that the magnet was always moved to the same positions at the front or back of the case. The beam carried a mirror, m, from which a beam of light from a lamp was reflected on to a scale about two metres distant. The oscillation of the beam and tube were followed on the scale by this line of light.

Measurements were first made with a clean, dry, empty tube fashioned from very light glass of low susceptibility. This was suspended on the hook c, counterpoised by a rider on E, and the suspended system was brought to rest with the damping magnet A. The magnet NS was turned to a position A at the front of the balance case, and when the line of light on the scale was still, the damping magnet was turned through an angle of 90°, the suspended system being thus set in oscillation. When the oscillations had died down, so that the line of light was moving over about 10 cm. on the scale, five consecutive readings of the turning points were taken. From these, the centre of swing of the motion was calculated.

The magnet NS was then turned to the position [illegible] at the back of the case, and a further set of [illegible] readings taken. The centre of swing for [illegible] was calculated, and by taking the difference between [illegible] centres of swing, a deflection for the empty tube was o[illegible] measurements were repeated with the magnet alternate[illegible] D positions, and a mean value for the deflection [illegible] The tube was then removed, weighed, filled to the ma[illegible] distilled water, weighed again, suspended on the b[illegible] counterpoised. Readings were taken as before, and [illegible] for the tube and water thus obtained. The measurements were then repeated with the tube filled with the liquid of which the susceptibility was required.

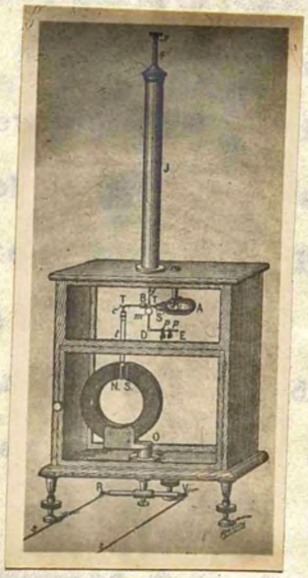
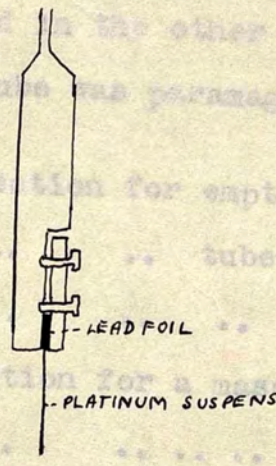


FIGURE VII.

~~Deflections~~ Differences were obtained in one direction for diamagnetic substances (all the liquids, and all the mixtures examined were diamagnetic) and in the other for paramagnetic substances (the glass of the tube was paramagnetic.)



If D_t = deflection for empty tube.

D_{t+w} = ... tube and water.

D_{t+s} = ... substance.

D_w = deflection for a mass m_w of water ($=D_{t+w} - D_t$)

D_s = ... m_s .. substance ($=D_{t+s} - D_t$)

The mass susceptibility is calculated from the formula:-

The magnet NS was then turned to its position B at the back of the case, and a further set of five turning points taken. The centre of swing for this position was calculated, and by taking the difference between the two centres of swing, a deflection for the empty tube was obtained. The measurements were repeated with the magnet alternately in the A & B positions, and a mean value for the deflection thus obtained. The tube was then removed, weighed, filled to the mark with boiled distilled water, weighed again, suspended on the balance beam, and counterpoised. Readings were taken as before, and the deflection for the tube and water thus obtained. The measurements were then repeated with the tube filled with the liquid of which the susceptibility was required.

~~Deflections~~ Displacements. were obtained in one direction for diamagnetic substances (all the liquids, and all the mixtures examined were diamagnetic) and in the other for paramagnetic substances (the glass of the tube was paramagnetic.)

If D = deflection for empty tube.

D_{t+w} = ... tube and water.

D_{t+s} = ... substance.

D_w = deflection for a mass m_w of water $(=D_{t+w} - D_t)$

D_s = ... m_s.. substance $(=D_{t+s} - D_t)$

The mass susceptibility is calculated from the formula:-

$$\chi = \frac{D_s m_w}{D_w m_s} \times (-0.72 \times 10^{-6})$$

where -0.72×10^{-6} is the mass susceptibility of water,[30]. which was taken as the standard of comparison in all the measurements. This formula however does not take account of the susceptibility of the air in the measuring tube, and a correction must be applied.

The corrected formula is:-

$$\chi = r\left[1+0.041\left(1+\frac{1}{rd}\right)\right] \times (-0.72 \times 10^{-6}).$$

where

$$r = \frac{D_s m_w}{D_w m_s}$$

d = specific gravity of substance.

Example of Method of Calculating Mass Susceptibility.

Empty Tube. Weight 1.253 grams.

Oscillations.

A Position. Turning Points.		Centre of Swing.	B Position. Turning Points.		Centre of Swing.
9.56				3.68	
	3.91		11.52		
9.43		6.701		3.85	7.641
	4.03		11.36		
9.31				4.00	
11.17			10.07		
	2.37			5.32	
10.98		6.721	9.96		7.663
	2.57			5.42	
10.77			9.84		

mean centre of swing 6.711.

mean centre of swing 7.652

$$D_t = 0.941$$

Tube and Water.

Weight of tube and water. 1.864 grams.

.. .. water. 0.614 ..

Oscillations.

A Position. Turning Points.		Centre of Swing.	B Position. Turning Points.		Centre of Swing.
15.33				4.34	
	3.02		14.80		
15.02		9.098		4.59	9.632
	3.30		14.57		
14.76				4.81	
	3.60			4.44	
14.50			14.70		
	3.84	9.106		4.69	9.632
14.24			14.47		
	4.09			4.91	

mean centre of swing 9.102.

mean centre of swing 9.632

$$D_{t+w} = 0.530$$

$$D_w = -0.411$$

Tube and Aniline.

Weight of Tube and Aniline. 1.891 grams.
.. .. Aniline. 0.638 ..

Oscillations.

A Position. Turning Points.		Centre of Swing.	B Position. Turning Points.		Centre of Swing.
	5.77			4.30	
12.74			15.37		
	5.92	9.296		4.53	9.886
12.59			15.10		
	6.09			4.78	
	5.24			6.12	
13.26			13.53		
	5.45	9.306		6.30	9.875
13.08			13.37		
	5.64			6.48	

mean centre of swing. 9.301 mean centre of swing. 9.881

$D_{t+s} = 0.580$

$D_s = -0.361$

Mass susceptibility of Aniline =

$$\frac{-0.361}{0.638} \times \frac{0.611}{-0.411}\left[1+0.041\left(1+\frac{1}{0841\times 1.015}\right)\right]\times(-0.72\times 10^{-6})$$

$$= -0.660 \times 10^{-6}$$

In Table IID, columns 2 & 3 give the values for the mass susceptibility of the pure liquids, and these are compared in columns 4 & 5 with those found by previous observers.

TABLE IID. MASS SUSCEPTIBILITY.

	Temperature.	Mass Susceptibility.	Temperature.	Mass Susceptibility.
Benzene.	15 - 20	-0.707×10^{-6}	16.8	-0.712×10^{-6} (21)
Toluene.	15 - 20	-0.718×10^{-6}	-	-0.729×10^{-6} (22)
Aniline.	15 - 21	-0.660×10^{-6}	-10	-0.661×10^{-6} (23)
			10	-0.692×10^{-6} (23)
M-Cresol	15 - 20	-0.578×10^{-6}	-	-
Nitrobenzene.	15 - 21	-0.497×10^{-6}	20	-0.499×10^{-6} (24)

RESULTS

TABLES AND CURVES.

TOLUENE AND META-CRESOL.

TOLUENE AND META-CRESOL. TABLE III

COMPOSITION OF THE MIXTURES.

MIXTURE.	WEIGHT OF TOLUENE. (in gms.)	WEIGHT OF m-CRESOL. (in gms.)	COMPOSITION IN MOLES %. TOLUENE.	m-CRESOL.
I.	25.82	4.35	87.5	12.5
II.	39.30	8.84	83.9	16.1
III.	34.56	18.22	69.0	31.0
IV.	30.20	25.17	58.5	41.5
V.	21.52	22.78	52.6	47.4
VI.	17.34	27.65	42.4	57.6
VII.	12.52	32.16	31.4	68.6
VIII.	9.01	36.56	22.4	77.6
IX.	4.28	41.01	10.9	89.1

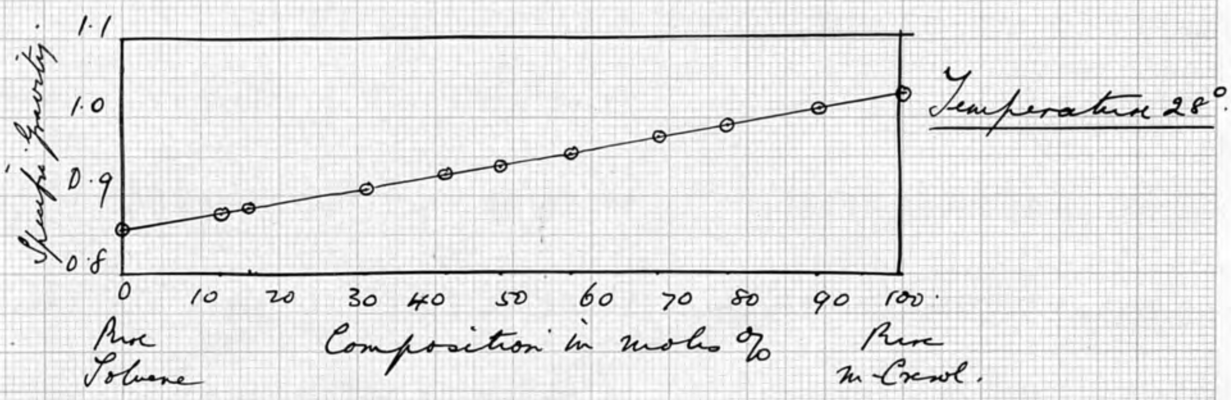
TOLUENE AND META-CRESOL. TABLE IV

SPECIFIC GRAVITIES AT 28°C.

SUBSTANCE.	WEIGHT OF SUBSTANCE. FILLING PYKNOMETER AT 28°. (in grams)	WEIGHT OF WATER FILLING PYKNOMETER AT 28°. (in grams)	SPECIFIC GRAVITY AT 28°. D_4^{28}.
TOLUENE.	1.712	1.992	0.857
I.	1.758	1.993	0.879
II.	1.770	..	0.885
III.	1.823	..	0.911
IV.	1.862	..	0.931
V.	1.881	..	0.940
VI.	1.915	..	0.957
VII.	1.952	..	0.975
VIII.	1.982	..	0.991
IX.	2.017	..	1.008
m-CRESOL.	2.059	..	1.029

Toluene and m-Cresol.

Specific Gravity and Composition. Figure IX.



TOLUENE AND META CRESOL. TABLE. VI

REFRACTIVE INDEX. TEMPERATURE 28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION.			REFRACTIVE INDEX.		
	C.	D.	F.	C.	D.	F.
TOLUENE.	39° 4.1'	39°12.1'	39°34.5'	1.48580	1.49030	1.50137
I.	37°59.1'	38° 5.4'	38°23.4'	1.49199	1.49663	1.50809
II.	37°31.5'	37°36.3'	37°54.4'	1.49459	1.49937	1.51080
III.	36°18.4'	36°22.9'	36°37.6'	1.50142	1.50620	1.51792
IV.	35°22.4'	35°26.9'	35°40.4'	1.50656	1.51133	1.52317
V.	34°50.5'	34°54.1'	35°7.8'	1.50950	1.51430	1.52606
VI.	33°55.9'	33°59.3'	34° 5.5'	1.51434	1.51920	1.53160
VII.	32°58.4'	33° 0.1'	33°4.2'	1.51942	1.52441	1.53696
VIII.	32°17.7'	32°20.1'	32°21.0'	1.52295	1.52787	1.54067
IX.	31°16.4'	31°16.4'	31°16.4'	1.52818	1.53329	1.54613
m-CRESOL.	30°21.7'	30°18.4'	30°17.7'	1.53275	1.53812	1.55097

£

TOLUENE AND META CRESOL TABLE VII

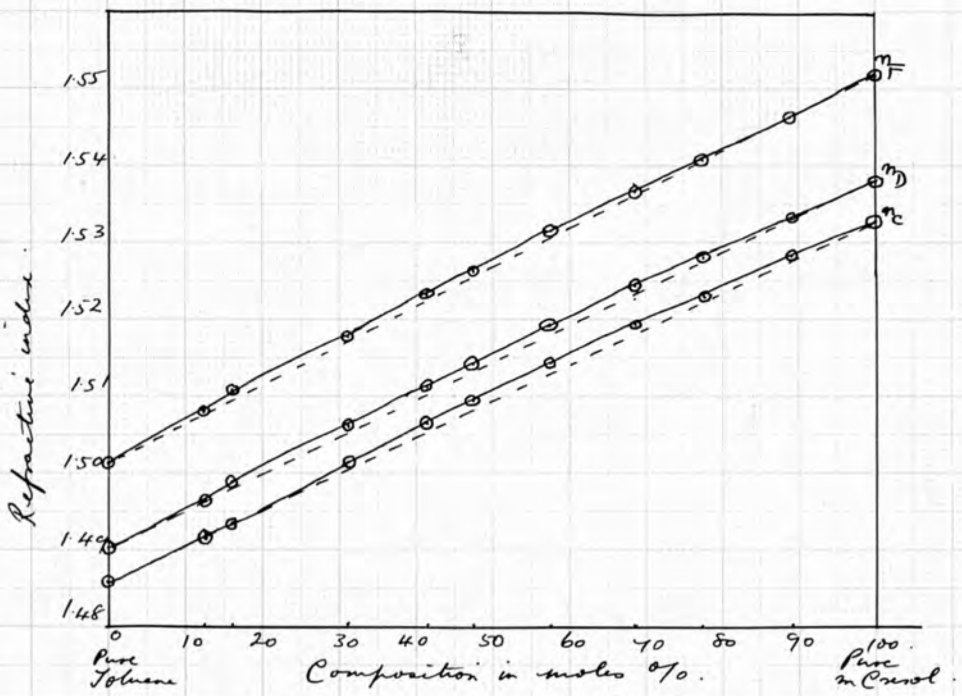
SPECIFIC AND MOLECULAR REFRACTIVITY AT 28°C.

SUBSTANCE.	SPECIFIC GRAVITY.	SPECIFIC REFRACTIVITY.			MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY		
		C.	D.	F.		C.	D.	F.
TOLUENE.	0.857	33.49	33.77	34.42	92.0	30.81	31.07	31.66
I.	0.879	33.02	33.29	33.93	94.0	31.05	31.29	31.90
II.	0.885	32.94	33.19	33.86	94.6	31.15	31.38	32.01
III.	0.911	32.36	32.60	33.25	97.0	31.37	31.61	32.23
IV.	0.931	31.96	32.21	32.83	98.6	31.52	31.77	32.38
V.	0.940	31.78	32.04	32.65	99.6	31.65	31.91	32.52
VI.	0.957	31.48	31.73	32.39	101.2	31.85	32.10	32.77
VII.	0.975	31.14	31.39	32.00	103.0	32.07	32.32	32.96
VIII.	0.991	30.84	31.09	31.71	104.4	32.20	32.45	33.10
IX.	1.008	30.56	30.80	31.42	106.3	32.48	32.74	33.39
m-CRESOL.	1.029	30.16	30.41	31.01	108.0	32.57	32.84	33.49

TOLUENE AND m CRESOL.

Refractive Index and Composition.

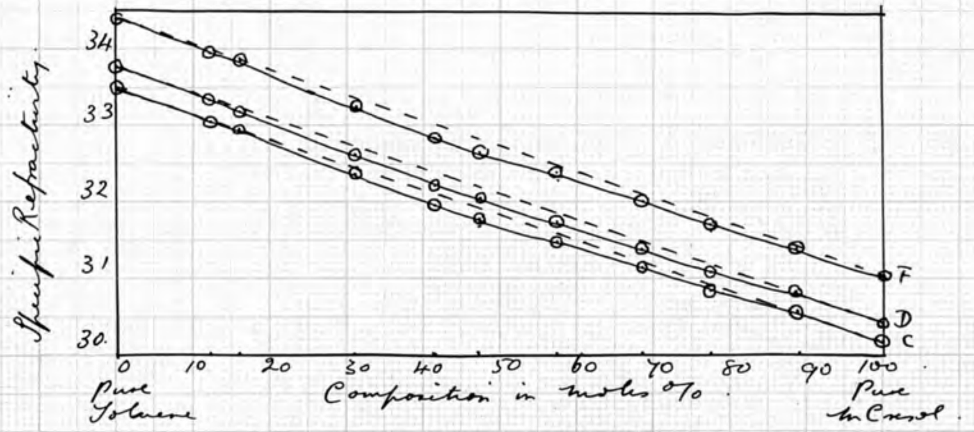
Figure XI



Temperature 28°.

Specific Refractivity and Composition.

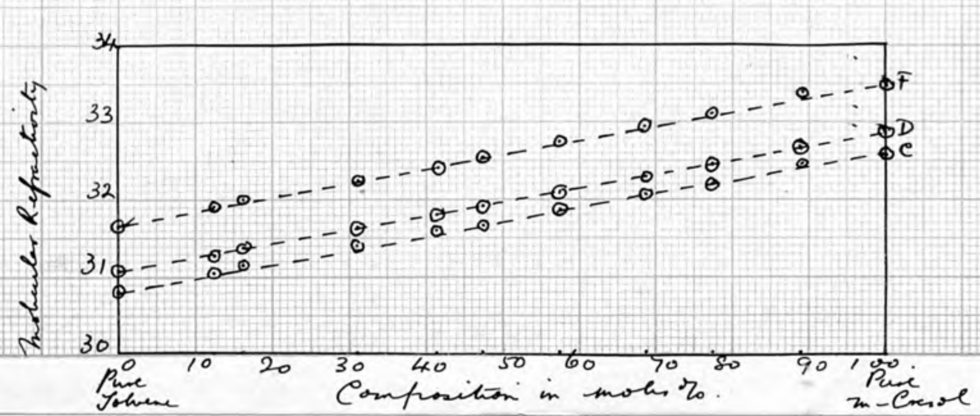
Figure XII



Temperature 28°.

Molecular Refractivity and Composition.

Figure XIII



Temperature 28°.

TOLUENE AND META CRESOL. TABLE VIII

DISPERSION AND DISPERSIVE POWER.

SUBSTANCE.	REFRACTIVE INDEX. C.	D.	F.	DISPERSION. $\times 10^3$	DISPERSIVE POWER. $\times 10^3$
TOLUENE.	1.48580	1.49030	1.50137	15.57	31.76
I.	1.49199	1.49663	1.50809	16.10	32.44
II.	1.49459	1.49937	1.51080	16.21	32.45
III.	1.50142	1.50620	1.51792	16.50	32.59
IV.	1.50656	1.51133	1.52317	16.61	32.48
V.	1.50950	1.51430	1.52606	16.56	32.20
VI.	1.51434	1.51920	1.53160	17.26	33.24
VII.	1.51942	1.52441	1.53696	17.54	33.45
VIII.	1.52295	1.52787	1.54067	17.72	33.57
IX.	1.52818	1.53329	1.54613	17.95	33.67
m-CRESOL.	1.53275	1.53812	1.55097	18.22	33.86

TOLUENE AND META CRESOL.   TABLE IX

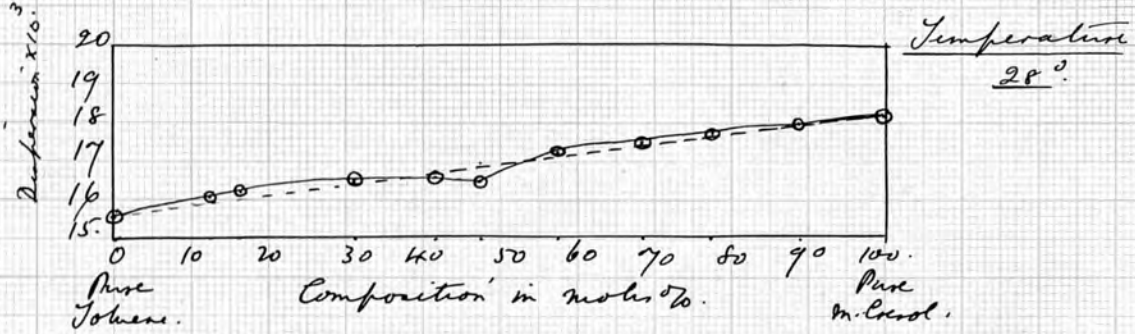
MOLECULAR DISPERSION.

