Hydrogen Bonding and Substituent Group Effects in Phénols. Part I. Apparent Dipole Moments and Infrared Spectra of N-(4-Hydroxybenzylidene)-4-Substituted-Anilines in Benzene, Carbon Tetrachloride, and Dioxan

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Apparent dipole moments in benzene and dioxan of benzylideneaniline and its two para-methyl derivatives have been determined, and used to obtain the inclination of the resultant moment to the N-C(ring) axis in each solvent. The moments in dioxan of 4-hydroxystilbene and 13 N-(4-hydroxybenzylidene)-4-substituted anilines are reported together with hydroxy-group stretching frequencies ν (OH) in carbon tetrachloride and dioxan. To explain the observed moments in dioxan, values of hydroxy-group bond moments μ (O-H) have been calculated. Both ν (OH) and μ (O-H) are found to be linearly related to the Hammett substituent constant, σ . The relative frequency shift in dioxan being adopted as a measure of the enthalpy change on solute-solvent association, these results provide another illustration of the dependence of μ (O-H) on the strength of hydrogen bonding.

CONSIDERABLE insight into the factors controlling the strength and polarity of hydrogen bonds formed by phenols, and the transmission of substituent group effects in phenolic compounds, has arisen from studies of dipole moments, μ , and hydroxy-group bond moments, $\mu(OH)$; stretching frequencies, v(OH), and band intensities A(OH); dissociation constants, K_a ; and association constants, K, corresponding frequency shifts $\Delta v(OH)$, and enthalpy changes for hydroxy-group association with various electron donors. Many linear relationships between the preceding variables (together with substituent group constants, σ) have been established.¹⁻¹⁴

Until now, little attention has been given ⁴ to phenolic systems with extended conjugation, from which intramolecular¹⁴ bonding is absent. Extension of the studies of hydroxyazobenzenes⁴ to phenolic benzylideneanilines permits investigation of the effect of two different orientations of the azomethine linkage on the hydrogenbonding ability and polarity of the hydroxy-group, and the transmission of substituent group effects to the latter.

In this paper apparent dipole moment determinations for benzylideneaniline (I, X = Y = H), N-(4-methylbenzylidene)aniline (I; X = Me, Y = H), and N-

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(benzylidene)-4-methylaniline (I; X = H, Y = Me) in benzene and dioxan are reported, together with the



Model for the calculation of hydroxy-group bond moments

moments in dioxan of 4-hydroxystilbene and a series of N-(4-hydroxybenzylidene)-4-substituted anilines (I; X = OH). Fundamental hydroxy-group stretching frequencies in carbon tetrachloride and dioxan are given for all the phenolic compounds.

(I) $4-X\cdot C_6H_4\cdot CH=N\cdot C_6H_4\cdot Y-4$

It is found that the resultant moment of benzylideneaniline is inclined at the angle 67° 46' to the N-C(ring) axis in benzene solution, and 67° 10' in dioxan. Using the latter result, we found that the calculated O-H bond moment of N-(4-hydroxybenzylidene)aniline in dioxan is greater than for phenol; the OH group stretching frequency is significantly less, and the frequency shift $\Delta v(OH)$ on association appreciably

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greater, than for phenol. These findings parallel the behaviour of 4-hydroxyazobenzene⁴ and may also be attributed to the additional conjugation in the benzylideneanilines. As in the case of the phenols and 4-hydroxyazobenzenes,⁴ both $\nu(OH)$ and $\mu(OH)$ give a linear plot against Hammett's substituent parameters, σ , the former decreasing and the latter increasing with increasing electron-attracting character of the substituent. The slope of the $\nu(OH)$ regression line is of opposite sign to that reported for N-(4-substituted benzylidene)-2-hydroxyanilines, in which intramolecular association occurs.14

EXPERIMENTAL

Materials.-Solvents. Benzene and dioxan, dried by prolonged refluxing over sodium, were distilled through a 1-m column packed with Fenske helices. The fractions of b.p. 80.1° at 760 mmHg and 101.4° at 760 mmHg, respectively, were collected and stored under anhydrous conditions. Dioxan was used on the same day for dipole moment measurements. Carbon tetrachloride ('Spectrosol') was dried over molecular sieve (Type 4A).