SUBSTANCE.	DISPERSION.	SPECIFIC GRAVITY.	MEAN MOLECULAR WEIGHT.	MOLECULAR DISPERSION. x10.
TOLUENE.	15.57	0.857	92.0	16.72
I.	16.10	0.879	94.0	17.23
II.	16.21	0.885	94.6	17.33
III.	16.50	0.911	97.0	17.56
IV.	16.61	0.931	98.6	17.60
V.	16.56	0.940	99.6	17.54
VI.	17.26	0.957	101.2	18.25
VII.	17.54	0.975	103.0	18.52
VIII.	17.72	0.991	104.4	18.67
IX.	17.95	1.008	106.3	18.92
m-CRESOL.	18.22	1.029	108.0	19.13

TOLUENE AND m.CRESOL.

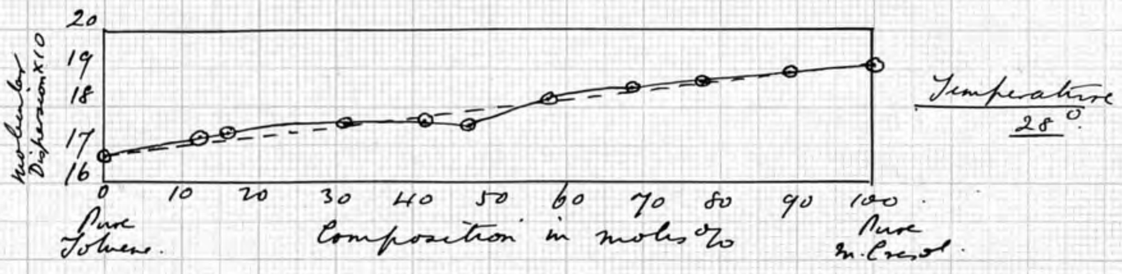
Dispersion and Composition.

Figure XIV



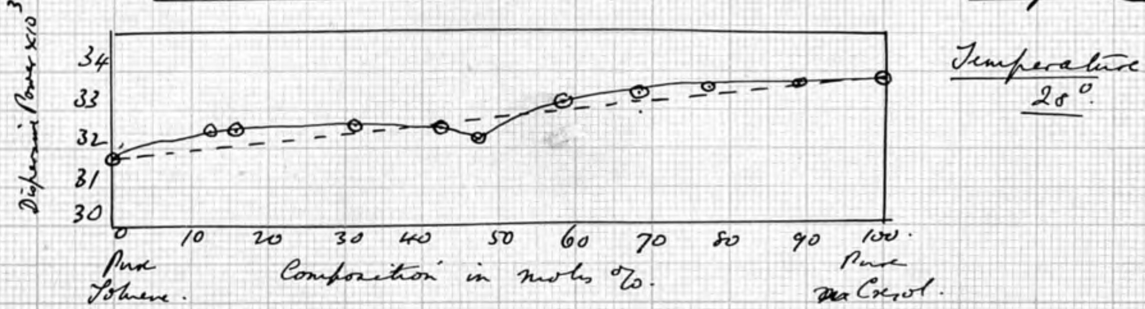
Molecular Dispersion and Composition.

Figure XV



Dispersive Power and Composition.

Figure XVI



TOLUENE AND META CRESOL TABLE X.

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE.	WEIGHT OF SILVER.	INITIAL TEMP. t_1°C.	FINAL TEMP. t_3°C.	$t_2 - t_3$.	$t_3 - t_1$.	SPECIFIC HEAT. cals/gm.	MEAN SPECIFIC HEAT. cals/gm.
TOLUENE.	38.72	17.70	22.60	26.92	84.08	4.32	0.384	
	38.13	17.70	23.71	28.07	82.93	4.36	0.378	0.383
	36.54	17.70	24.21	28.60	82.40	4.39	0.388	
E.	32.36	17.10	21.77	26.36	84.64	4.59	0.409	
	31.82	15.36	22.88	27.00	84.00	4.12	0.412	0.408
	31.13	17.10	23.80	28.46	82.54	4.66	0.402	
D.	33.89	17.70	21.76	26.25	84.75	4.49	0.421	
	32.51	17.70	23.40	27.88	83.12	4.48	0.429	0.425
C.	33.99	17.70	21.84	26.18	84.82	4.34	0.439	
	33.33	17.70	23.63	28.10	82.90	4.47	0.419	0.436
	32.68	17.10	24.31	28.45	82.55	4.14	0.449	
B.	33.97	17.10	21.06	25.28	85.72	4.22	0.442	
	33.36	6.08	23.22	24.76	86.24	1.54	0.438	0.441
	33.00	17.70	22.25	26.63	84.37	4.38	0.444	
A.	34.18	16.35	24.57	28.32	82.68	3.75	0.461	
	32.95	17.10	24.55	28.64	82.36	4.09	0.451	0.456
m-CRESOL.	34.42	17.70	20.80	24.75	86.25	3.95	0.500	
	33.72	17.70	22.75	26.51	84.49	3.76	0.529	0.515

Specific Heat of Silver.........................0.056 cals/gm

Water equivalent of calorimeter & thermometer. 4.44 gms.

Initial temperature of silver. (t_2).........111°C.

TOLUENE AND META CRESOL. TABLE XI

COMPOSITION OF MIXTURES FOR HEAT PROPERTIES.

SUBSTANCE.	WEIGHT OF TOLUENE. (in gms)	WEIGHT OF m-CRESOL. (in gms).	COMPOSITION OF MIXTURES IN MOLES %. ~~TOLUENE.~~ m-CRESOL	~~m-CRESOL.~~ TOLUENE.
E.	26.42	6.07	21.3	78.7
D.	22.16	11.88	38.6	61.4
C.	15.93	17.93	56.9	43.1
B.	10.39	23.62	72.7	27.3
A.	5.19	29.81	87.1	12.9

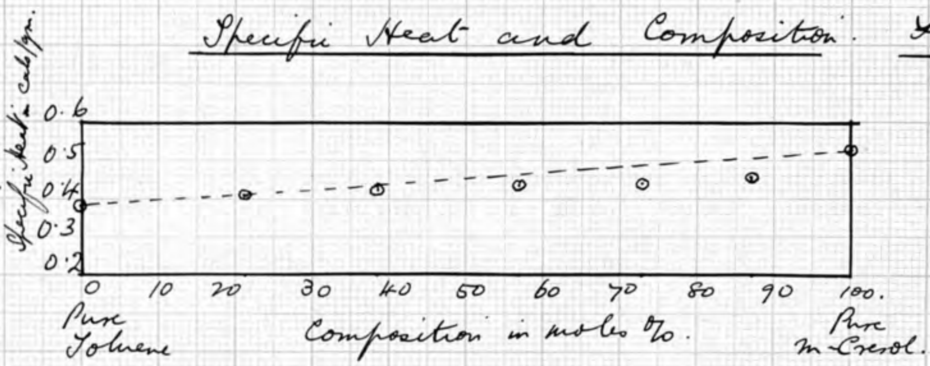
HEAT OF MIXING. XII

SUBSTANCE.	INITIAL TEMP. t^oC.	FINAL TEMP. t_m^oC	t_m-t.	SPECIFIC HEAT OF MIXTURE. (cals/gm)	WEIGHT OF MIXTURE. (gms)	HEAT OF MIXING. (cals/gm).
E.	22.20	19.12	3.08	0.408	32.49	1.68
D.	22.85	19.22	3.63	0.425	34.04	2.02
C.	23.19	19.58	3.61	0.436	33.86	2.05
B.	21.83	19.29	2.54	0.441	34.01	1.45
A.	23.36	21.98	1.38	0.456	35.00	0.89

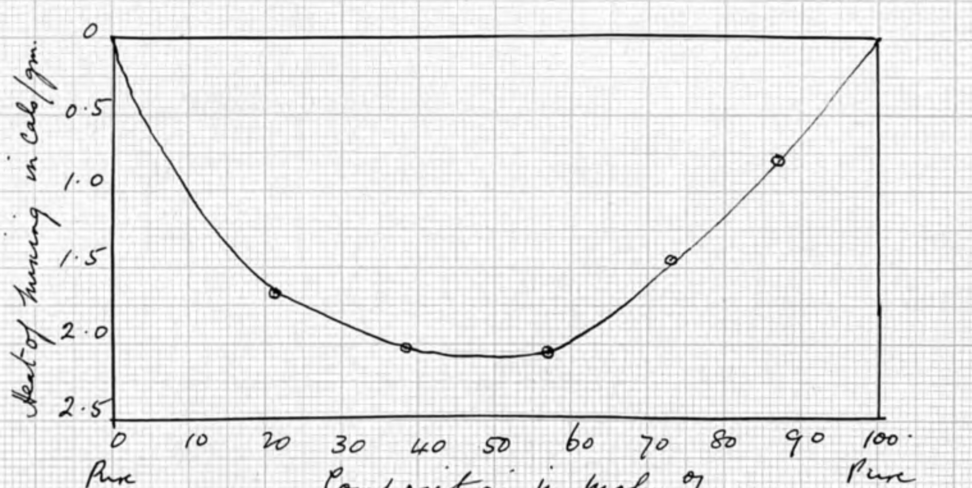
BBBB £

Toluene and m-Cresol.

Specific Heat and Composition. Figure XVII.



Heat of mixing and Composition. Figure XVIII.



TOLUENE AND META CRESOL.

COMPOSITION OF MIXTURE IIIA.

WEIGHT OF m-CRESOL.	WEIGHT OF TOLUENE.	COMPOSITION OF MIXTURE IN MOLES %. m-CRESOL.	TOLUENE.
3.13gm.	6.00gm.	30.8	69.2

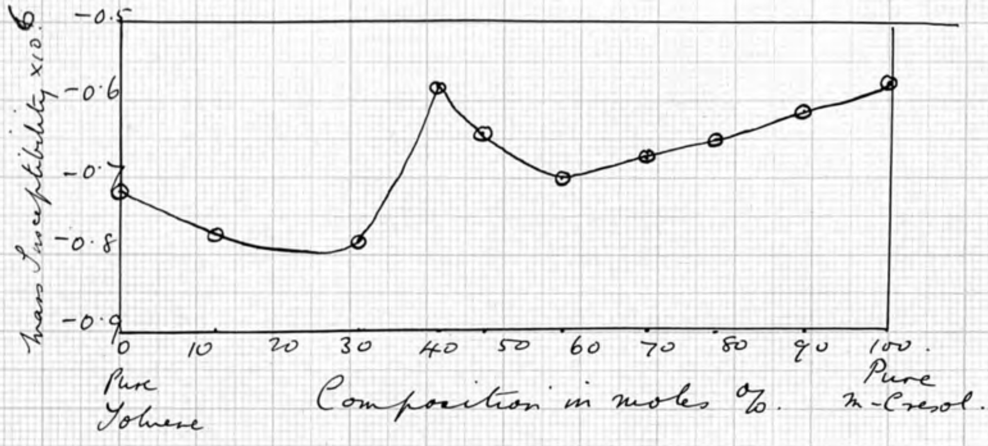
TOLUENE AND META CRESOL. TABLE XIII.

MAGNETIC SUSCEPTIBILITY. TEMPERATURE 15°- 21°C.

SUBSTANCE.	DEFLECTION FOR WATER.	MASS OF WATER.	DEFLECTION FOR SUBSTANCE.	MASS OF SUBSTANCE	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY. $\times 10^6$
TOLUENE.	0.411	0.611	0.331	0.539	0.857	-0.718
I.	0.617	0.661	0.501	0.543	0.879	-0.774
IIIA.	0.411	0.611	0.396	0.587	0.910	-0.784
IV.	0.617	0.661	0.411	0.600	0.931	-0.582
V.	..	..	0.453	0.596	0.940	-0.642
VI.	..	..	0.512	0.613	0.957	-0.702
VII.	..	..	0.507	0.633	0.975	-0.673
VIII.	..	..	0.482	0.623	0.991	-0.651
IX.	..	..	0.463	0.636	1.008	-0.614
m-CRESOL.	0.411	0.611	0.327	0.663	1.029	-0.578

Toluene and m-Cresol

Mass Susceptibility and Composition. Figure XIX



ANILINE AND META-CRESOL.

METAnCRESOL AND ANILINE. TABLE XIV

COMPOSITION OF THE MIXTURES.

SUBSTANCE.	WEIGHT OF m-CRESOL. (in gms)	WEIGHT OF ANILINE. (in gms)	COMPOSITION IN MOLES %. m-CRESOL.	ANILINE.
I.	46.02	5.11	88.6	11.4
II.	40.94	10.16	77.6	22.4
III.	35.80	15.73	66.2	33.8
IV.	30.64	19.65	57.3	42.7
V.	24.53	25.38	45.4	54.6
VI.	20.51	29.96	37.1	62.9
VII.	11.45	34.89	22.0	78.0
VIII.	7.37	40.15	13.7	86.3
IX.	7.36	45.62	12.2	87.8

ANILINE AND META-CRESOL. TABLE XV

SPECIFIC GRAVITIES AT 28°C.

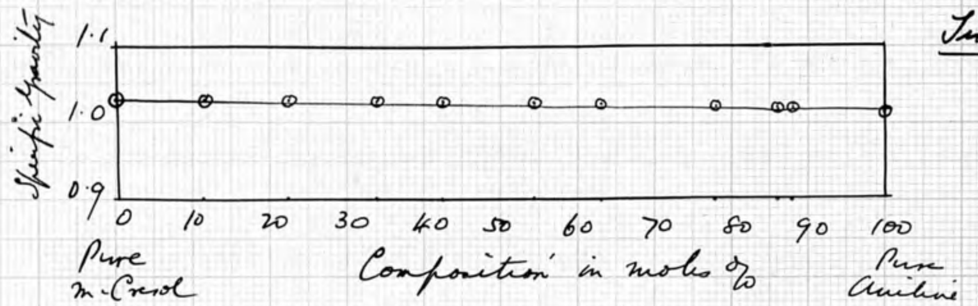
SUBSTANCE.	WEIGHT OF SUBSTANCE FILLING PYKNOMETER AT 28°. (in grams)	WEIGHT OF WATER FILLING PYKNOMETER AT 28°. (in grams)	SPECIFIC GRAVITY D_4^{28}
m-CRESOL.	2.059	1.993	1.029
I.	2.059	..	1.029
II.	2.058	..	1.028
III.	2.057	..	1.028
IV.	2.056	..	1.028
V.	2.055	..	1.028
VI.	2.047	..	1.023
VII.	2.043	..	1.021
VIII.	2.039	..	1.019
IX.	2.038	..	1.019
ANILINE.	2.030	..	1.015

Aniline and m Cresol

Specific Gravity and Composition

Figure XX

Temperature 28°.



ANILINE AND META CRESOL. TABLE XVII

REFRACTIVE INDEX AT 28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION			REFRACTIVE INDEX.		
	C.	D.	F.	C.	D.	F.
m-CRESOL.	30°21.7'	30°18.4'	30° 17.7'	1.53275	1.53812	1.55097
I.	29°31.0'	29°27.5'	29°20.0'	1.53692	1.54228	1.55563
II.	28°32.6'	28°29.4'	28°14.3'	1.54159	1.54692	1.56081
III.	27°32.0'	27°25.7'	27° 3.5'	1.54634	1.55187	1.56622
IV.	26°42.3'	26°33.8'	26° 6.1'	1.55012	1.55579	1.57048
V.	25°38.8'	25°26.4'	24°48.8'	1.55484	1.56075	1.57604
VI.	24°50.6'	24°36.5'	23°52.1'	1.55831	1.56431	1.57997
VII.	23°15.8'	22°56.4'	21°54.2'	1.56488	1.57117	1.58771
VIII.	22°21.4'	21°57.4'	20°42.8'	1.56849	1.57502	1.59214
IX.	22° 8.6'	21°45.6'	20°31.0'	1.56932	1.57577	1.59284
ANILINE.	20°37.8'	20° 8.9'	18°35.5'	1.57502	1.58170	1.59948

ANILINE AND META CRESOL TABLE XVIII

SPECIFIC AND MOLECULAR REFRACTIVITY AT 28°C.

SUBSTANCE.	DENSITY.	SPECIFIC REFRACTIVITY.			MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY.		
		C	D	F		C	D	F.
m-CRESOL.	1.029	30.16	30.41	31.01	108.0	32.57	32.84	33.49
I.	1.029	30.34	30.59	31.22	106.3	32.25	32.52	33.18
II.	1.028	30.56	30.82	31.47	104.7	32.00	32.27	32.95
III.	1.028	30.81	31.07	31.74	102.9	31.70	31.96	32.64
IV.	1.028	31.00	31.27	31.95	101.5	31.49	31.77	32.45
V.	1.028	31.24	31.52	32.21	99.8	31.18	31.45	32.15
VI.	1.023	31.53	31.81	32.53	98.5	31.06	31.33	32.05
VII.	1.021	31.90	32.19	32.96	96.3	30.72	30.99	31.74
VIII.	1.019	32.12	32.43	33.21	95.0	30.56	30.85	31.60
IX.	1.019	32.18	32.48	33.26	94.8	30.52	30.80	31.54
ANILINE.	1.015	32.56	32.87	33.69	93.0	30.28	30.57	31.33

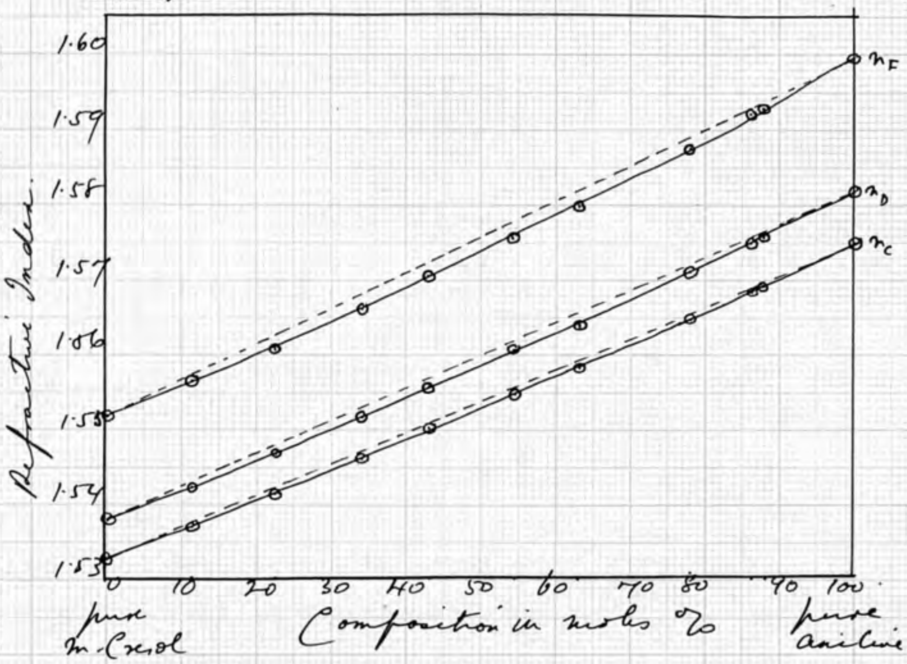
~~32.84~~

ANILINE AND m. CRESOL.

Refractive Index and Composition

Figure XXII

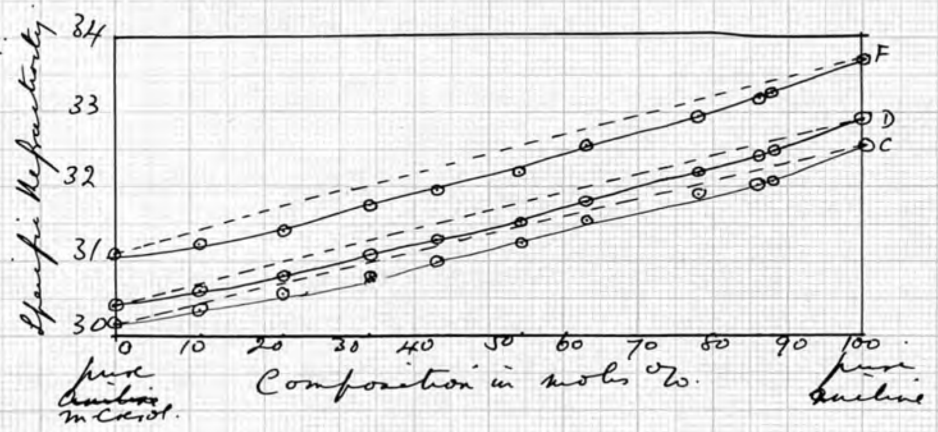
Temperature 28°.



Specific Refractivity and Composition

Figure XXIII

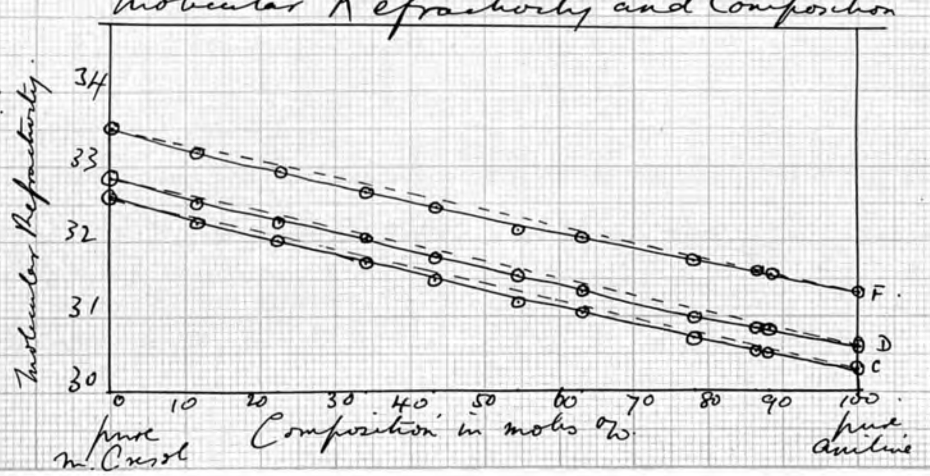
Temperature 28°



Molecular Refractivity and Composition

Figure XXIV

Temperature 28°.



ANIDINE AND META CRESOL. TABLE XIX

DISPERSION AND DISPERSIVE POWER.

SUBSTANCE.	REFRACTIVE INDEX.			DISPERSION. $\times 10^3$	DISPERSIVE POWER. $\times 10^3$.
	C.	D.	F.		
m-CRESOL.	1.53275	1.53812	1.55097	18.22	33.86
I.	1.53692	1.54228	1.55563	18.71	34.49
II.	1.54159	1.54692	1.56081	19.22	35.14
III.	1.54634	1.55187	1.56622	19.88	36.02
IV.	1.55012	1.55579	1.57048	20.36	36.64
V.	1.55484	1.56075	1.57604	21.20	37.80
VI.	1.55831	1.56431	1.57997	21.66	38.39
VII.	1.56488	1.57117	1.58771	22.83	39.96
VIII.	1.56849	1.57502	1.59214	23.65	41.12
IX.	1.56932	1.57577	1.59284	23.52	40.85
ANILINE.	1.57502	1.58170	1.59948	24.46	42.06

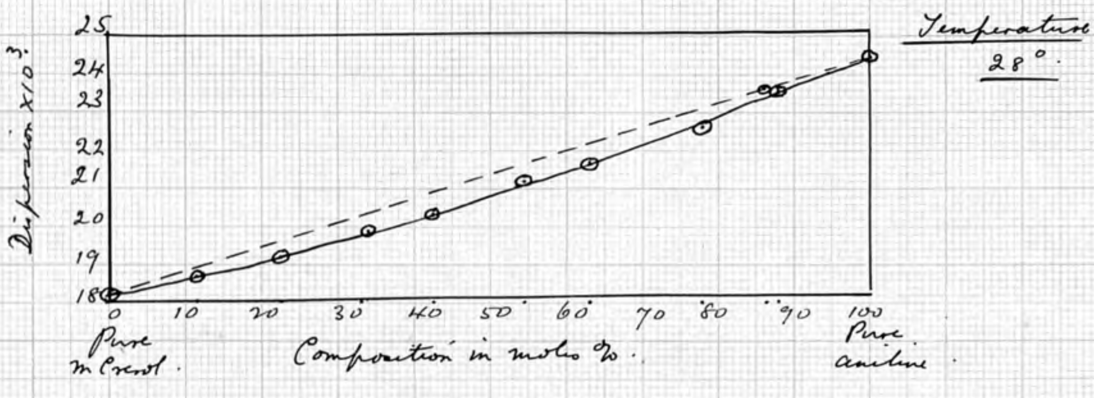
ANILINE AND META CRESOL. TABLE XX

MOLECULAR DISPERSION.

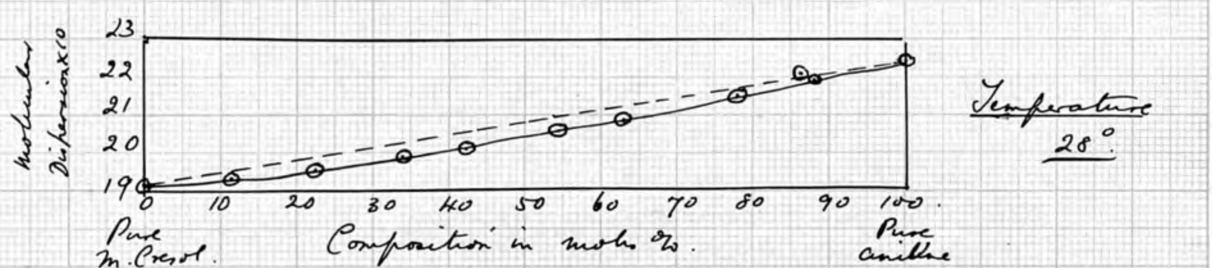
SUBSTANCE.	DISPERSION	SPCIFIC GRAVITY.	MEAN MOLECULAR WEIGHT.	MOLECULAR DISPERSION. x10.
m-CRESOL.	18.22	1.029	108.0	19.13
I.	18.71	1.029	106.3	19.32
II.	19.22	1.028	104.7	19.55
III.	19.88	1.028	102.9	19.89
IV.	20.36	1.028	101.6	20.12
V.	21.20	1.028	99.8	20.59
VI.	21.66	1.023	98.5	20.85
VII.	22.83	1.021	96.3	21.53
VIII.	23.65	1.019	95.0	22.08
IX.	23.52	1.019	94.8	21.90
ANILINE.	24.46	1.015	93.0	22.42

ANILINE AND m. CRESOL.

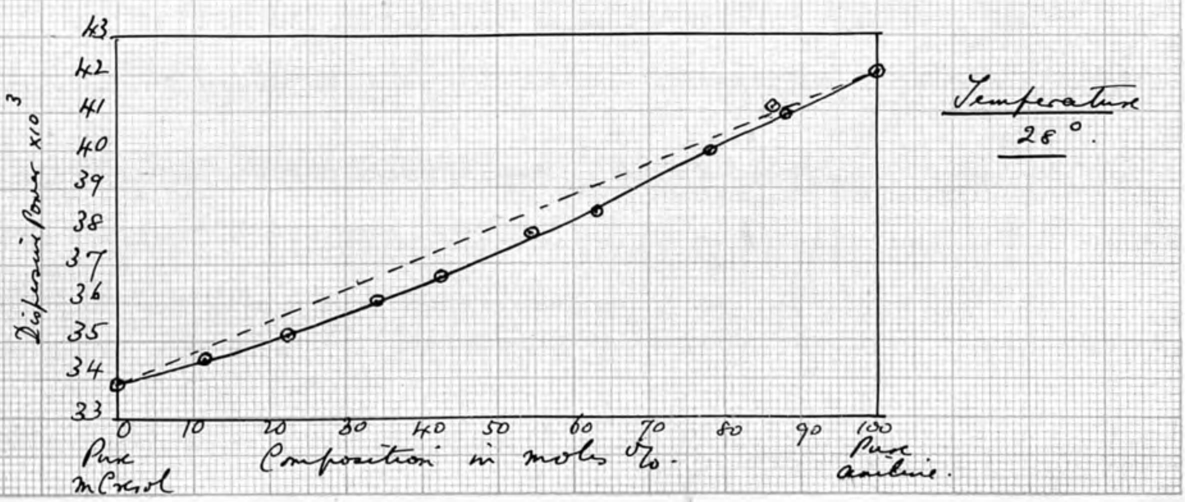
Dispersion and Composition. Figure XXV



Molecular Dispersion and Composition. Figure XXVI



Dispersive Power and Composition. Figure XXVII



ANILINE AND META-CRESOL. TABLE XXI.

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE. (in gms)	WEIGHT OF SILVER. (in gms)	INITIAL TEMP. t_1°C.	FINAL TEMP. t_3°C.	t_2-t_3.	t_3-t_1.	SPECIFIC HEAT. (cals/gm)	MEAN SPECIFIC HEAT. (cals/gm)
m-Cresol.	34.42	17.70	20.80	24.75	86.25	3.95	0.500	
	33.73	17.70	22.75	26.51	84.49	3.76	0.529	0.515
E.	34.98	17.42	23.57	27.62	83.38	4.05	0.447	
	33.75	17.42	24.21	28.13	82.87	3.92	0.479	0.463
D.	35.13	17.42	21.33	25.42	85.58	4.09	0.455	
	34.61	17.42	23.15	27.10	83.90	3.95	0.470	0.463
C.	35.84	17.42	20.07	24.15	86.85	4.08	0.455	
	34.91	17.42	21.58	25.57	85.43	3.99	0.471	0.463
B.	35.54	17.42	21.38	25.39	85.61	4.01	0.461	
	34.99	17.42	22.30	26.17	84.83	3.87	0.484	0.473
A.	35.64	17.42	22.10	26.14	84.86	4.04	0.450	
	35.13	17.42	24.10	27.99	83.01	3.89	0.466	0.462
	34.48	17.42	24.66	28.56	82.44	3.90	0.469	
Aniline.	36.02	16.81	21.50	25.48	85.52	3.98	0.438	
£	34.73	17.42	23.05	27.08	83.92	4.03	0.457	0.448

Water Equivalent of Calorimeter and Thermometer....... 4.44 gms.

Specific Heat of Silver..................................0.056 cals/gm.

Initial Temperature of Silver.......................111°C.

ANILINE AND META CRESOL. TABLE XXII

COMPOSITION OF MIXTURES FOR HEAT PROPERTIES.

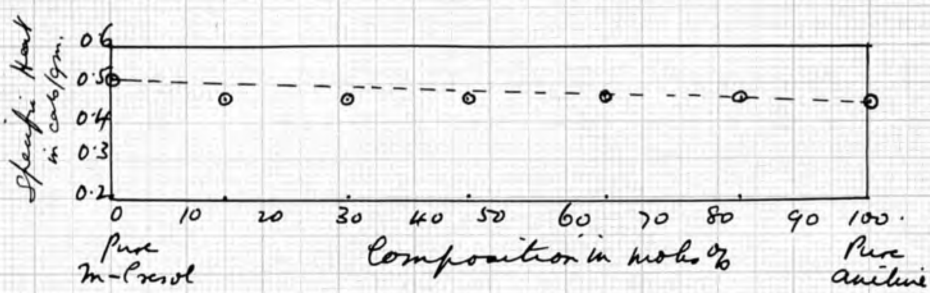
SUBSTANCE.	WEIGHT OF ANILINE. (in gms.)	WEIGHT OF m-CRESOL. (in gms.)	COMPOSITION OF MIXTURES IN MOLES %. ANILINE.	m-CRESOL.
m E.	6.03	28.98	15.2	84.8
D.	12.14	22.99	31.3	68.7
C.	18.19	17.61	47.1	52.9
B.	24.31	11.22	65.1	34.9
A.	30.27	5.37	82.9	17.1

HEAT OF MIXING. XXIII

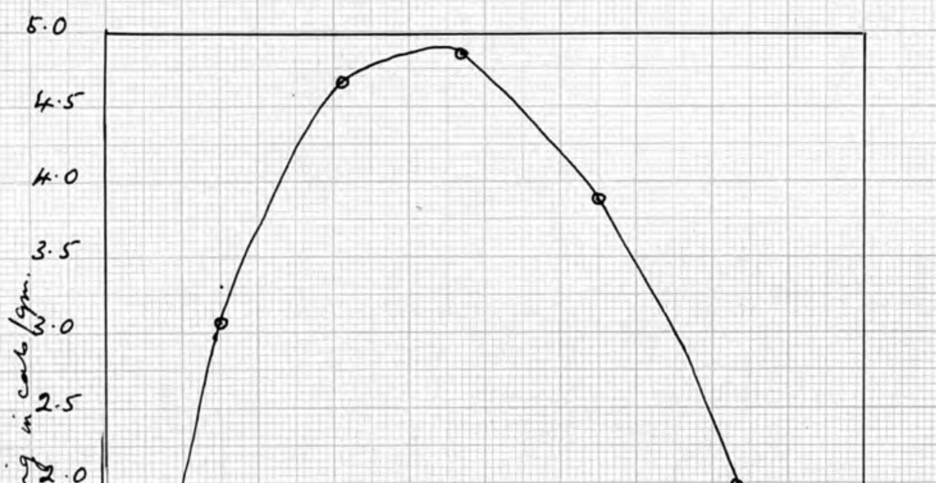
SUBSTANCE.	INITIAL TEMP. $t^{o}C.$	FINAL TEMP. $t_m^{o}C.$	$t_m-t.$	SPECIFIC HEAT OF MIXTURE. (cals/gm)	WEIGHT OF MIXTURE. (in gms)	HEAT OF MIXING. (cals/gm)
E.	21.12	26.30	5.18	0.463	35.01	3.06
D.	20.85	28.75	7.90	0.463	35.13	4.66
C.	19.55	27.81	8.26	0.463	35.80	4.85
B.	20.74	27.22	6.48	0.473	35.53	3.88
A.	21.92	25.28	3.36	0.462	35.64	1.97

Aniline and m- Cresol.

Specific Heat and Composition. Figure XXVIII.



Heat of mixing and Composition. Figure XXIX.



ANILINE AND META CRESOL. TABLE XIIIA.

COMPOSITION OF MIXTURES FOR SUSCEPTIBILITY MEASUREMENTS.

SUBSTANCE.	WEIGHT OF ANILINE.	WEIGHT OF m-CRESOL	COMPOSITION OF MIXTURES IN MOLES %.	
			ANILINE.	m-CRESOL.
1.	1.00gms.	9.08gms.	11.3	88.7
2.	2.00 ..	8.21 ..	22.1	77.9
3.	3.06 ..	7.14 ..	33.2	66.8
4.	4.12 ..	6.16 ..	43.7	56.3
5.	4.99 ..	5.19 ..	52.8	47.2
6.	6.14 ..	4.11 ..	63.4	36.6
7.	7.17 ..	3.09 ..	72.9	27.1
8.	8.10 ..	2.05 ..	82.1	17.9
9.	9.25 ..	1.19 ..	90.0	10.0

ANILINE AND META CRESOL. TABLE XXIV.

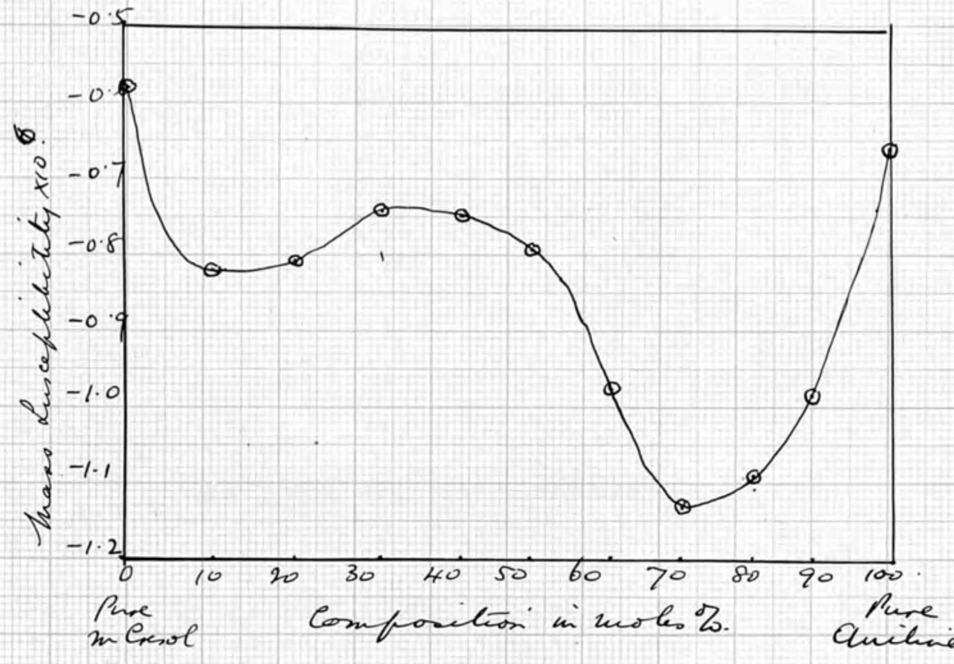
MAGNETIC SUSCEPTIBILITY. TEMPERATURE 15°- 21°C.

SUBSTANCE.	DEFLECTION FOR WATER.	WEIGHT OF WATER.	DEFLECTION FOR SUBSTANCE.	WEIGHT OF SUBSTANCE.	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY $\times 10^{+6}$
m-CRESOL.	0.411	0.611	0.327	0.663	1.029	-0.578
1.	..	..	0.458	0.646	1.029	-0.819
2.	..	..	0.452	0.646	1.028	-0.808
3.	..	..	0.419	0.655	1.028	-0.742
4.	..	..	0.492	0.669	1.028	-0.749
5.	..	..	0.459	0.669	1.028	-0.793
6.	..	..	0.563	0.664	1.023	-0.974
7.	..	..	0.630	0.637	1.021	-1.13
8.	..	..	0.602	0.632	1.019	-1.09
9.	..	..	0.571	0.665	1.019	-0.986
ANILINE.	..	..	0.361	0.638	1.015	-0.660

ANILINE AND m-CRESOL

Mass Susceptibility and Composition

Figure XXX.



ANILINE AND NITROBENZENE.

ANILINE AND NITROBENZENE. TABLE XXV

COMPOSITION OF THE MIXTURES.

SUBSTANCE.	WEIGHT OF ANILINE.	WEIGHT OF NITROBENZENE.	COMPOSITION IN MOLES%. ANILINE.	NITROBENZENE.
I.	3.01	32.64	10.9	89.1
II.	6.13	28.89	21.9	78.1
III.	9.80	25.32	33.9	66.1
IV.	11.53	21.62	41.4	58.6
V.	15.37	17.99	53.0	47.0
VI.	18.32	14.58	62.4	37.6
VII.	21.50	10.88	72.3	27.7
VIII.	24.63	7.26	81.8	18.2
IX.	27.62	3.50	91.3	8.7

ANILINE AND NITROBENZENE. TABLE XXVI

SPECIFIC GRAVITIES, AT 28°C.