Phenols. Phenol was distilled and the middle fraction recrystallised from light petroleum (b.p. 60-80°); m.p. 41.5°. p-Hydroxystilbene was prepared by a published method; ¹⁵ m.p. 189.5---190.0°.

Intermediates. p-t-Butylaniline, prepared by Craig's method,¹⁶ had b.p. 240-242° at 774 mmHg. Other amines and aldehydes were of AnalaR or reagent grade, and were redistilled or recrystallised before use.

Benzylideneanilines. These compounds are easily prepared.¹⁷ Since they are readily hydrolysed,^{17a,18} the reaction was conducted in non-aqueous media. In the general method, the aldehyde (0.1 mol. equiv.) was heated with the amine (0.1 mol. equiv.) in either toluene, or toluene-n-pentyl alcohol containing sufficient alcohol to render the reactants soluble. The mean volume of water (removed by azeotropic distillation) from 30 syntheses was 1.71 cm³ (theoretical: 1.80 cm³). The solid product obtained after cooling and filtration was recrystallised to constant m.p., by use of light petroleum (b.p. 40-60°) for the non-hydroxy-compounds, and pure dioxan for the phenolic compounds. M.p.s (Kofler hot-stage apparatus; corrected) and physical characteristics are shown in Table 1. All the compounds were characterised by their i.r. spectra, 19a and potentiometrically by titration as bases in anhydrous acetic acid, with acetous perchloric acid as titrant.19b Since many benzylideneanilines are phototropic,²⁰ they were stored in dark brown bottles in an atmosphere of dry nitrogen.

Dipole Moments .- Dielectric constants (relative permittivities), ε , and refractive indices, $n_{\rm p}$, of solutions of graded weight fraction, w, of each compound in the appropriate solvent were determined at 298.20 ± 0.02 K (N.P.L. calibrated thermometer).

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Dielectric constants, accurate to 0.0001, were measured with an internally thermostatted, heterodyne-beat dipole-

TABLE 1						
N-(4-Substituted benzylidene)-4-substituted-anilines X•C ₆ H ₄ •CH=N•C ₆ H ₄ •Y						
No.	x	Y	Appear- ance ^a	M.p./°C (Corr.)	M.p. (lit.)	
(1) (2) (3)	H H Me	H Me H	V.p.y.pl. V.p.y.n. V.p.y.h.pr.	51.0 - 51.5 33.5 - 34.0 44.5 - 45.0	52 o 35 c	
(4) (5)	HO HO	NMe ₂ OMe	g.h.pr. p.y.h.pr.	257 - 258 $212 \cdot 5 - 213 \cdot 0$	211.0—211.5 ª (corr.)	
(6) (7) (8) (9) (10)	HO HO HO HO	Bu ^t Me H F Cl	p.y.h.n. p.y.h.pr. p.y.n. p.y.h.pr. p.y.h.n.	$183 \cdot 5 - 184 \cdot 0$ $217 - 218$ $196 \cdot 0 - 196 \cdot 5$ $182 \cdot 5 - 183 \cdot 0$ $187 \cdot 0 - 187 \cdot 5$	218 ° ^d (corr.) 194—195 °	
(11)	но	Br	p.y.h.n.	198.0-198.5	$(corr.) \dagger$ 193—194 a	
(12) (13) (14) (15) (16) (17)	HO HO HO HO p-Hy sti	I CO_2Et COMe CN NO_2 vdroxy- lbene	p.y.h.n. y.h.pl. y.h.n. b.y.n. b.y.h.n. w.pl.	$\begin{array}{c} 210 \cdot 0 &210 \cdot 5 \\ 176 \cdot 5 &177 \cdot 0 \\ 214 \cdot 5 &215 \cdot 0 \\ 164 &165 \\ 204 \cdot 5 &205 \cdot 5 \\ 189 \cdot 5 &190 \cdot 0 \end{array}$	(COIT.) Ţ 189,¢ 184·5 ¢	

V = very, p = pale, b = bright, w = white, y = yellow, g = golden, h = hexagonal, n = needles, pl = plates, pr = prisms.
Org. Synth., 1946, Coll. Vol. I, 2nd edn., p. 80.
I. M. Heilbron and H. M. Bunbury, 'Dictionary of Organic Constructor's Product Scottingendo, London, 1943. Compounds,' Eyre and Spottiswoode, London, 1943. 4 A. Senier and R. B. Forster, J. Chem. Soc., 1914, 105, 2462. Ref. 16.

 \dagger Dimorphous (ref. d); trituration yields variety with m.p. 193—194° (Cl); 203—204° (Br).

meter, type DM 01, manufactured by Wissenschaftlich-Technische Werkstätten, G.m.b.H.

The thermostatted dielectric cell, type D.F.L.1, of 20 cm³ capacity, had gold-plated internal plates. The linear capacitor was calibrated by means of benzene ($\varepsilon = 2.2725$). carbon tetrachloride ($\varepsilon = 2.2274$), and cyclohexane ($\varepsilon =$ 2.0139). Reproducibility was ensured by switching the instrument on 5 h before use and by suspending the flasks containing the solutions in a thermostatted bath 30 min before measurements.

TABLE 2					
100w	ε	$n_{\rm D}$	100w	ε	$n_{\rm D}$
(1) N-(Benzylidene)aniline in benzene			(1) <i>N</i> -(E	Benzyliden in dioxan	e)aniline
$\begin{array}{c} 0.0000\\ 0.2279\\ 0.4524\\ 0.6805\\ 0.9089\\ 1.1394\\ 1.3635\end{array}$	2.2725 2.2769 2.2813 2.2851 2.2894 2.2937 2.2980	1-49714 1-49745 1-49783 1-49808 1-49838 1-49870 1-49905	0.0000 0.1946 0.3874 0.3885 0.5807 0.5847 0.7798 0.9739 1.1644	$\begin{array}{c} 2 \cdot 2109 \\ 2 \cdot 2156 \\ 2 \cdot 2200 \\ \\ 2 \cdot 2247 \\ \\ 2 \cdot 2294 \\ 2 \cdot 2341 \\ 2 \cdot 2385 \end{array}$	1.42014 1.42044 1.42100 1.42149 1.42187 1.4229 1.4229
			$\begin{array}{c} \alpha = 2 \\ 0 \\ P_{2} \\ \mu \end{array}$	$\begin{array}{l} 375; \ \nu = \\ = 50.54 \\ p = 1.57 \end{array}$	0.621; cm ³ ;

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 1966; (b) D. C. Colinese, unpublished results.
 ²⁰ V. G. Lindemann, Z. wiss. Phot., 1955, 50, 347.