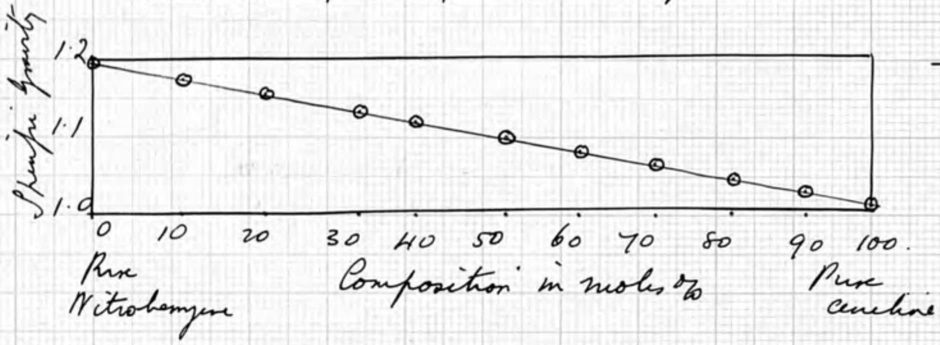
SUBSTANCE.	WEIGHT OF SUBSTANCE FILLING PYKNOMETER AT 28°. (in grams)	WEIGHT OF WATER FILLING PYKNOMETER AT 28°. (in grams)	SPECIFIC GRAVITY D_4^{28}.
NITROBENZENE	2.388	1.993	1.194
I.	2.352	1.993	1.176
II.	2.316	..	1.157
III.	2.273	..	1.136
IV.	2.247	..	1.123
V.	2.207	..	1.104
VI.	2.172	..	1.086
VII.	2.137	..	1.068
VIII.	2.097	..	1.048
IX.	2.063	..	1.031
ANILINE.	2.030	..	1.015

Aniline and Nitrobenzene

Specific Gravity and Composition

Figure XXXI

Temperature 28°



ANILINE AND NITROBENZENE. TABLE XXVIII

REFRACTIVE INDEX AT 28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION.			REFRACTIVE INDEX.		
	C".	D.	F.	C.	D.	F.
NITROBENZENE.	28°19.9'	27°59.2'	26°49.3'	1.54260	1.54928	1.56729
I.	27°47.9'	27° 2.4'	–	1.54510	1.55365	–
II.	27° 7.4'	26°42.0'	–	1.54822	1.55518	–
III.	26°20.9'	25°53.8'	–	1.55173	1.55876	–
IV.	25°50.0'	25°22.7'	–	1.55401	1.56102	–
V.	24°58.8'	24°29.9'	–	1.55772	1.56478	–
VI.	24°15.5'	23°46.6'	–	1.56077	1.56778	–
VII.	23°26.4'	22°56.4'	–	1.56415	1.57117	–
VIII.	22°34.6'	22° 4.2'	–	1.56763	1.57458	–
IX.	21°35.4'	21° 4.9'	–	1.57144	1.57832	–
ANILINE.	20°37.8' (~~32.6'~~)	20° 8.9'	18°35.5	1.57502 (~~1.57533~~)	1.58170 (~~1.58274~~)	1.59948

ANILINE AND NITROBENZENE. TABLE XXIX

SPECIFIC AND MOLECULAR REFRACTIVITY AT28°C.

SUBSTANCE.	SPECIFIC GRAVITY.	SPECIFIC REFRACTIVITY.			MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY.		
		C.	D.	F.		C.	D.	F.
NITRO-BENZENE.	1.194	26.38	26.61	27.37	123.0	32.45	32.73	33.67
I.	1.176	26.89	27.25	–	119.7	32.20	32.61	–
II.	1.157	27.45	27.74	–	116.5	31.99	32.32	–
III.	1.136	28.11	28.41	–	112.8	31.71	32.04	–
IV.	1.123	28.54	28.83	–	110.6	31.56	31.88	–
V.	1.104	29.21	29.52	–	107.1	31.29	31.61	–
VI.	1.086	29.82	30.12	–	104.3	31.10	31.42	–
VII.	1.068	30.46	30.77	–	101.3	30.84	31.16	–
VIII.	1.048	31.20	31.51	–	98.5	30.73	31.03	–
IX.	1.031	31.88	32.21	–	95.6	30.49	30.79	–
ANILINE.	1.015	32.56	32.87	33.69	93.0	30.28	30.57	31.33

ANILINE AND NITROBENZENE

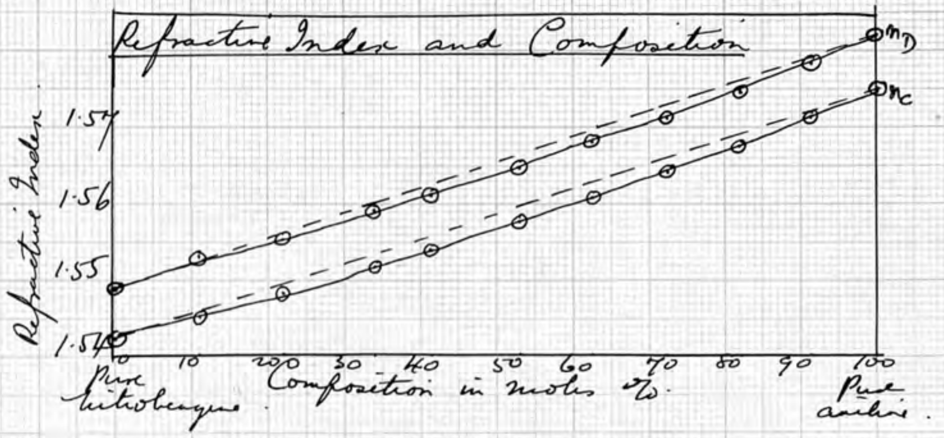
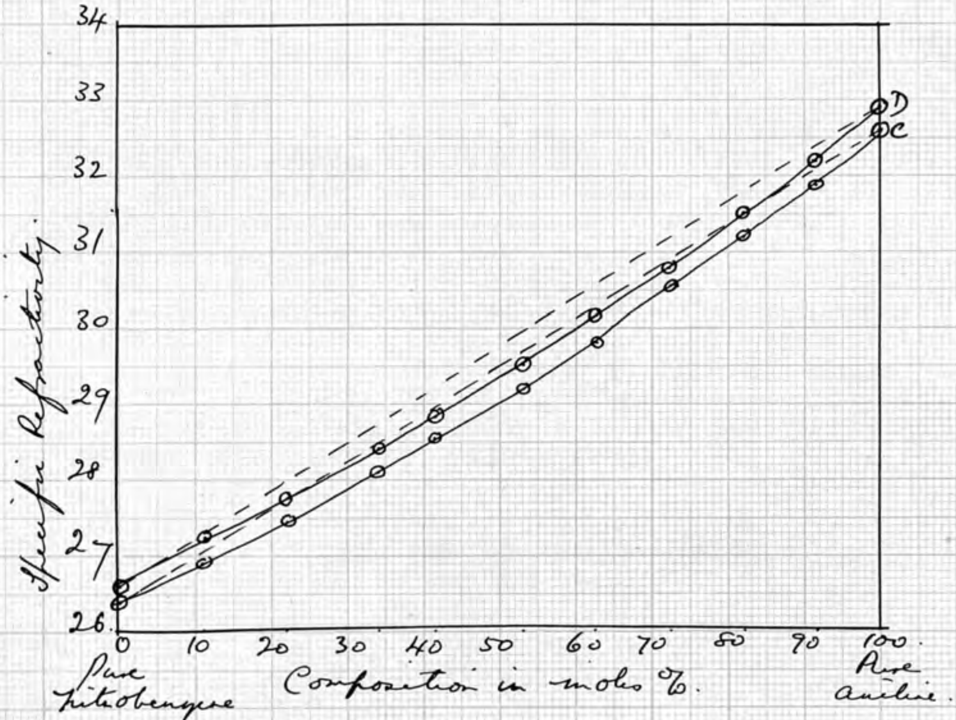


Figure XXXIII

Temperature 28°.

Specific Refractivity and Composition.

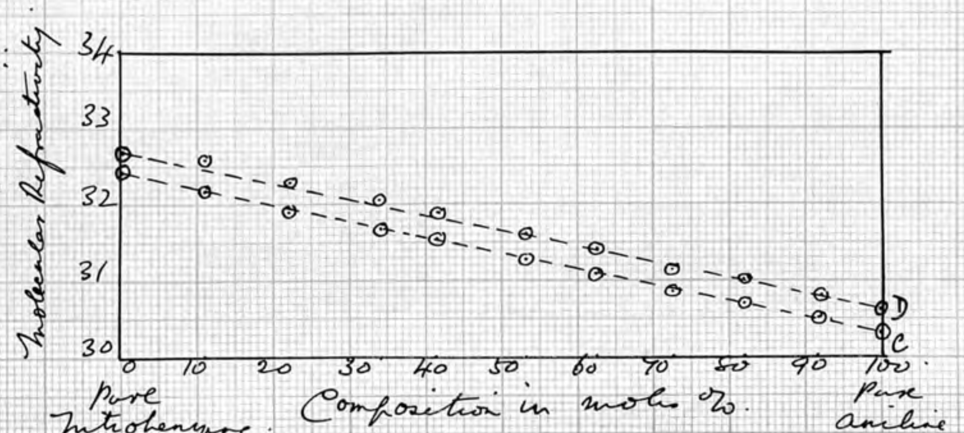
Figure XXXIV



Temperature 28°.

Molecular Refractivity and Composition

Figure XXXV



Temperature 28°.

ANILINE AND NITROBENZENE. TABLE XXX

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE.	WEIGHT OF SILVER.	INITIAL TEMP. t_1	FINAL TEMP. t_3	t_2-t_3	t_3-t_1	SPECIFIC HEAT. in cals per gm.	MEAN SPECIFIC HEAT. in cals/gm.
NITRO-BENZENE.	42.91	17.20	22.07	26.25	85.25	4.18	0.354	
	42.31	17.20	23.52	27.55	83.95	4.03	0.359	0.355
	41.63	17.20	23.85	28.15	83.35	4.30	0.0.342	
A.	45.53	17.20	17.48	21.57	89.93	4.09	0.367	
	44.95	17.20	18.35	22.65	88.85	4.30	0.344	0.356
B.	40.96	17.20	18.85	23.16	88.34	4.31	0.373	
	40.28	17.20	19.76	23.92	87.58	4.16	0.393	0.383
	39.69	17.20	20.97	25.19	86.31	4.22	0.384	
C.	39.64	17.20	18.75	23.02	88.48	4.27	0.392	
	39.10	17.20	20.78	24.96	86.54	4.18	0.396	0.394
D.	38.70	17.20	20.20	24.26	87.24	4.06	0.420	
	38.15	17.20	22.10	26.07	85.43	3.97	0.427	0.426
	37.74	17.20	22.62	26.57	84.93	3.95	0.431	
E.	37.67	17.20	21.20	25.10	86.40	3.90	0.448	
	37.04	17.20	22.68	26.60	84.90	3.92	0.443	0.446
ANILINE.	36.02	16.81	21.50	25.48	85.52	3.98	0.438	
	34.73	17.42	23.05	27.08	83.92	4.03	0.457	0.448

Water Equivalent of Calorimeter and Stirrer and Thermometer.--- 4.44. gms.

Specific Heat of Silver.-- 0.056. cals/gm.

Temperature of Silver.---111.5C.

" " " for Aniline ----------------------------111.0°C

ANILINE AND NITROBENZENE. TABLE XXXI

COMPOSITION OF MIXTURES FOR HEAT DETERMINATIONS.

SUBSTANCE.	WEIGHT OF NITROBENZENE. (in gms.)	WEIGHT OF ANILINE. (in gms.)	COMPOSITION OF MIXTURES IN MOLES %. NITROBENZENE.	ANILINE.
A.	39.68	5.83	90.0	10.0
B.	28.76	12.18	75.8	24.2
C.	21.63	18.01	61.4	38.6
D.	14.39	24.30	43.9	56.1
E.	7.09	30.60	23.5	76.5
F.				

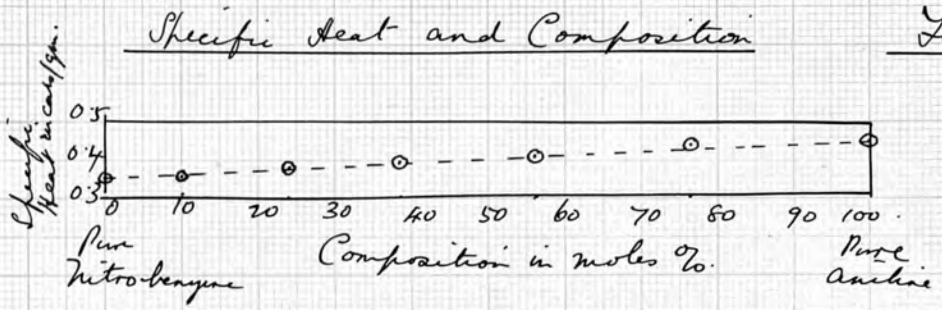
HEAT OF MIXING. XXXII

SUBSTANCE.	INITIAL TEMP. t.	FINAL TEMP. t_m.	$t_m - t$	SPECIFIC HEAT OF MIXTURE. (cals/gm)	WEIGHT OF MIXTURE. (in gms.)	HEAT OF MIXING. (cals/gm).
A.	18.02	16.80	1.22	0.356	45.51	0.553
B.	19.47	17.21	2.26	0.383	40.94	1.11
C.	19.41	17.00	2.41	~~03.94~~ 0.394	39.64	1.22
D.	20.45	18.15	2.30	0.426	38.69	1.24
E.	22.10	20.60	1.50	0.446	37.69	0.85

Aniline and Nitrobenzene

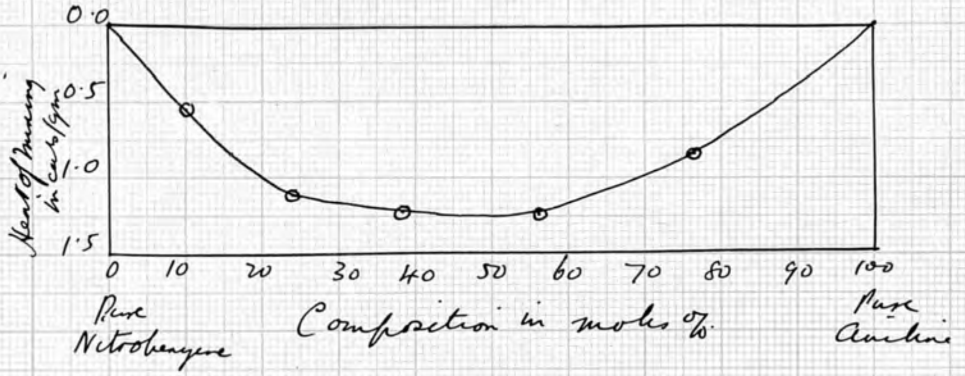
Specific Heat and Composition

Figure XXXVI



Heat of Mixing and Composition

Figure XXXVII



ANILINE AND NITROBENZENE. TABLE XXXIII.

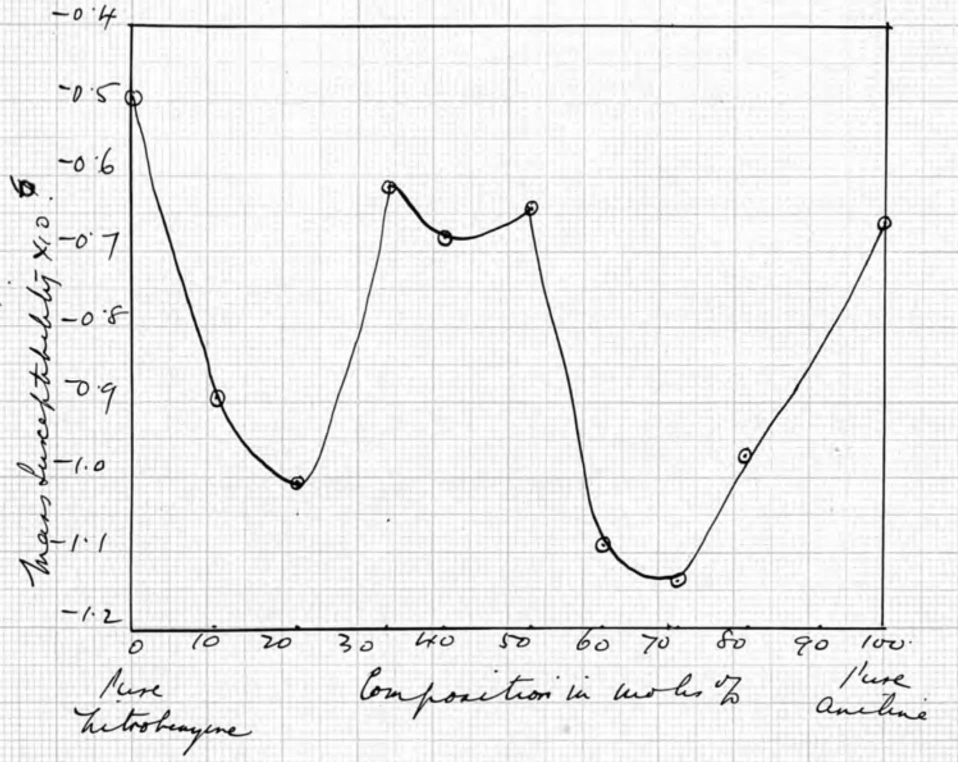
MAGNETIC SUSCEPTIBILITY. TEMPERATURE 15° - 21° C.

SUBSTANCE.	DEFLECTION FOR WATER.	WEIGHT OF WATER.	DEFLECTION FOR SUBSTANCE.	WEIGHT OF SUBSTANCE	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY. $\times 10^{-6}$
NITRO-BENZENE.	0.411	0.611	0.311	0.733	1.194	-0.497
I.	..	..	0.569	0.730	1.176	-0.894
II.	..	..	0.661	0.726	1.157	-1.04
III.	..	..	0.385	0.728	1.136	-0.616
IV.	..	..	0.410	0.697	1.123	-0.682
V.	..	..	0.381	0.688	1.104	-0.644
VI.	..	..	0.661	0.692	1.086	-1.091
VII.	..	..	0.645	0.648	1.068	-1.137
VIII.	..	..	0.535	0.662	1.048	-0.971
ANILINE.	..	..	0.361	0.638	1.015	+0.660

Aniline and Nitrobenzene

Mass Susceptibility and Composition

Figure XXXVIIA



BENZENE AND TOLUENE.

BENZENE AND TOLUENE. TABLE XXXIV

COMPOSITION OF THE MIXTURES.

SUBSTANCE.	WEIGHT OF BENZENE.	WEIGHT OF TOLUENE.	COMPOSITION OF MIXTURES IN MOLES %. BENZENE.	TOLUENE.
I.	1.79	15.68	11.9	88.1
II.	3.53	13.81	23.2	76.8
III.	5.32	12.11	34.1	65.9
IV.	6.99	10.40	44.2	55.8
V.	8.82	8.68	54.5	45.5
VI.	10.59	6.92	64.3	35.7
VII.	12.29	5.19	73.6	26.4
VIII.	13.20	3.47	81.8	18.2
IX.	15.88	1.74	91.5	8.5

BENZENE AND TOLUENE. TABLE XXXV

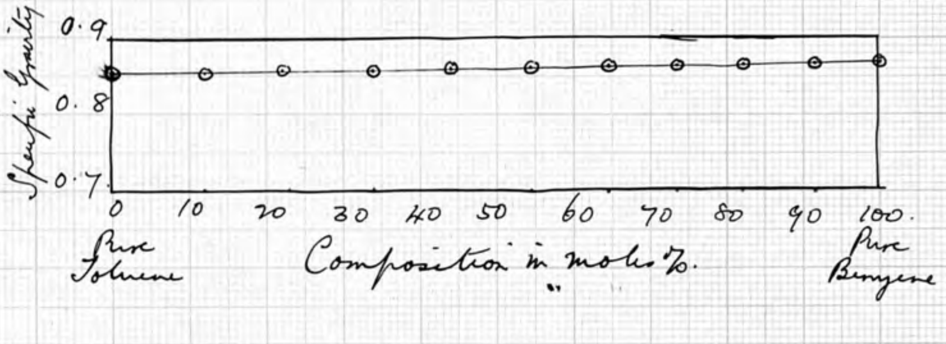
SPECIFIC GRAVITIES AT 28°

SUBSTANCE.	WEIGHT OF SUBSTANCE FILLING PYKNOMETER AT 28° (in grams)	WEIGHT OF WATER FILLING PYKNOMETER AT 28° (in grams)	SPECIFIC GRAVITY AT 28° D_4^{28}.
TOLUENE	1.712	1.992	0.857
I.	1.712	..	0.856
II..	1.715	..	0.858
III.	1.717	..	0.859
IV.	1.718	..	0.859
V.	1.721	..	0.861
VI.	1.727	..	0.864
VII.	1.731	..	0.866
VIII.	1.735	..	0.868
IX.	1.735	..	0.868
BENZENE.	1.740	..	0.871

Benzene and Toluene.