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(9) N			2000		
	(Benzylide	ene)-4-	(2) N_{-}	(Benzylider	16
(2) IV	(Denzynu)		mothul	aniling in d	1.
metnya	tunne m i	Jenzene	methy	amme m c	
0.0000	2.2725	1.49678	0.0000	2.2095	
0.2304	2.2763	1.49708	0.1952	$2 \cdot 2140$	1
0.4597	9.9909	1.40728	0.2007	9.9175	
0.4004	2.2002	1 40700	0.5070	2 2110	1
0.6884	2.2836	1.49769	0.2876	$2 \cdot 2215$	1
0.9126	2.2873	1.49802	0.7799	2.2253	1
1.1411	$2 \cdot 2907$	1.49830	0.9729	$2 \cdot 2292$	•
1.9797	9.9045	1.40961	1.1604	9,9334	-
1.9191	2.7940	1.49001	1.1094	2.7994	1
$\alpha = 1$	615: $v =$	0.399:	α == 3	2.049: v =	(
. P	- 44.49		P.	-44.186	• •
01 200	- 110	···· ,	04 20		
μ	B = 1.481	5	μ	$u_{\rm D} = 1.47 {\rm D}$	
(3) N-(A-)	Jethvihen	zulidene)-	(3) N_(4.	Methylben	7.
(0) 10-(in the second	eynache)=	(0) 11-(4-	line in dies	2
ann	ine in benz	zene	am	me m diox	a
0.0000	2.2725	1.49695	0.0000	2.2110	
0.2295	2.2768	1.49723	0.1942	2.2162	1
0 4590	9.9090	1.40759	0.2002	0.0010	-
0.4589	2.2820	1.49793	0.3892	2.2212	1
0.6902	2.2868	1.49776	0.5835	$2 \cdot 2268$	
0.9195	$2 \cdot 2918$	1.49818	0.7791	$2 \cdot 2319$	1
1.1494	9.9065	1.40929	0.0750	9.9268	-
1.1494	2.2900	1.49090	0.9709	2.2300	1
1.3726	2.3018	1.49875	1.1690	2.2421	
$\alpha - 2$	$092 \cdot \nu -$	0.381 ·	$\alpha - 2$	$665 \cdot v = 0$).
~ _ _ _	en er .	0.001,	~ _ _	69.67	,
$0P_{2\infty}$	= 02.03 (Jill ^o ,	0Γ ₂ α	5 = 02.07 C	n
μ	$_{\rm B} = 1.75$ I	D	μ	$L_{\rm D}=1.75~{ m D}$	
(A) NT (A TT		and idena)	(5) N (A 1		_
(4) IV-(4-H	yaroxyber	izyndene)-	(0) IV-(4-II	yuroxyben	z
4-dimet	nylaminoa	niline in	4-me	thoxyaniin	le
	dioxan			dioxan	
0.0000	0.000	1 41000	0 0000	0.0194	
0.0000	2.2093	1.41988	0.0000	2.2134	1
0.0495	2.2104	1.42006	0.0983	$2 \cdot 2186$	
0.0974	$2 \cdot 2132$	1.42014	0.1941	$2 \cdot 2235$	1
0.1055	9.9161	1.49049	0.9900	9,9989	-
0.1900	2.2101	1.42045	0.2099	2.2200	1
0.2439	2.2181	1.42057	0.3872	$2 \cdot 2339$	
0.2926	$2 \cdot 2191$	$1 \cdot 42067$	0.4864	2.2385	
			0.5873	$2 \cdot 2444$	
			00010		. '
$\alpha = 3 \cdot$	$459; \nu =$	0.798;	$\alpha = 5$	227; v = 0).
$0P_{n\infty}$	= 102.28	cm ³ ;	$0P_{0\alpha}$	$_{0} = 165.90$	с
· · · ·	n = 2.24	n .		n = 2.85 D	
μ		0	٣	. <u>р</u> — д со р	
(6) N-(4-H	ydroxyber	nzylidene)-	(7) N-(4-H	ydroxyben	z
4-t-hut	vlaniline i	n dioxan (4-methy	laniline in	d
0.0000	0.000/	1 41004	0.0000	0.0140	Ϊ.
	2·2084	1.41984	0.0000	2.2142	
0.0000					
0.0000 0.1013	2.2119	1.42007	0.0980	$2 \cdot 2189$	1
0.0000 0.1013 0.1938	$2 \cdot 2119$ $2 \cdot 2155$	1.42007 1.42025	0.0980 0.1948	$2 \cdot 2189$ $2 \cdot 2233$	
0.0000 0.1013 0.1938 0.2012	$2 \cdot 2119$ $2 \cdot 2155$ $2 \cdot 2188$	1.42007 1.42025 1.42046	0.0980 0.1948 0.2002	$2 \cdot 2189$ $2 \cdot 2233$ $2 \cdot 9271$	
0.0000 0.1013 0.1938 0.2912	$2 \cdot 2119$ $2 \cdot 2155$ $2 \cdot 2188$	$1 \cdot 42007$ $1 \cdot 42025$ $1 \cdot 42046$	0.0980 0.1948 0.2903	$2 \cdot 2189$ $2 \cdot 2233$ $2 \cdot 2271$	
$0.0000 \\ 0.1013 \\ 0.1938 \\ 0.2912 \\ 0.3916$	$2 \cdot 2119$ $2 \cdot 2155$ $2 \cdot 2188$ $2 \cdot 2231$	$\begin{array}{c} 1 \cdot 42007 \\ 1 \cdot 42025 \\ 1 \cdot 42046 \\ 1 \cdot 42071 \end{array}$	$0.0980 \\ 0.1948 \\ 0.2903 \\ 0.3894$	$2 \cdot 2189$ $2 \cdot 2233$ $2 \cdot 2271$ $2 \cdot 2316$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821 \end{array}$	$ \begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \end{array} $	$1 \cdot 42007 \\1 \cdot 42025 \\1 \cdot 42046 \\1 \cdot 42071 \\1 \cdot 42087$	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\end{array}$	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2271 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \end{array}$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\end{array}$	$2 \cdot 2119$ $2 \cdot 2155$ $2 \cdot 2188$ $2 \cdot 2231$ $2 \cdot 2259$ $2 \cdot 2259$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\end{array}$	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2271 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \\ 2 \cdot 2403 \end{array}$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\end{array}$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.212	