Specific Gravity and Composition.

Figure XXXVIII



TOLUENE AND BENZENE TABLE XXXVII

REFRACTIVE INDEX AT 28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION. C.	D.	F.	REFRACTIVE INDEX. C.	D.	F.
TOLUENE.	39° 4.1'	39°12.1'	39°34.5'	1.48590	1.49030	1.50137
I.	38°59.1'	39° 7.5'	39°26.8'	1.48628	1.49074	1.50210
II.	38°56.2'	39° 4.9'	39°24.1'	1.48655	1.49098	1.50236
III.	38°50.8'	38°58.2'	39°17.8'	1.48708	1.49161	1.50296
IV.	38°45.0'	38°52.9'	39°10.8'	1.48763	1.49213	1.50362
V.	38°37.9'	38°46.2'	39° 2.1'	1.48831	1.49277	1.50444
VI.	38°32.1'	38°40.9'	38°57.4'	1.48886	1.49327	1.50489
VII.	38°24.4'	38°34.9'	38°49.1'	1.48960	1.49384	1.50568
VIII.	38°21.1'	38°30.9'	38°45.6'	1.48991	1.49422	1.50601
IX.	38°12.8'	38°20.6'	38°35.7'	1.49069	1.49519	1.50694
BENZENE.	38° 5.3'	38°13.0'	38°28.2'	1.49140	1.49591	1.50764

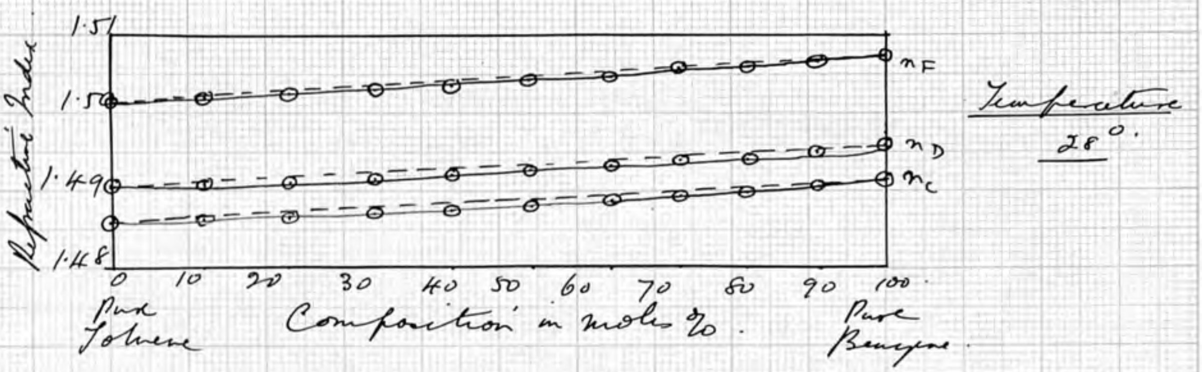
TOLUENE AND BENZENE. TABLE XXXVIII

SPECIFIC AND MOLECULAR REFRACTIVITY AT 28°C.

SUBSTANCE.	SPECIFIC GRAVITY.	SPECIFIC REFRACTIVITY.			MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY.		
		C.	D.	F.		C.	D.	F.
TOLUENE.	0.857	33.49	33.77	34.42	92.0	30.81	31.07	31.66
I.	0.856	33.55	33.81	34.47	90.3	30.30	30.53	31.13
II.	0.858	33.52	33.77	34.43	88.8	29.76	29.98	30.58
III.	0.859	33.51	33.79	34.42	87.2	29.21	29.46	30.00
IV.	0.859	33.52	33.78	34.44	85.8	28.76	28.98	29.55
V.	0.861	33.50	33.76	34.43	84.4	28.27	28.49	29.06
VI.	0.864	33.41	33.67	34.34	83.0	27.73	27.95	28.50
VII.	0.866	33.38	33.62	34.31	81.7	27.27	27.48	28.03
VIII.	0.868	33.32	33.57	34.25	80.6	26.85	27.05	27.60
IX.	0.868	33.36	33.62	34.30	79.2	26.42	26.63	27.16
BENZENE.	0.871	33.29	33.55	34.22	78.0	25.96	26.16	26.69

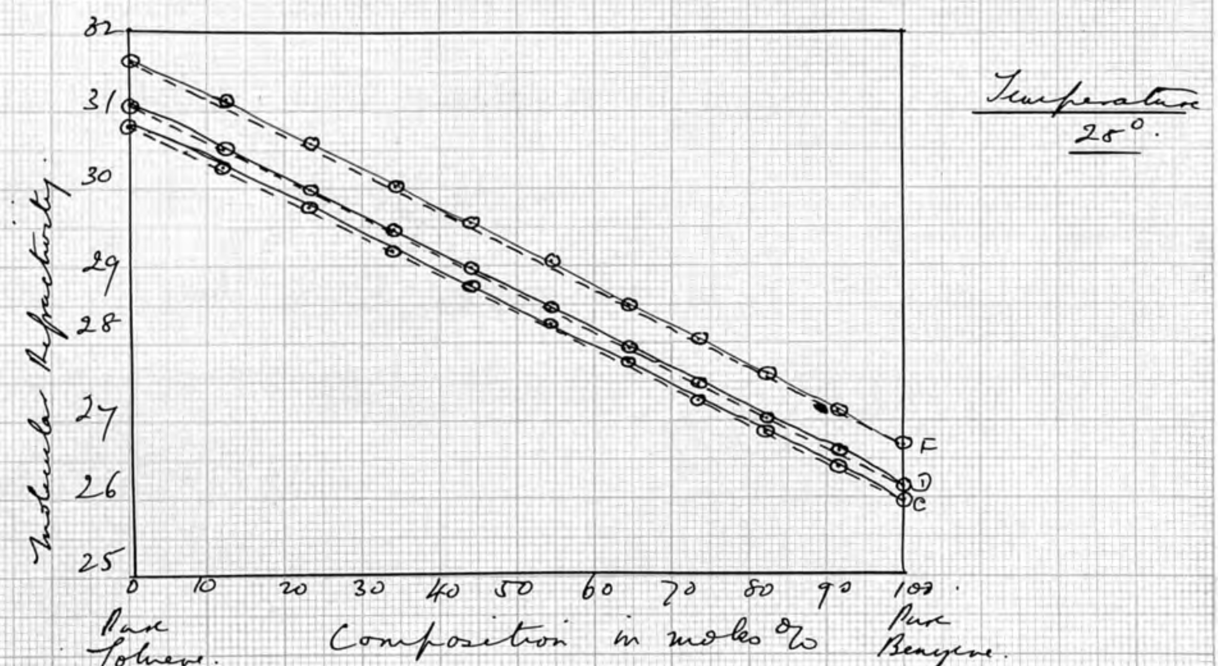
BENZENE AND TOLUENE.

Refractive Index and Composition. Figure XL



Specific Refractivity and Composition. Figure XLI

Molecular Refractivity and Composition. Figure XLII



TOLUENE AND BENZENE. TABLE XXXIX

DISPERSION AND DISPERSIVE POWER.

SUBSTANCE	REFRACTIVE INDEX. C.	D.	F.	DISPERSION $\times 10^3$	DISPERSIVE POWER. $\times 10^3$
TOLUENE.	1.48580	1.49030	1.50137	15.57	31.76
I.	1.48628	1.49074	1.50210	15.82	32.25
II.	1.48655	1.49098	1.50236	15.81	32.21
III.	1.48708	1.49161	1.50296	15.88	32.30
IV.	1.48763	1.49213	1.50362	15.99	32.49
V.	1.48831	1.49277	1.50444	16.13	32.73
VI.	1.48886	1.49327	1.50489	16.03	32.49
VII.	1.48960	1.49384	1.50568	16.08	32.57
VIII.	1.48991	1.49422	1.50601	16.10	32.58
IX.	1.49069	1.49519	1.50694	16.25	32.81
BENZENE.	1.49140	1.49591	1.50764	16.24	32.75

TOLUENE AND BENZENE. TABLE XL

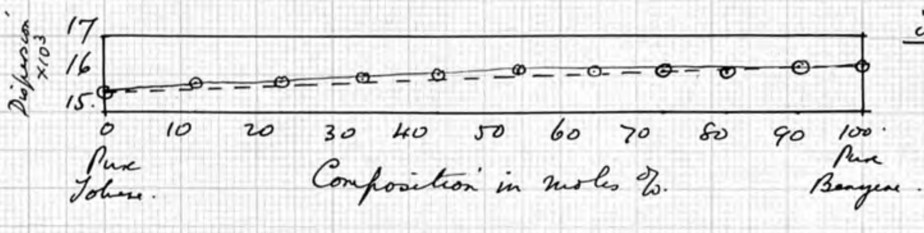
MOLECULAR DISPERSION.

SUBSTANCE.	DISPERSION.	SPECIFIC GRAVITY.	MEAN MOLECULAR WEIGHT.	MOLECULAR DISPERSION. x10
TOLUENE.	15.57	0.857	92.0	16.72
I.	15.82	0.856	90.3	16.69
II.	15.81	0.858	88.8	16.37
III.	15.88	0.859	87.2	16.13
IV.	15.99	0.859	85.8	15.97
V.	16.13	0.861	84.4	15.81
VI.	16.03	0.864	83.0	15.40
VII.	16.08	0.866	81.7	15.18
VIII.	16.10	0.868	80.6	14.96
IX.	16.25	0.868	79.2	14.84
BENZENE.	16.24	0.871	78.0	14.55

BENZENE AND TOLUENE.

Dispersion and Composition.

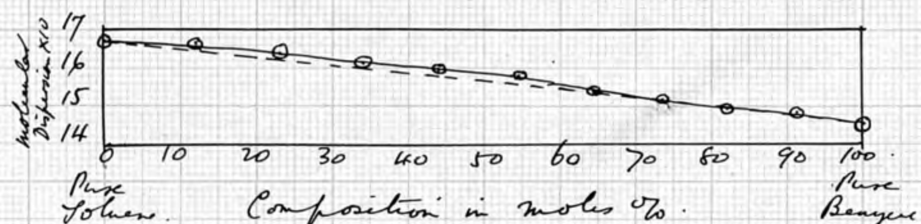
Figure XLIII



Temperature 28°.

Molecular Dispersion and Composition.

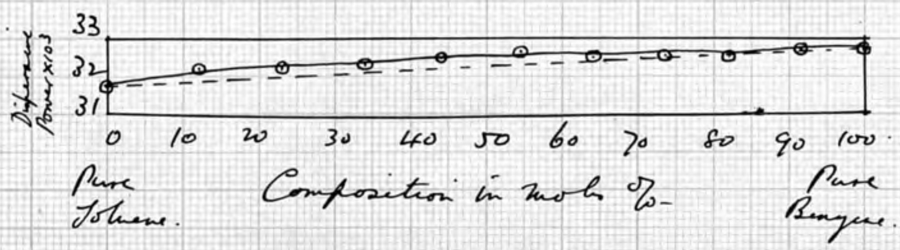
Figure XLIV



Temperature 28°.

Dispersive Power and Composition.

Figure XLV



Temperature 28°.

TOLUENE AND BENZENE. TABLE XLI

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE.	WEIGHT OF SILVER.	INITIAL TEMP. t_1	FINAL TEMP. t_3	t_2-t_3	t_3-t_1	SPECIFIC HEAT. in cals/gm.	MEAN SPECIFIC HEAT. in cals/gm.
TOLUENE.	38.72	17.70	22.60	26.92	84.08	4.32	0.384	
	38.13	17.70	23.71	28.07	82.93	4.36	0.378	0.383
	36.54	17.70	24.21	28.60	82.40	4.39	0.388	
A.	30.36	17.19	16.90	20.30	59.70	3.40	0.410	
	29.86	17.19	18.12	21.47	58.53	3.35	0.415	0.413
B.	30.74	17.19	17.58	20.90	59.10	3.32	0.413	
	30.34	17.19	18.41	21.72	58.28	3.31	0.412	0.413
C.	30.97	17.19	17.50	20.70	59.30	3.20	0.433	
	30.49	17.19	17.40	20.85	59.15	3.45	0.396	0.415
D.	30.63	17.19	18.40	21.62	58.38	3.22	0.425	
	30.16	17.19	19.83	23.00	57.00	3.17	0.427	0.426
E.	30.69	17.19	19.00	22.06	57.94	3.06	0.449	0.449
BENZENE.	31.24	17.19	16.80	19.85	60.15	3.05	0.466	
	30.70	17.19	17.70	20.67	59.33	2.97	0.482	0.474

Water Equivalent of Calorimeter, Thermometer, and stirrer.----4.44 gms.

SpecificHeat of Silver,--0.056 cals/gm.

Initial Temperature of Silver.------------------------------~~111~~°C. 80°C

BENZENE AND TOLUENE. TABLE XLII

COMPOSITION OF MIXTURES FOR HEAT PROPERTIES.

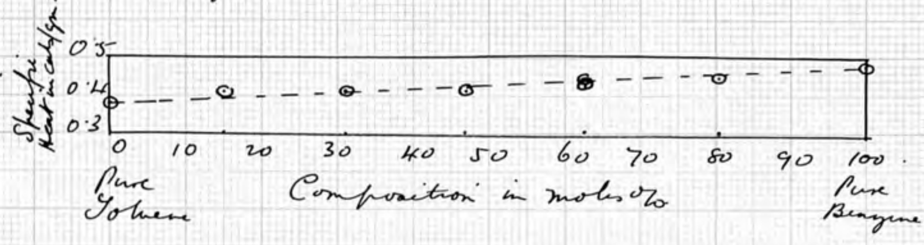
SUBSTANCE.	WEIGHT OF TOLUENE. (in gms.)	WEIGHT OF BENZENE. (in gms)	COMPOSITION OF MIXTURES IN MOLES %. Toluene.	Benzene.
A.	25.25	5.24	85.0	15.0
B.	20.25	10.59	69.3	30.7
C.	15.17	15.93	52.9	47.1
D.	10.41	20.41	37.6	62.4
E.	5.27	25.57	19.6	80.4

HEAT OF MIXING. XLIII

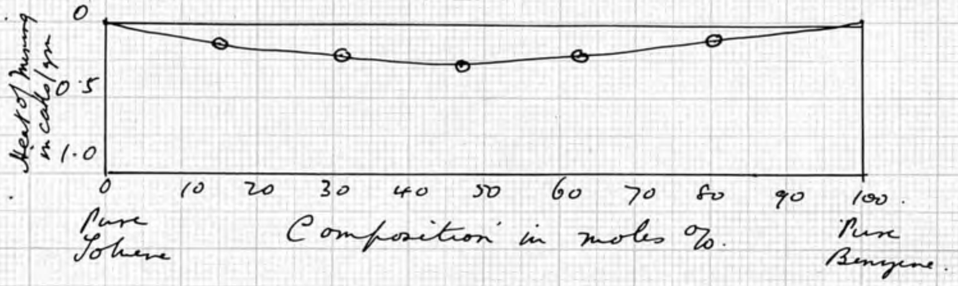
SUBSTANCE.	INITIAL TEMP. $t^oC.$	FINAL TEMP. $t_m^oC.$	t_m-t	WEIGHT OF MIXTURE. (in gms)	SPECIFIC HEAT OF SUBSTANCE. (cals/gm.)	HEAT OF MIXING. (cals/gm)
A.	16.97	16.71	0.26	30.49	0.413	0.145
B.	17.89	17.48	0.41	30.84	0.413	0.228
C.	18.20	17.70	~~05.0~~ 0.50	31.10	0.415	0.279
D.	18.70	18.30	0.40	30.82	0.426	0.228
E.	19.10	18.90	0.20	30.74	0.449	0.119

Benzene and Toluene

Specific Heat and Composition. Figure XLVI



Heat of Mixing and Composition Figure XLVII



BENZENE AND TOLUENE. TABLE XLIV.

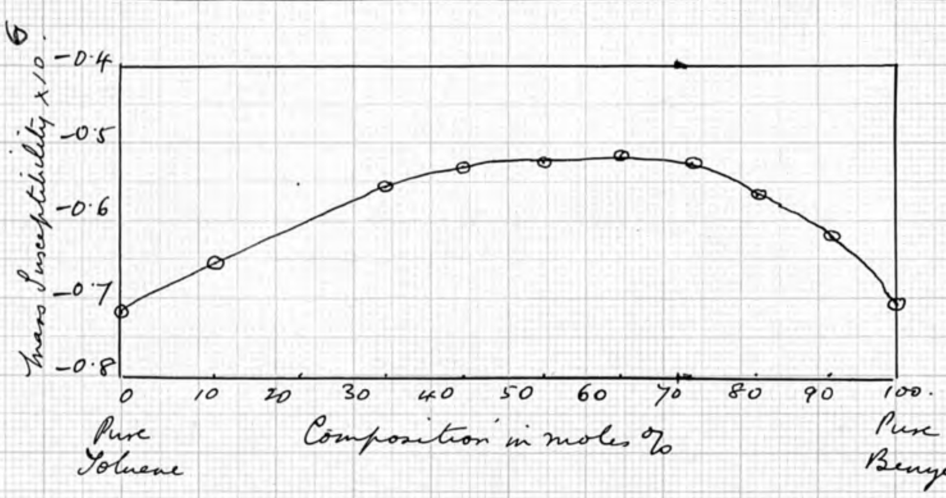
MAGNETIC SUSCEPTIBILITY. TEMPERATURE 15^{o}-21^{o}C.

SUBSTANCE.	DEFLECTION FOR WATER.	WEIGHT OF WATER.	DEFLECTION FOR SUBSTANCE.	WEIGHT OF SUBSTANCE	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY. x10^{+6}.
TOLUENE.	0.411	0.611	0.331	0.539	0.857	-0.718
I.	..	..	0.295	0.530	0.856	-0.655
II.	..	..	0.253	0.545	0.858	-0.551
III.	..	..	0.249	0.534	0.859	-0.554
IV.	..	..	0.239	0.539	0.859	-0.528
V.	..	..	0.232	0.526	0.861	-0.526
VI.	..	..	0.232	0.540	0.864	-0.513
VII.	..	..	0.236	0.537	0.866	-0.524
VIII.	..	..	0.258	0.537	0.868	-0.569
IX.	..	..	0.283	0.537	0.868	-0.621
BENZENE.	..	..	0.336	0.556	0.871	-0.707

Toluene and Benzene.

Mass Susceptibility and Composition.

Figure XLVIII



BENZENE AND META-CRESOL.

META-CRESOL AND BENZENE. TABLE XLV

COMPOSITION OF THE MIXTURES.

SUBSTANCE.	WEIGHT OF m-CRESOL. (in gms)	WEIGHT OF BENZENE. (in gms)	COMPOSITION IN MOLES %. m-CRESOL.	BENZENE.
I.	19.48	1.91	88.0	12.0
II.	16.38	3.50	76.8	23.2
III.	14.48	5.36	66.1	33.9
IV.	12.35	7.00	56.0	44.0
V.	10.18	8.94	45.1	54.9
VI.	8.05	10.51	35.6	64.4
VII.	6.18	12.50	26.3	73.7
VIII.	4.14	13.99	17.6	82.4
IX.	2.14	15.95	8.8	91.2

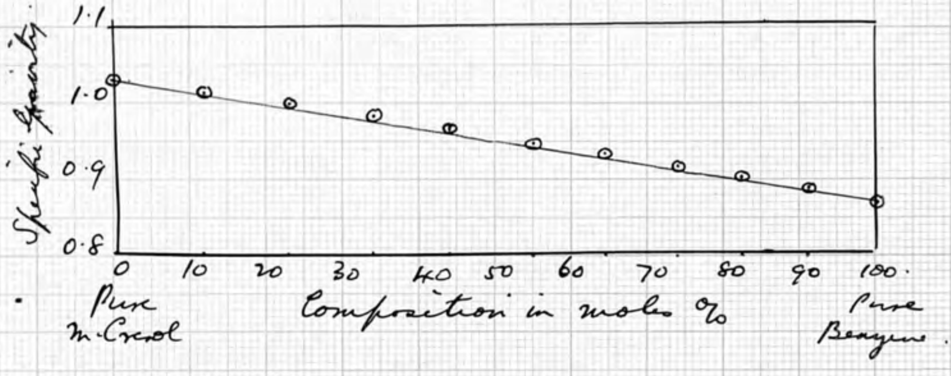
META CRESOL-AND BENZENE. TABLE XLVI

SPECIFIC GRAVITIES AT 28°.

SUBSTANCE.	WEIGHT OF SUBSTANCE FILLING PYKNOMETER AT 28°.	WEIGHT OF [redacted] FILLING PYKNOMETER AT 28°.	SPECIFIC GRAVITY AT 28° D_4^{28}.
m-CRESOL.	2.059	1.993	1.029
I.	2.029 [redacted]	..	1.014
II.	1.996	..	0.998
III.	1.962	..	0.981
IV.	1.935	..	0.967
V.	1.900	..	0.950
VI.	1.871	..	0.935
VII.	1.836	..	0.918
VIII.	1.806	..	0.903
IX.	1.776	..	0.888
BENZENE.	1.740	1.992	0.871

Benzene and m-Cresol.

Specific Gravity and Composition   Figure XLIX.



META CRESOL AND BENZENE. TABLE. XLVIII

REFRACTIVE INDEX AT28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION.			REFRACTIVE INDEX.		
	C.	D.	F.	C.	D.	F.
m-CRESOL.	30°21.7'	30°18.4'	30°17.7'	1.53275	1.53812	1.55097
I.	31° 0.8'	30°57.2'	30°56.2'	1.52949	1.53491	1.54781
II.	31°37.7'	31°37.7'	31°37.7'	1.52638	1.53150	1.54435
III.	32°35.8'	32°38.4'	32°40.4'	1.52138	1.52629	1.53901
IV.	33° 9.0'	33°14.0'	33°17.7'	1.51849	1.52319	1.53579
V.	34° 0.7'	34° 5.0'	34° 9.7'	1.51392	1.51869	1.53124
VI.	34°53.6'	34°55.3'	35° 2.7'	1.50918	1.51419	1.52652
VII.	35°45.2'	35°48.7'	35°57.4'	1.50447	1.50934	1.52159
VIII.	36°30.5'	36°33.1'	36°44.0'	1.50028	1.50525	1.51733
IX.	37°22.2'	37°24.9'	37°41.4'	1.49547	1.50044	1.51202
BENZENE.	38° 5.3'	38°13.0'	38°28.2'	1.49140	1.49591	1.50764

m-CRESOL AND BENZENE. TABLE XLIX

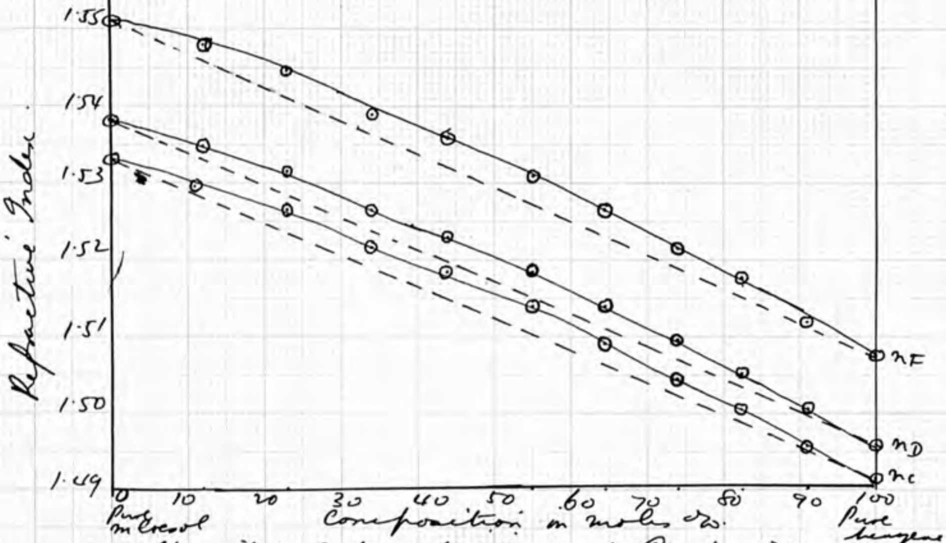
SPECIFIC AND MOLECULAR REFRACTIVITY AT 28°C.

SUBSTANCE.	SPECIFIC GRAVITY.	SPECIFIC REFRACTIVITY. C.	D.	F.	MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY. C.	D.	F.
m-CRESOL.	1.029	30.16	30.41	31.01	~~10.80~~ 108.0	32.57	32.84	33.49
I.	1.014	30.44	30.70	31.31	104.4	31.78	32.05	32.69
II.	0.998	30.78	31.03	31.66	101.0	31.09	31.34	31.98
III.	0.981	31.08	31.32	31.95	97.8	30.39	30.63	31.24
IV.	0.967	31.35	31.59	32.22	~~95.6~~ 94.8	~~29.97~~ 29.73	~~30.21~~ 29.95	~~30.81~~ 30.55
V.	0.950	31.70	31.95	32.59	91.5	29.00	29.22	29.82
VI.	0.935	31.95	32.21	32.86	88.7	28.33	28.57	29.14
VII.	0.918	32.29	32.56	33.21	85.9	27.74	27.97	28.53
VIII.	0.903	32.60	32.88	33.54	83.3	27.15	27.38	27.94
IX.	0.888	32.88	33.15	33.80	80.7	26.54	26.75	27.28
BENZENE.	0.871	33.29	33.55	34.22	78.0	25.96	26.16	26.69

m. CRESOL AND BENZENE.

Refractive Index and Composition

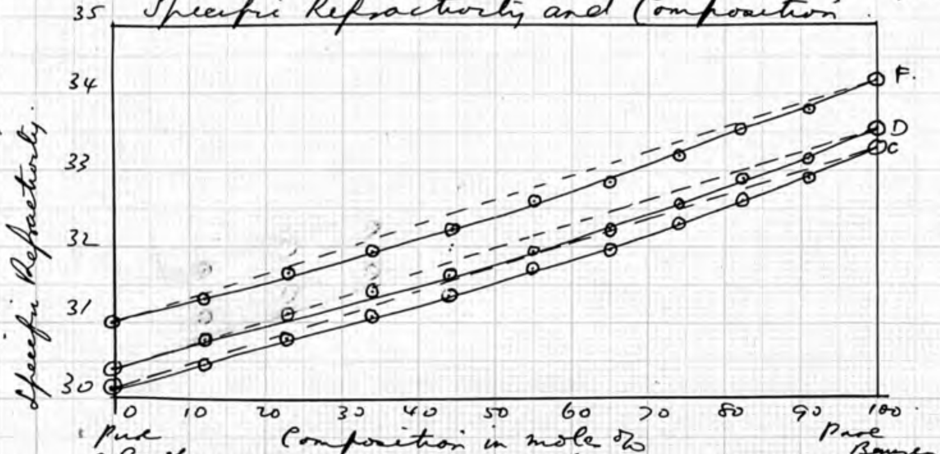
Figure LI



Temperature 28°.

Specific Refractivity and Composition

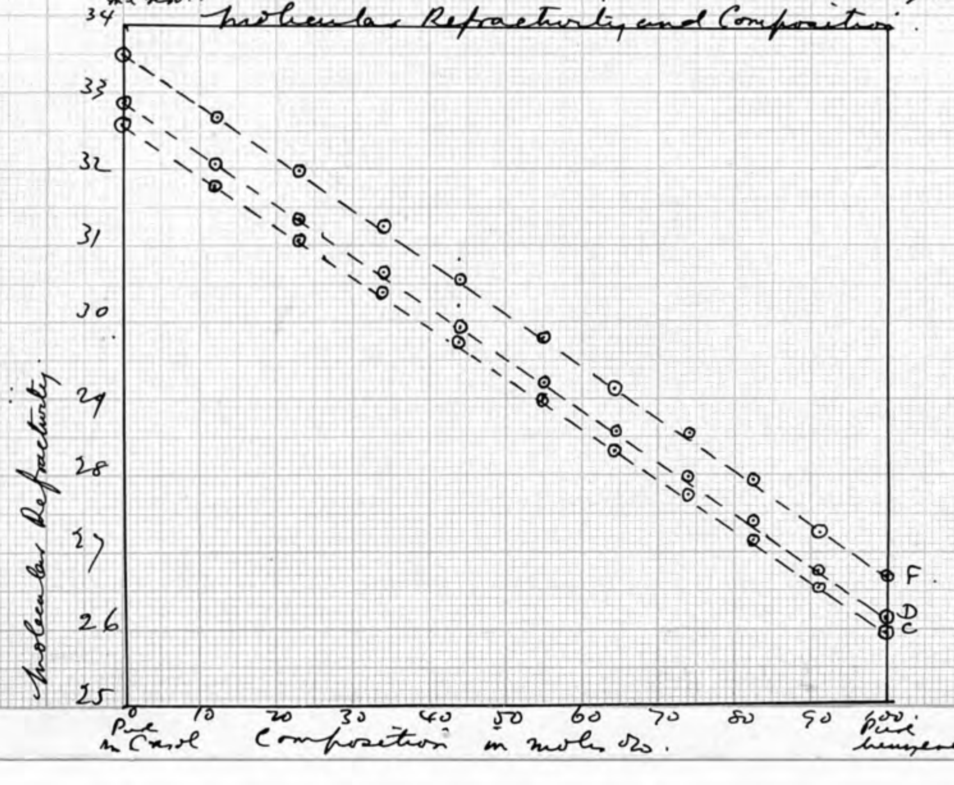
Figure LII



Temperature 28°.

Molecular Refractivity and Composition

Figure LIII



Temperature 28°.

META CRESOL AND BENZENE. TABLE L.

DISPERSION AND DISPERSIVE POWER.

SUBSTANCE.	REFRACTIVE INDEX.			DISPERSION.	DISPERSIVE POWER.
	C.	D.	F.	$\times 10^3$	$\times 10^3$.
m-CRESOL.	1.53275	1.53812	1.55097	18.22	33.86
I.	1.52949	1.53491	1.54781	18.32	34.26
II.	1.52638	1.53150	1.54435	17.97	33.82
III.	1.52138	1.52629	1.53901	17.63	33.50
IV.	1.51849	1.52319	1.53579	17.30	33.06
V.	1.51392	1.51869	1.53124	17.32	33.39
VI.	1.50918	1.51419	1.52652	17.34	33.71
VII.	1.50447	1.50934	1.52159	17.12	33.61
VIII.	1.50028	1.50525	1.51733	17.05	33.73
IX.	1.49547	1.50044	1.51202	16.55	33.08
BENZENE.	1.49140	1.49591	1.50764	16.24	32.75

META CRESOL AND BENZENE TABLE L1

MOLECULAR DISPERSION.

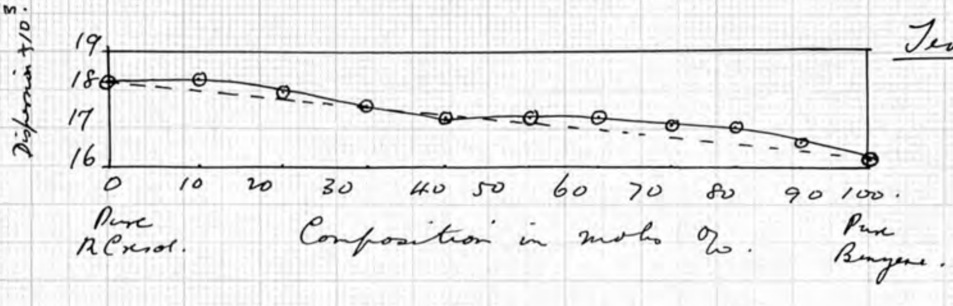
SUBSTANCE.	DISPERSION	SPECIFIC GRAVITY.	MEAN MOLECULAR WEIGHT.	MOLECULAR DISPERSION. x10
m-CRESOL.	18.22	1.029	108.0	19.13
I.	18.32	1.014	104.4	18.87
II.	17.97	0.998	101.0	18.20
III.	17.63	0.981	97.8	17.58
IV.	17.30	0.967	~~95.6~~ 94.8	~~17.10~~ 16.95
V.	17.32	0.950	91.5	16.68
VI.	17.34	0.935	88.7	16.44
VII.	17.12	0.918	85.9	16.03
VIII.	17.05	0.903	83.3	15.73
IX.	16.55	0.888	80.7	15.04
BENZENE.	16.24	0.871	78.0	14.55

m-Cresol and Benzene

Dispersion and Composition.

Figure LIV

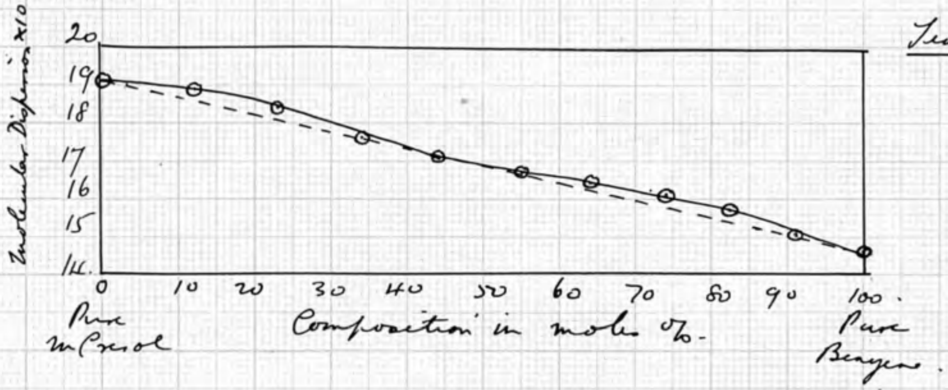
Temperature 28°.



Molecular Dispersion and Composition

Figure LV

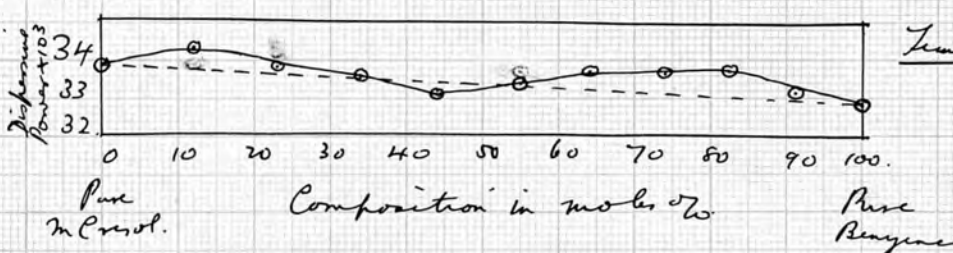
Temperature 28°.



Dispersive Power and Composition.

Figure LVI

Temperature 28°.



META-CRESOL AND BENZENE.   TABLE LII.

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE. (in gms)	WEIGHT OF SILVER. (in gms)	INITIAL TEMP. t_1°C.	FINAL TEMP. t_2°C.	t_2-t_3.	t_3-t_1.	SPECIFIC HEAT. in cals/gm.	MEAN SPECIFIC HEAT in cals/gm.
m-Cresol.	34.42	17.70	20.80	24.75	86.25	3.95	0.500	
	33.72	17.70	22.75	26.51	84.49	3.76	0.529	0.515
A.	35.83	17.19	14.35	18.57	92.43	4.22	0.464	0.464
B.	34.58	17.19	13.82	18.14	92.86	4.32	0.470	
	34.11	17.19	16.62	20.62	90.38	4.00	0.507	0.487
	33.40	15.11	17.38	21.10	89.90	3.72	0.480	
C.	33.72	17.19	14.95	19.36	91.64	4.41	0.461	
	33.18	17.19	17.38	21.50	89.50	4.12	0.496	0.479
D.	34.58	17.19	13.42	17.96	93.04	4.54	0.442	
	34.13	17.19	16.52	20.82	90.18	4.30	0.461	0.452
E.	32.61	17.19	15.02	19.70	91.30	4.68	0.440	
	32.08	17.19	17.39	21.80	89.20	4.41	0.469	0.455
Benzene.	31.24	17.19	16.80	19.85	60.15	3.05	0.466	
	30.70	17.19	17.70	20.67	59.33	2.97	0.482	0.474

Temperature of Silver.......111°C(for all mixtures and for m-cresol)
80°C(for benzene)

Water equivalent of calorimeter and thermometer.........4.44 gms.

Specific Heat of Silver..................................0.056 cals/gm.

META CRESOL AND BENZENE. TABLE LIII.

COMPOSITION OF MIXTURES FOR HEAT PROPERTIES.

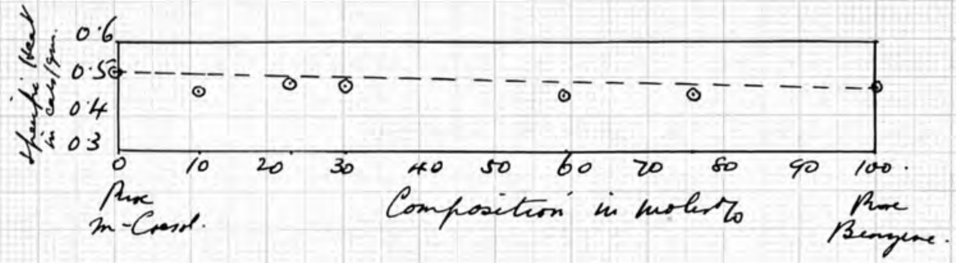
SUBSTANCE.	WEIGHT OF m-CRESOL. (in gms.)	WEIGHT OF BENZENE. (in gms)	COMPOSITION OF MIXTURES IN MOLES %. CRESOL.	BENZENE.
A.	30.68	5.31	88.9	11.1
B.	24.42	10.29	76.7	23.3
C.	21.13	12.68	69.8	30.2
D.	11.34	23.17	40.4	59.6
E.	6.15	26.59	24.3	75.7

HEAT OF MIXING. LIV

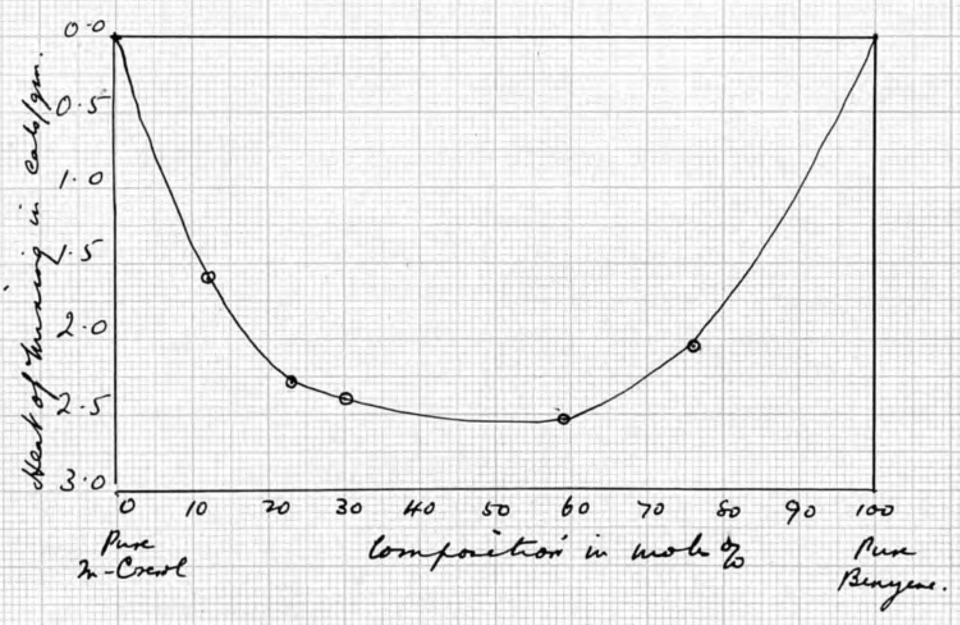
SUBSTANCE.	INITIAL TEMP. t^o.	FINAL TEMP. t_m^oC.	$t_m - t$	WEIGHT OF MIXTURE. (in gms)	SPECIFIC HEAT OF MIXTURE. (cals/gm.)	HEAT OF MIXING. (cals/gm.)
A.	14.85	12.13	2.72	35.99	0.464	1.60
B.	16.00	12.30	3.70	34.71	0.487	2.28
C.	17.23	13.31	3.92	33.81	0.479	2.39
D.	15.85	11.50	4.35	34.51	0.452	2.53
E.	16.60	13.13	3.47	32.74	0.455	2.05

m- Cresol and Benzene.