0.0980 0.1948 0.2903 0.3894 0.4868 0.5819	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2271 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \\ 2 \cdot 2403 \\ 5 \cdot 7 \end{array}$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3 \end{array}$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617;	$\begin{array}{c} 0.0980 \\ 0.1948 \\ 0.2903 \\ 0.3894 \\ 0.4868 \\ 0.5819 \\ \alpha = 4 \end{array}$	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2271 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \\ 2 \cdot 2403 \\ 507; \ \nu = 0 \end{array}$	· · · · · · · · · · · · · · · · · · ·
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ {}_{0}P_{2\infty}\end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \end{array}$	$\begin{array}{c} 1 \cdot 42007 \\ 1 \cdot 42025 \\ 1 \cdot 42046 \\ 1 \cdot 42071 \\ 1 \cdot 42087 \\ 1 \cdot 42113 \\ 0 \cdot 617; \\ cm^{3}; \end{array}$	$\begin{array}{c} 0.0980 \\ 0.1948 \\ 0.2903 \\ 0.3894 \\ 0.4868 \\ 0.5819 \\ \alpha = 4 \cdot \\ 0.9_{20} \end{array}$	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2271 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \\ 2 \cdot 2403 \\ 507; \ \nu = 0 \\ \rho = 131 \cdot 85 \end{array}$), c
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 461 \end{array}$	$\begin{array}{c} 1.42007\\ 1.42025\\ 1.42046\\ 1.42071\\ 1.42087\\ 1.42087\\ 1.42113\\ 0.617;\\ cm^3;\\ \end{array}$	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{-1}\\ 0.0P_{2\infty}\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\mu = 131.85$ $\mu = 2.54$ D), c
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\end{array}$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 461 \\ p = 2 \cdot 461 \end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm^3 ;	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4\\ 0.P_{2\alpha}\\ \mu\end{array}$	$\begin{array}{c} 2 \cdot 2189 \\ 2 \cdot 2233 \\ 2 \cdot 2231 \\ 2 \cdot 2316 \\ 2 \cdot 2360 \\ 2 \cdot 2403 \\ 507; \ \nu = 0 \\ 0 = 131 \cdot 85 \\ c_{\rm D} = 2 \cdot 54 \\ \end{array}$), c
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha = 3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H)\end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 461 \\ y droxy ber \end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; b nzylidene)-	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\cdot\\ 0.P_{2\alpha}\\ \mu\\ (8)\ N-(4-H)\end{array}$	2.2189 2.2233 2.2231 2.22316 2.2360 2.2403 $507; \nu = 0$ $\mu = 131.85$ $\mu = 2.54 \text{ p}$ ydroxyben:) c
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\cdot\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anih)\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 635; $\nu = 123.58$ p = 2.46 1 ydroxyber ine in benz	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; o	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\cdot\\ {}_{0}P_{2\alpha}\\ \mu\\ (8) N-(4-H\\ ani)\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 $507; \nu = 0$ $\rho = 131.85$ $r_{D} = 2.54$ D ydroxyben: line in diox) c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ {}_{0}P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anilibrium)\\ 0.0000 \end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu =$ = 123.58 $_{\rm D} = 2.46$ I ydroxyber ine in benz 2.2795	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; Drzylidene)- zene 1.40714	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4\\ 0.P_{2\alpha}\\ \mu\\ (8) \ N-(4-H)\\ \alpha = 1\\ (8) \ N-(4-H)\\ \alpha = 1\\ 0.0000 \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\mu = 131.85$ $\mu = 2.54$ D ydroxyben. line in diox 2:2109	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anil:\\ 0.0000\\ 0.1142\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu =$ = 123.58 $_{\rm D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2725	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0^{P_{2}\alpha}\\ \mu\\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0072\\ \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = (0, -1)^{-1}$ $\nu = -131.85$ $\nu = 2.54$ D (ydroxyben: line in diox 2:2102 $\nu = 2.02$	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H)\\ anil:\\ 0.0000\\ 0.1146\\ 0.1146\end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ p \\ p \\ droxyber \\ me in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \end{array}$	1.42007 1.42025 1.42025 1.42071 1.42087 1.42113 0.617; cm ³ ; o nzylidene)- zene 1.49714 1.49727 1.49724	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ 0P_{2\alpha}\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 $507; \nu = 0$ $\mu = 131.85$ $\mu_D = 2.54 D$ ydroxyben: line in diox 2:2102 2:2154) c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anih\\ 0.0000\\ 0.1146\\ 0.1733\\ \end{array}$	$\begin{array}{r} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu =\\ = 123.58\\ p = 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; Drzylidene)- zene 1.49714 1.49727 1.49733	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ 0.P_{2\alpha}\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ \end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2360 5.07; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54$ D yydroxyben: line in diox 2.2102 2.2154 2.2206	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ \end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ p \\ y droxy ber \\ ine in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2783 \\ 2 \cdot 2783 \\ 2 \cdot 2783 \\ 2 \cdot 2801 \end{array}$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49727 1.49733 1.49743	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0^{-}p_{2\alpha}\\ \mu\\ (8)\ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\rho = 131.85$ $\rho = 2.54$ D (ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.9876\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu =$ = 123.58 $_{\rm D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2783 2.2801 2.2821	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; o tzylidene)- zene 1.49714 1.49727 1.49743 1.49743	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4\\ 0.9_{2\alpha}\\ \mu\\ (8) \ N-(4+1)\\ \alpha = 1\\ (8) \ N-(9+1)\\ \alpha = 1\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.2953\\ 0.2953\\ 0.2977\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 $507; \nu = 0$ $\rho = 131.85$ $\rho_D = 2.54 \text{ D}$ ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2261	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.2876\\ 0.1753\end{array}$	$\begin{array}{r} 2.2119\\ 2.2155\\ 2.2155\\ 2.2281\\ 2.2295\\ 2.2295\\ 635; \nu = \\ = \\ 123.58\\ p = \\ 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2783\\ 2.2801\\ 2.2821\\ 2.2$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49743 1.49743	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0^{P_{2}\alpha}\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.3674\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\rho = 131.85$ $\rho = 2.54$ D (ydroxyben: line in diox 2.2102 2.2154 2.2261 2.2261 2.2261	c za
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ \ \ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ \end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ p = 2 \cdot 46 \\ p = 2 \cdot 46 \\ p = 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2783 \\ 2 \cdot 2801 \\ 2 \cdot 2840 \\ \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; o nzylidene)- zene 1.49714 1.49727 1.49733 1.49743 1.49749 1.49753	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ 0P_{2\alpha}\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864 \end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; v = 0 p = 131.85 $p_D = 2.54 D$ ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2364	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anither $	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu =$ = 123.58 $_{\rm D} = 2.46$ 1 ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2821 2.2821 2.2840 2.2859	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. nzylidene)- zene 1.49714 