Specific Heat and Composition. Figure LVII.



Heat of Mixing and Composition. Figure LVIII.



BENZENE AND META CRESOL. TABLE LV.

MAGNETIC SUSCEPTIBILITY. TEMPERATURE $15^{\circ} - 20^{\circ}C$.

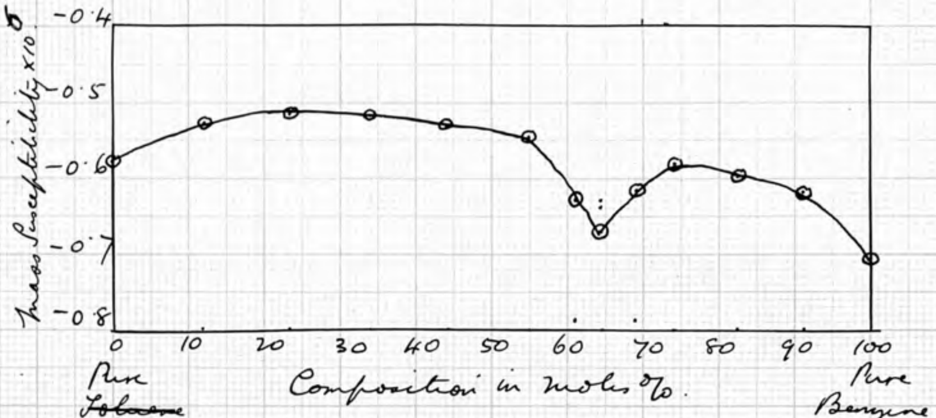
SUBSTANCE.	DEFLECTION FOR WATER.	WEIGHT OF WATER.	DEFLECTION FOR SUBSTANCE.	WEIGHT OF SUBSTANCE.	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY. $\times10^{+6}$
m-CRESOL.	0.411	0.611	0.327	0.663	1.029	-0.578
I.	0.4768	0.577	0.371	0.677	1.014	-0.527
II.	..	..	0.348	0.651	0.998	-0.515
III.	..	..	0.334	0.623	0.981	-0.517
IV.	..	..	0.342	0.622	0.967	-0.530
V.	..	..	0.353	0.622	0.950	-0.547
VA.	..	..	0.394	0.597	0.940	-0.631
VI.	..	..	0.425	0.604	0.935	-0.671
VIA.	..	..	0.378	0.586	0.925	-0.618
VII.	..	..	0.363	0.602	0.918	-0.580
VIII.	..	..	0.360	0.580	0.903	-0.597
IX.	..	..	0.405	0.630	0.888	-0.617
BENZENE.	0.411	0.611	0.336	0.556	0.871	-0.707

COMPOSITION OF MIXTURES VA AND VIA.

SUBSTANCE.	WEIGHT OF BENZENE.	WEIGHT OF m-CRESOL.	COMPOSITION IN MOLES %. BENZENE.	m-CRESOL.
VA.	4.42gm.	3.93gm.	60.9	39.1
VIA.	4.43..	2.80..	68.7	31.3

BENZENE AND m-CRESOL.

Mass Susceptibility and Composition — Figure LIX



NITROBENZENE AND META-CRESOL.

NITROBENZENE AND META-CRESOL. TABLE LVI.

COMPOSITION OF THE MIXTURES.

SUBSTANCE.	WEIGHT OF NITROBENZENE. (in grams)	WEIGHT OF m-CRESOL. (in grams)	COMPOSITION IN MOLES %. NITROBENZENE.	m-CRESOL.
I.	2.37	18.44	10.1	89.9
II.	4.99	16.32	21.2	78.8
III.	7.09	13.95	30.8	69.2
IV.	9.67	12.25	40.9	59.1
V.	10.87	10.14	48.5	51.5
VI.	14.33	8.12	60.8	39.2
VII.	16.72	6.07	70.7	29.3
VIII.	19.38	4.08	80.7	19.3
IX.	21.50	2.11	89.9	10.1

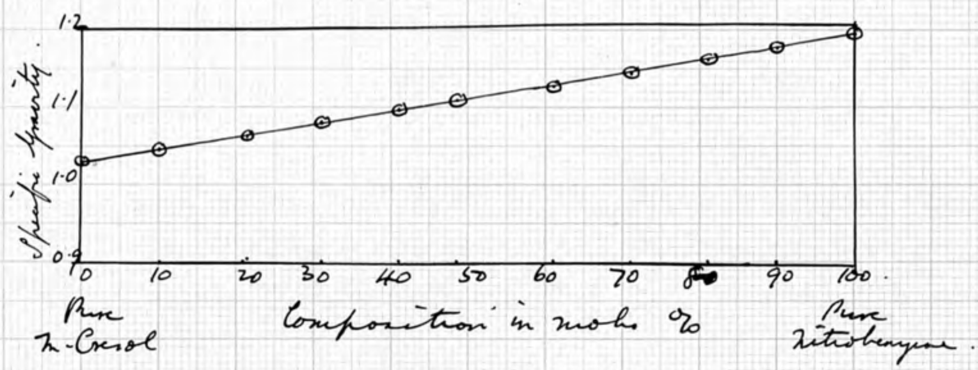
META-CRESOL AND NITROBENZENE. TABLE LVII

SPECIFIC GRAVITIES AT 28°C.

SUBSTANCE.	WEIGHT OF SUBSTANCE FILLING PYKNOMETER AT 28°. (in grams)	WEIGHT OF WATER FILLING PYKNOMETER AT 28°. (in grams)	SPECIFIC GRAVITY D_4^{28}.
m-CRESOL.	2.059	1.993	1.029
I.	2.090	1.992	1.045
II.	2.125	..	1.063
III.	2.161	..	1.081
IV.	2.194	..	1.097
V.	2.215	..	1.108
VI.	2.255	..	1.128
VII.	2.287	..	1.144
VIII.	2.323	..	1.162
IX.	2.353	..	1.177
NITROBENZENE.	2.388	1.993	1.194

Nitrobenzene and m-Cresol.

Specific Gravity and Composition. Figure IX.



META CRESOL AND NITROBENZENE. TABLE LIX

REFRACTIVE INDEX AT 28°C.

SUBSTANCE.	CORRECTED ANGLES OF DEVIATION. C.	D.	F.	REFRACTIVE INDEX. C.	D.	F.
m-CRESOL.	30°21.7'	30°18.4'	30°17.7'	1.53275	1.53812	1.55097
I.	30°14.8'	30°12.6'	29°59.5'	1.53333	1.53860	1.55246
II.	29°58.2'	29°52.0'	29°28.3'	1.53470	1.54029	1.55498
III.	29°43.2'	29°35.2'	29°5.0'	1.53592	1.54166	1.55684
IV.	29°30.7'	29°20.7'	28°42.6'	1.53694	1.54282	1.55860
V.	29°19.0'	29°7.8'	28°25.2'	1.53788	1.54387	1.55996
VI.	29° 6.8'	28°53.2'	28°1.5'	1.53887	1.54503	1.56180
VII.	29° 0.7'	28°46.0'	27°49.5'	1.53936	1.54560	1.56274
VIII	28°47.4'	28°30.3'	27°28.0'	1.54042	1.54685	1.56437
IX.	28° ~~35.5~~ 33.1'	28°16.3'	27° 8.1'	1.54156	1.54794	1.56588
NITROBENZENE.	28°19.9'	27°59.2'	26°49.3'	1.54260	1.54928	1.56729

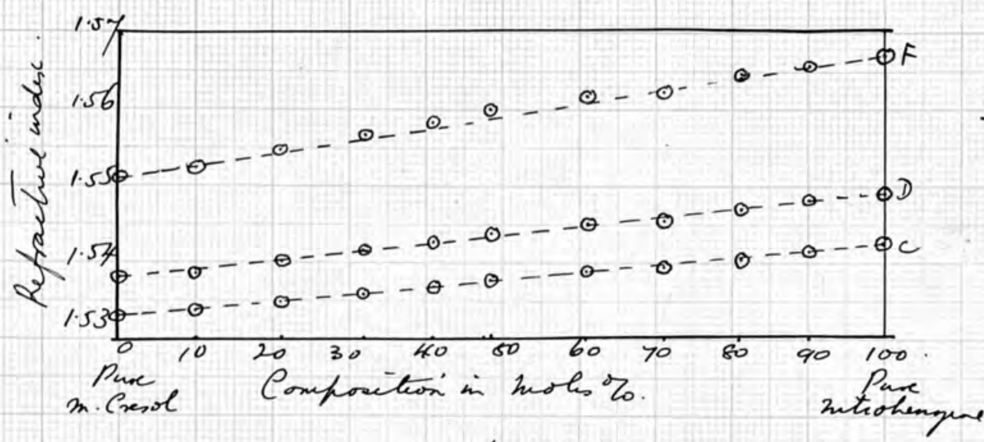
META CRESOL AND NITROBENZENE. TABLE LX.

SPECIFIC AND MOLECULAR REFRACTIVITY AT 28°C.

SUBSTANCE.	SPECIFIC GRAVITY.	SPECIFIC REFRACTIVITY.			MEAN MOLECULAR WEIGHT.	MOLECULAR REFRACTIVITY.		
		C.	D.	F.	C.	C.	D.	F.
m-CRESOL.	~~10.29~~ 1.029	30.16	30.41	31.01	10.80	32.57	32.84	33.49
I.	1.045	29.71	29.95	30.59	109.5	32.54	32.81	33.51
II.	1.063	29.28	29.54	30.21	111.2	32.56	32.85	33.59
III.	1.081	28.84	29.10	29.77	112.6	32.47	32.76	33.52
IV.	1.097	28.45	28.72	29.41	114.2	32.50	32.80	33.59
V.	1.108	28.23	28.49	29.18	115.3	32.55	32.85	33.65
VI.	1.128	27 76	28.03	28.74	117.1	32.52	32.83	33.66
VII.	1.144	27 40	27.67	28.38	118.6	32.51	32.82	33.67
VIII.	1.162	27 02	27.29	28.01	120.1	32.45	32.76	33.63
IX.	1.177	26 68	26.99	27.71	121.5	32.41	32.78	33.66
NITRO-BENZENE.	1.194	26 38	26.61	27.37	123.0	32.45	32.73	33.67

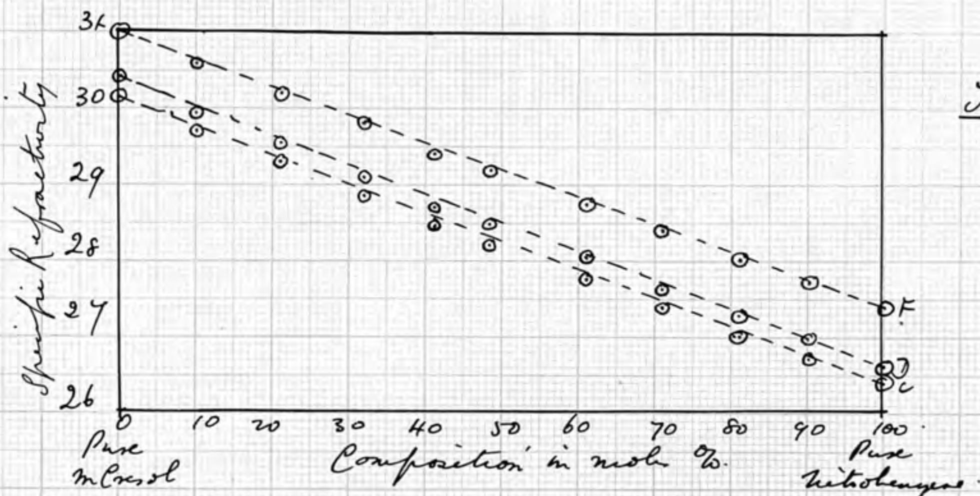
m. CRESOL AND NITROBENZENE

Refractive Index and Composition. Figure LXII



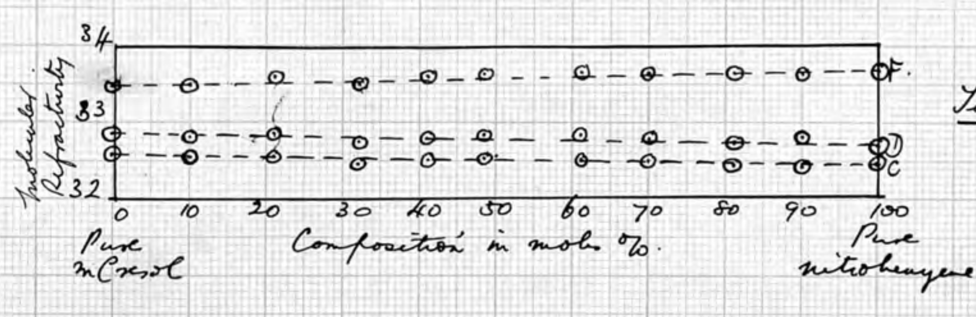
Temperature 28°

Specific Refractivity and Composition. Figure LXIII



Temperature 28°.

Molecular Refractivity and Composition. Figure LXIV



Temperature. 28°.

META CRESOL AND NITROBENZENE. TABLE LXI.

DISPERSION AND DISPERSIVE POWER.

SUBSTANCE.	REFRACTIVE INDEX. C.	D.	F.	DISPERSION $\times 10^3$	DISPERSIVE POWER. $\times 10^3$
m-CRESOL.	1.53275	1.53812	1.55097	18.22	33.86
I.	1.53333	1.53860	1.55246	19.13	35.51
II.	1.53470	1554029	1.55498	20.28	37.54
III.	1.53592	1.54166	1.55684	20.92	38.61
IV.	1.53694	1.54282	1.55860	21.66	39.91
V.	1.53788	1.54387	1.55996	22.08	40.59
VI.	1.53887	1.54503	1.56180	22.93	42.07
VII.	1.53936	1.54560	1.56274	23.38	42.85
VIII.	1.54042	1.54685	1.56437	23.95	43.79
IX.	1.54156	1.54794	1.56588	~~25.32~~ 24.32	44.39
NITRO-BENZENE.	1.54260	1.54928	1.56729	24.69	44.94

META CRESOL AND NITROBENZENE. TABLE LXII.

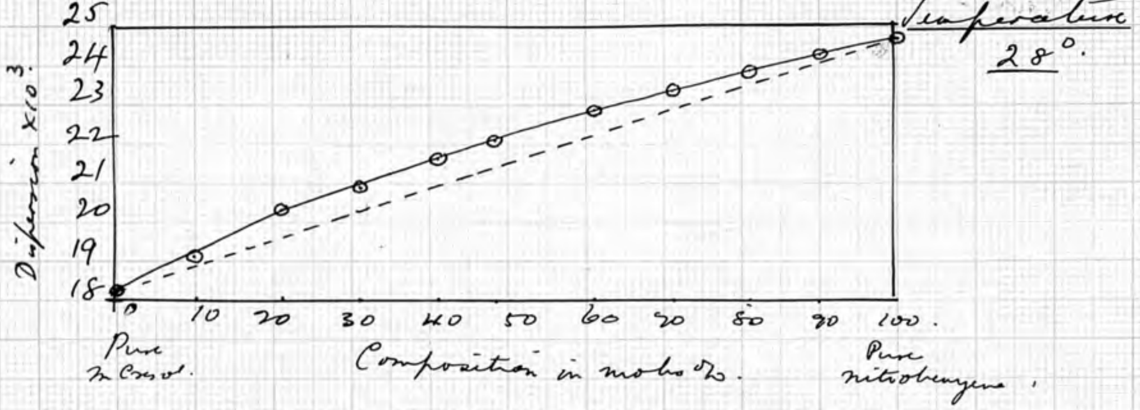
MOLECULAR DISPERSION.

SUBSTANCE.	DISPERSION.	SPECIFIC GRAVITY.	MEAN MOLECULAR WEIGHT.	MOLECULAR DISPERSION. X10
m-CRESOL.	18.22	1.029	108.0	19.13
I.	19.13	1.045	109.5	20.04
II.	20.28	1.063	111.2	21.22
III.	20.92	1.081	112.6	21.79
IV.	21.66	1.097	114.2	22.55
V.	22.08	1.108	115.3	22.97
VI.	22.93	1.128	117.1	23.81
VII.	23.38	1.144	118.6	24.25
VIII.	23.95	1.162	120.1	24.75
IX.	24.32	1.177	121.5	25.10
NITRO-BENZENE.	24.69	1.194	123.0	25.39

m Cresol and Nitrobenzene

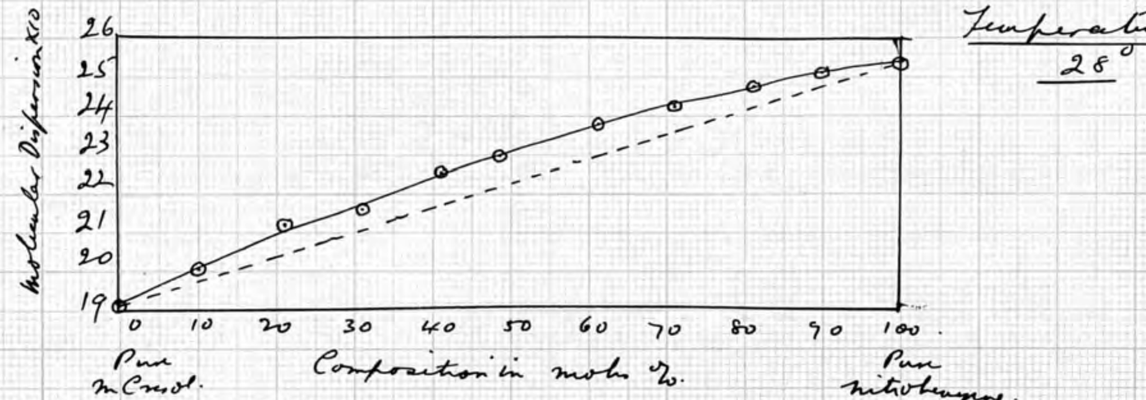
Dispersion and Composition.

Figure LXV



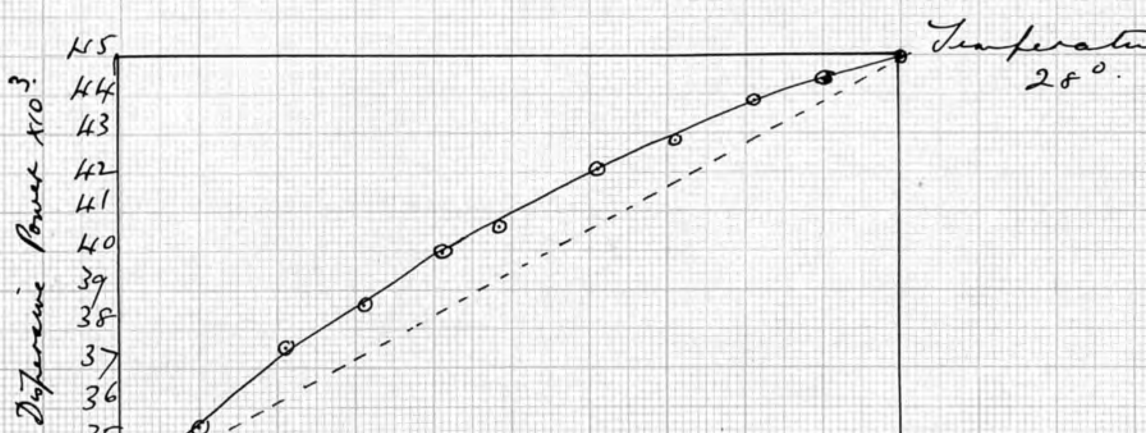
Molecular Dispersion and Composition.

Figure LXVI



Dispersive Power and Composition.

Figure LXVII



NITROBENZENE AND META CRESOL. TABLE LXIII.

SPECIFIC HEAT.

SUBSTANCE.	WEIGHT OF MIXTURE. (in gms)	WEIGHT OF SILVER. (in gms)	INITIAL TEMP. t_1^oC	FINAL TEMP. t_3^oC	t_2-t_3.	t_3-t_1.	SPECIFIC HEAT. (cals/gm)	MEAN SPECIFIC HEAT. (cals/gm)
m-Cresol.	34.42	17.70	20.80	24.75	86.25	3.95	0.500	
	33.72	17.70	22.75	26.51	84.49	3.76	0.529	0.515
A.	37.23	17.20	19.90	22.44	57.56	2.54	0.467	
	36.70	17.20	21.62	23.94	56.06	2.32	0.513	0.490
B.	38.13	17.20	17.80	20.52	59.48	2.72	0.436	
	37.54	17.20	18.97	21.55	58.45	2.58	0.462	0.449
C.	39.29	17.20	18.42	21.16	58.84	2.74	0.413	
	38.91	17.20	20.19	22.85	57.15	2.66	0.418	0.416
D.	39.19	17.20	16.82	19.82	60.18	3.00	0.380	
	38.84	17.20	19.10	21.85	58.15	2.75	0.410	0.395
E.	41.12	17.20	18.47	21.34	58.66	2.87	0.371	
	40.57	17.20	20.52	23.22	56.78	2.70	0.390	0.381
Nitro-	42.91	17.20	22.07	26.25	85.25	4.18	0.354	
benzene.	42.31	17.20	23.52	27.55	83.95	4.03	0.369	0.355
	41.63	17.20	23.85	28.15	83.35	4.30	0.342	

Water equivalent of calorimeter and thermometer..4.44 gms.

Temperature of Silver.....................80^oC.(for mixtures)
111^oC.(for m-cresol)
111.5^oC.(for nitrobenzene)

SPECIFIC HEAT OF SILVER....................0.056 cals/gm.

META CRESOL AND NITROBENZENE. TABLE LXIV

COMPOSITION OF MIXTURES FOR HEAT PROPERTIES.

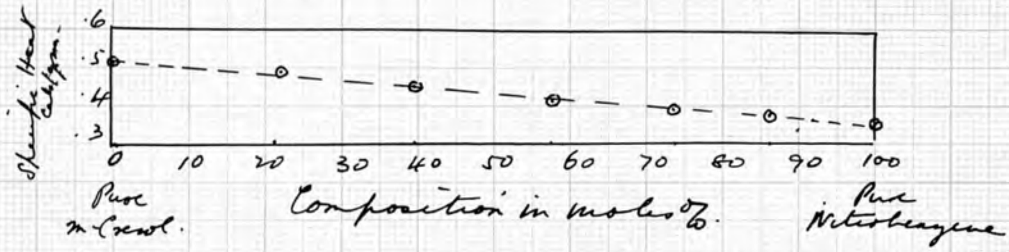
SUBSTANCE.	WEIGHT OF m-CRESOL. (in gms)	WEIGHT OF NITROBENZENE. (in gms.)	COMPOSITION OF MIXTURES IN MOLES %. m-CRESOL.	NITROBENZENE.
A.	30.18	7.04	79.0	21.0
B.	24.20	13.95	60.4	39.6
C.	17.95	21.37	42.5	57.5
D.	11.31	27.90	26.3	73.7
E.	6.34	34.81	13.8	86.2

HEAT OF MIXING. LXV

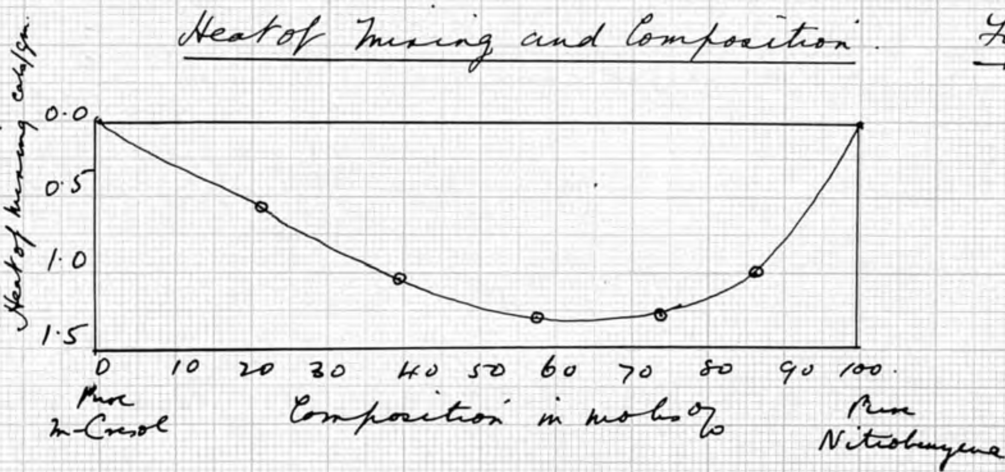
SUBSTANCE.	INITIAL TEMP. t°C.	FINAL TEMP. t_m°C.	$t_m - t$	WEIGHT OF MIXTURE. (in gms)	SPECIFIC HEAT OF MIXTURE. (cals/gm)	HEAT OF MIXING. (cals/gm.)
A.	19.50	18.61	0.89	37.22	~~0.580~~ 0.490	~~0.551~~ 0.569
B.	18.90	17.08	1.82	38.15	0.449	1.03
C.	19.60	17.15	2.45	39.32	0.416	1.30
D.	17.82	15.33	2.49	39.21	0.395	~~12.7~~ 1.27
E.	19.70	17.66	2.04	41.15	0.381	1.00

m-Cresol and Nitrobenzene

Specific Heat and Composition. Figure LXVIII.



Heat of Mixing and Composition. Figure LXIX.



META CRESOL AND NITROBENZENE. TABLE LXVI.

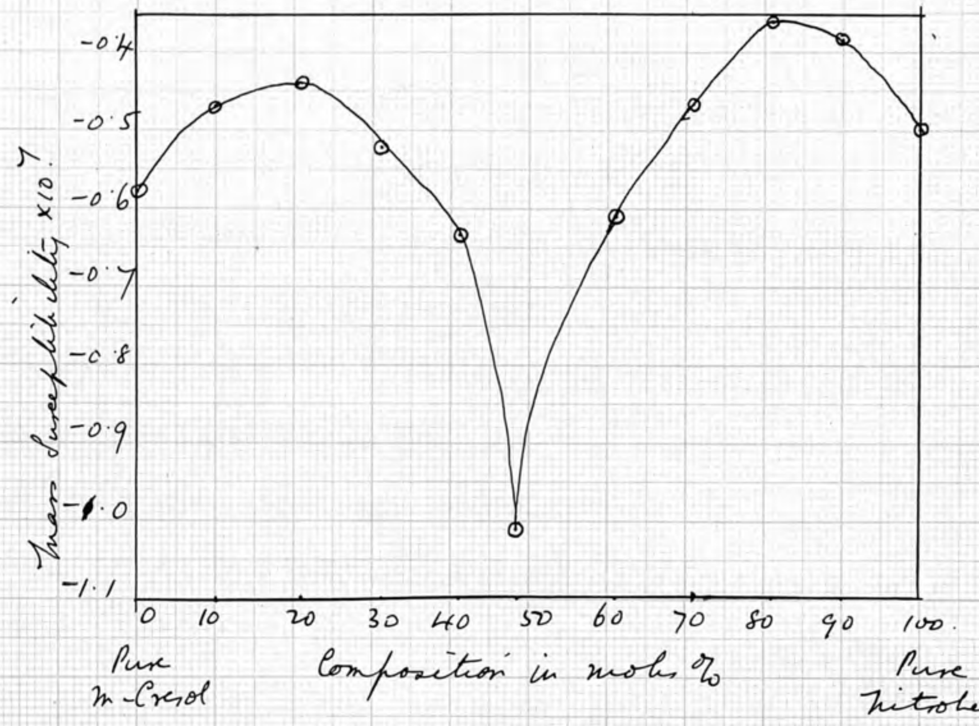
MAGNETIC SUSCEPTIBILITY. TEMPERATURE 15° - 21°.

SUBSTANCE.	DEFLECTION FOR WATER.	WEIGHT OF WATER.	DEFLECTION FOR SUBSTANCE.	WEIGHT OF SUBSTANCE.	SPECIFIC GRAVITY.	MASS SUSCEPTIBILITY. $\times 10^{+7}$
m-CRESOL	0.411	0.611	0.327	0.663	1.029	-0.578
I.	0.476	0.577	0.328	0.676	1.045	-0.469
II.	..	..	0.311	0.686	1.063	-0.440
III.	..	..	0.375	0.692	1.081	-0.520
IV.	..	..	0.470	0.704	1.097	-0.633
V.	..	..	0.748	0.692	1.108	-1.01
VI.	..	..	0.465	0.723	1.128	-0.611
VII.	..	..	0.350	0.725	1.144	-0.464
VIII.	..	..	0.275	0.744	1.162	-0.361
IX.	..	..	0.299	0.752	1.177	-0.386
NITRO-BENZENE.	0.411	0.611	0.311	0.733	1.194	-0.497

m-Cresol and Nitrobenzene

Mass Susceptibility and Composition

Figure LXX



DISCUSSION OF RESULTS.

For all the physical properties investigated, the property-composition curves should be straight lines if the mixtures are ideal, i.e. if there is no change of molecular complexity or compound formation on mixing. It is thus concluded from the preceding curves that not one of the six mixtures examined is ideal. A slight deviation below the idealmixture line (that joining the values of the physical property for the two pure constituents of a mixture) would indicate that to a certain extent, dissociation of some of the molecules had taken place on mixing. A slight deviation above the straight line would indicate association. A more marked deviation, may indicate the formation of a compound or definite molecular complex.

I. Consideration of the Property-Composition Curves for each of the Mixtures.

(1) Toluene and m-Cresol.

The curves for specific gravity, and molecular refractivity, (figures IX, XIII) are all straight lines. Those for refractive index, specific refractivity, and specific heat (figures XI, XII, XVII) deviate only slightly. The three dispersion curves (figures XIV, XV, XVI) and the magnetic susceptibility curve (figure XIX) shew ,however, an interesting abnormality between 40% & 50% m-cresol in the mixture; the dispersions a sharp minimum, the susceptibility a sharp maximum. The heat of mixing curve also shews a minimum at this composition. This evidence is not sufficient to indicate formation of a compound, and it is difficult to picture what compound could be formed of t toluene and m-cresol. On the other hand the evidence is in favour of some change taking place which is more definite than a simple association, which would manifest itself at all compositions causing regularly deviating curves.

(2) Aniline and m-Cresol.

In these mixtures, it is only the specific gravity (figure XX) which is a straight line. All the optical properties and the specific heat (figures XXIII to XXVIII) shew deviation below the ideal mixture line. The heat of mixing (figure XXIX) shews a maximum at about 40% aniline, and the susceptibility curve (figure XXX) shews a maximum at this composition. These agree with the viscosity curves for this mixture by Tsakalatos[25], while the freezing point curves by Kreeman[26] indicates the formation of a compound, one molecule of aniline to one molecule of meta cresol. The displacement of the maximum in the viscosity curve has been accounted for[27] by the ternary nature of the system, consisting of the inactive binary mixture, and the compound, which displaces the maximum toward the component which has the higher viscosity. However, it is difficult to see how this could explain the displacement in the other property-composition curves.

3) Aniline and Nitrobenzene.

For the preparation of these mixtures colourless aniline and very pale yellow nitrobenzene were used. Immediately the components were mixed, a deep orange colour appeared. This in itself was indicative of a change occuring.

The curves for the specific gravity, molecular refractivity, and specific heat (figures XXXI, XXXV, XXXVI) are straight lines. The refractive index and specific refractivity (figures XXXIII to XXXIV) are convex toward the composition axis. The dispersions could not be calculated, as they involve n_F. (The blue F line was absent after passage of hydrogen light through the solutions, as they were orange, and thus absorbed blue light.) The heat of mixing and susceptibility (figures XXXVII & XXXVIIA) shew minima at about 40% which agree with a melting point curve by Kreeman which shews a eutectic at 40%.

4) Benzene and Toluene.

This mixture was investigated because

there appeared to be no likelihood of compound formation, and it was thought that the mixtures might possibly be of the ideal type, except in so far as benzene is known to be an associating solvent. An examination of the curves reveals the fact that the mixtures are certainly not ideal, although the specific gravity, refractive index, specific and molecular refractivity, and specific heat (figures XXXVIII, XXX XL, XLI, XLII, XLVI) all give straight lines, or nearly so. The dispersion curves (figures XLIII, XLIV, XLV) are slightly concave to the composition axis, the heat of mixing shews a minimum at 50%, and the magnetic susceptibility a maximum in this region. This may be explained by the nature of benzene as an associating liquid.

5) Benzene and meta-Cresol.

This series of mixtures was investigated in order to see if the property-composition curves bore any resemblance to thosecfor toluene and m-cresol. The specific gravity curve (figure XLIX) is slightly concave to the composition axis, whereas that for toluene-m-cresol is a straight line. (figure IX) The refractive index, specific and molecular refractivity (figures LI, LII, LIII) deviate always in the same sense as the corresponding ones for toluene and m-cresol, (figures XI, XII, XIII). The dispersion curves (figures LIV, LV, LVI) shew the same remarkable sharp minimum, though the composition at which this occurs has changed from 50% - 60% to 40% - 50% hydrocarbon. The specific heats in both cases are slightly below the ideal mixture line, and the heat of mixing curves resemble one another. The susceptibility curves (figures LIX,XIX) are interesting in the fact that they both shew abnormalities at the same percentage hydrocarbon, but it is a remarkable fact that while in the case of toluene-m-cresol this takes the form of a sharp maximum, in the benzene-cresol curve it is a sharp minimum.

(6) NITROBENZENE AND META CRESOL.

As in the case of nitrobenzene and aniline, a marked colour change took place on mixing the two pure components, colourless m-cresol and very pale yellow nitrobenzene giving a dark greenish yellow solution on mixing.

The specific gravity, refractive index, specific and molecular refractivity, and specific heat (figures LX,LXII,LXIII,LXIV,LXVIII) are all straight lines. The most marked deviations are noted in the dispersion curves (figures LXV,LXVI,LXVII) heat of mixing and magnetic susceptibility (figures LXIX,LXX) but the minimum of the heat of mixing curve does not correspond with a remarkable portion of the susceptibility curve, and the dispersion does not shew a definite maximum at any particular composition.

II. THE VALUE OF THE DIFFERENT PROPERTIES IN DETECTING CHANGES TAKING PLACE ON MIXING TWO LIQUIDS.

Specific Gravity. For the six mixtures investigated, the specific gravity curves are straight lines, except in the case of m-cresol-benzene, where a very slight deviation is noted.

Specific Heat. The specific heat curves shew a deviation only in the case of nitrobenzene-m-cresol, and it is a very slight one.

Thus it appears that the changes taking place on mixing two liquids are of a nature which produce little or no effect on the specific gravity or the specific heat.

Refractive Index. This property, and the derived specific and molecular refractivity, seldom shew much deviation, and are thus of very little use for investigating these mixtures.

Dispersion, Heat of Mixing, Susceptibility. It is these properties, especially magnetic susceptibility, which shew by far the greatest fluctuations, and must therefore be regarded as the most sensitive. These properties are, of all those investigated, the most fundamental, having their origin within the atoms, depending upon their state as regards radiation, thermal, optical or electrical.

Hildebrand[29] suggested that the deviations in the property-composition curves were due to the field surrounding the molecules, and this of course, depends on the radiation states of the molecules, and of the atoms composing them. This certainly shews why all degrees of variation are possible, from nearly "ideal" mixtures, through mixtures exhibiting "association", to those shewing "compound formation." It shews very strikingly that the phenomena of association and compound formation are by no means distinct. The one merges gradually into the other. This is being realised in part in the electronic theory of valency, valency now being now regarded as of different types.

The problem of stating precisely what happens on mixing two organic liquids is at present difficult, and will continue so until the theory of ~~atomic structure~~ valency has so far been advanced as to explain the nature of molecules.

CONCLUSIONS.

1. Not one of the mixtures examined is "ideal"; change, or changes, take place on mixing in every case.

2. Specific gravity, refractive index, specific and molecular refractivity, and specific heat, are properties which are not very sensitive to changes in association, dissociation and also compound formation.

3. Dispersion, molecular dispersion, dispersive power, heat of mixing, and magnetic susceptibility, especially the latter, are very sensitive to these changes; therefore measurement of these properties is to be prefered in investigations of the changes which occur on mixing liquids.

REFERENCES.

(1) Young, Fortey.

Journ.Chem.Soc. 83 58.

(2) Luginin.

Ann.de chim.et de Phys. (7) 13 332.

(3) Regnault.

Jahr.uber die Fort.der Chem. 1863 70.

(4) Neubeck.

Zeit.fur Phys.Chem. 1 656.

(5) Kahlbaum, and Wirkner.

Zeit.fur Phys.Chem. 26 601.

Studien uber Dampfspannkraftmessungen 2 Abt, 1 Halfte. Basel 1897 p.54,64.

(6) Perkin.

Journ.Chem.Soc. 69 1180.

(7) Luginin.

Ann.de Chim.et de Phys.(7) 27 119.

(8) Kahlbaum, and Wirkner.

As for (5) above.

(9) Richards and Matthews.

Zeit.fur Phys.Chem. 61 452.

Journ.Amer.Chem.Soc. 30 10.

(10) Pinette.

Liebig's Annalen der Chem. 243 40.

Zander.

Liebig's Annalen der Chem. 214 138.

(11) & (12)

Lachowicz.

Ber. 21 2210

(13)

Bruhl.

Liebig's Annalen der Chem. 200 189.

(14) Ratz

Zeit.fur Phys.Chem. 19 98.

(15) Bruhl.

Liebig's Annalen der Chem. 200 187.

(16) Friswell.

Journ.Chem.Soc. 71 1011.

(17) Richards and Matthews.

As for (9)

(18) Landolt Bornstein.

Physikalisch-Chemische Tabellen. Vol.2 p 973-982.

(19) do.

do. Vol.2. p 1265.

(20) Spencer & John.

Proc.Roy.Soc.1927A 116 61-72

(21) Ishiwara.
(22) Pascal.
(23) Oxley.
(24) Oxley.

International Critical Tables of Numerical Data. Nat.Research Council of U.S.A. Vol.6. p.362.

(25) Tsakalatos.

Bull.Soc.Chim. (4) 3 234.

(26) Kreeman.

Monatshefte. 27 98.

(27) Hatschek.

Viscosity of Liquids.

(28) Kreeman.

Monatshefte. 25 1299.

(29) Hildebrand.

Solubility.

(30) Stoner.

Magnetism and Atomic Structure.

My thanks are due to Professor Spencer for suggesting this research, to the Department of Scientific and Industrial Research for a grant in aid held during the period of experimental investigation, and to the Chemical Society for a grant to assist with the purchase of materials.