1.49714 1.49733 1.49743 1.49743 1.49753 1.49761	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0.720\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54$ D ν_y droxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2414	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0.P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ 0.3470\\ 0.4038\\ 0.2876\\ $	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2239 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = \\ 123 \cdot 58 \\ p = 2 \cdot 46 \\ p \\ p \\ r \\ r$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49727 1.49743 1.49743 1.49743 1.49753 1.49751	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0^{-}p_{2\alpha}\\ \mu\\ (8)\ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \dots \\ 5839\end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = (0, -1)$ $\nu = (1, -$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ ani)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $v =$ = 123.58 $_{\rm D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2783 2.2821 2.2821 2.2820 2.2859 321; $v =$	1.42007 1.42025 1.42026 1.42046 1.42087 1.42087 1.42113 0.617; cm ³ ; D nzylidene) zene 1.49714 1.49727 1.49743 1.49749 1.49753 1.49761 0.350;	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4.\\ 0.P_{2\alpha}\\ \mu\\ (8) \ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5.\\ \end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54$ D ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.22414 364; $\nu = 0$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ ani)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ 0.P_{2\infty}\end{array}$	$\begin{array}{r} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = \\ 123 \cdot 58 \\ p = \\ 2 \cdot 46 \\ 1 \\ p \\ q \\ droxy ber \\ ne in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2801 \\ 2 \cdot 2821 \\ 2 \cdot 2821 \\ 2 \cdot 2859 \\ 321; \nu = \\ = \\ 110 \cdot 10 \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49749 1.49753 1.49761 0.350; cm ³ ;	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0.92\alpha\\ \mu\\ (8)\ N-(4-H\\ ani)\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ 0.92\infty\end{array}$	$\begin{array}{l} 2\cdot2189\\ 2\cdot2233\\ 2\cdot2231\\ 2\cdot2316\\ 2\cdot2360\\ 2\cdot2403\\ 507; \ \nu=0\\ p=131\cdot85\\ p=2\cdot54\ p\\ p=2\cdot54\ p\\ pdroxyben\\ line\ in\ diox\\ 2\cdot2102\\ 2\cdot2154\\ 2\cdot2206\\ 2\cdot2261\\ 2\cdot2311\\ 2\cdot2364\\ 2\cdot2414\\ 364; \ \nu=0\\ =148\cdot65 \end{array}$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4H)\\ a.ni:l\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \ \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ 1 \\ p \\ droxyber \\ p \\ droxyber \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2801 \\ 2 \cdot 2801 \\ 2 \cdot 2840 \\ 2 \cdot 2859 \\ 321; \ \nu = \\ = 110 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 110 \cdot 10 \\ p \\ = 2 \cdot 32 \\ 1 \\ p \\ = 10 \cdot 10 \\ p \\ $	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49727 1.49743 1.49749 1.49753 1.49761 0.350; cm ³ ; D	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0P_{2\alpha}\\ \mu\\ (8)\ N-(4-H\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5^{-}\\ 0P_{2\alpha}\\ \mu\\ \mu\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\rho = 131.85$ $\rho = 2.54 \text{ D}$ (ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2261 2.2311 2.2364 2.2414 364; $\nu = 0$ = 148.655 = 2.70 D	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ {}_{0}P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ ani)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ {}_{0}P_{2\infty}\\ \mu\\ \mu\\ (9)\ \mu\\ (1)\ \mu\\ (1)\ \mu\\ (2)\ \mu\\ (1)\ \mu\\ (2)\ $	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = 123.58\\ p = 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2821\\ 2.2821\\ 2.2821\\ 2.2821\\ 2.2859\\ 321; \nu = \\ = 110.10\\ p = 2.321\\ \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.49714 1.49714 1.49727 1.49733 1.49743 1.49743 1.49743 1.49761 0.350; cm ³ ; 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ 0P_{2\infty}\\ \mu_{\rm D}\\ (2)\ \mu\\ 0.000\\ 0.0$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54 \text{ D}$ ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2261 2:2364 2:2414 366; $\nu = 0$ = 148.65 G = 2.70 D	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ a-nii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4-H) \\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4-H) \\ 0.162$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2239 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \text{ I} \\ p = 2 \cdot 46 \text{ I} \\ y \text{droxyber} \\ 100 \text{ in benz} \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2830 \\ 2 \cdot 2830 \\ 2 \cdot 2831 \\ 2 \cdot 2840 \\ 2 \cdot 2859 \\ 321; \nu = \\ = 110 \cdot 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ p = 2 \cdot 32 \text{ I} \\ 1 - 10 \\ 1 - $	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49727 1.49743 1.49743 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; D benzyl-	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0^{-}p_{2\alpha}\\ \mu\\ (8)\ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5^{-}\\ 0^{-}p_{2\alpha}\\ \mu_{D}\\ \mu_{D}\\ (10)\ N-(1-1)^{-}p_{2\alpha}\\ \mu_{D}\\ \mu_{D}\\ (10)\ N-(1-1)^{-}p_{2\alpha}\\ \mu_{D}\\ \mu_{D$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54 \text{ D}$ ydroxyben. line in diox 2.2102 2.2154 2.2261 2.2261 2.2261 2.2261 2.2261 2.2261 2.2261 2.2261 2.2261 2.2264 2.2264 2.2264 2.2271 2.2364 2.2270 2.2154 2.2270 2.2270 2.2154 2.2270 2.2270 2.2154 2.2270 2.27700 2.2770 2.2770 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.27700 2.2770000000000	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ \ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ \mu\\ \mu\\ (9) \ N-(4\\ (dene)-) \end{array}$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ 1 \\ p \\ droxyber \\ me in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2783 \\ 2 \cdot 2801 \\ 2 \cdot 2840 \\ 2 \cdot 2859 \\ 321; \nu = \\ = 110 \cdot 10 \\ p \\ B = 2 \cdot 32 \\ 1 \\ 1 \\ 1 \\ 0 \\ r \\ r$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.49714 1.49727 1.49727 1.49749 1.49749 1.49749 1.49753 1.49761 0.350; cm ³ ; 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0P_{2\alpha}\\ \mu\\ (8)\ N-(4-H\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5^{-}\\ 0P_{2\alpha}\\ \mu\\ \mu\\ 0\ D\\ m\\ 0\ D\\ m\\$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54$ D ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2261 2.2311 2.2364 2.2414 364; $\nu = 0$ = 148.655 = 2.70 D 4-Hydroxy 4-chloroanid	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\end{array}$	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = \\ 123.58\\ p = 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.28201\\ 2.2$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49749 1.49749 1.49761 0.350; cm ³ ; D benzyl- line in	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0.920\\ \mu\\ (8)\ N-(4-H)\\ anit\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ 0.920\\ \mu_{D}\\ (10)\ N-(idene)-40\\ \mu_{D}\\ (10)\ N-(idene$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ (ydroxyben: line in diox 2:2102 2:2154 2:2261 2:2261 2:2364 2:2261 2:2364 2:2264 2:2264 2:2364 2:2414 364; $\nu = 0$ = 148.65 = 2.70 D 4-Hydroxy	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H)\\ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0002\\ \mu\\ (10) \$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $v =$ = 123.58 $_{\rm D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2763 2.27763 2.2801 2.2821 2.2840 2.2859 321; $v =$ = 110.10 $_{\rm B} = 2.32$ I t-Hydroxy 4-fluoroani dioxan	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49727 1.49743 1.49743 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; D benzyl- iline in	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0^{-} 0^{-} 2 \alpha \\ \mu \\ (8) \ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5^{-}\\ 0^{-} P_{2} \alpha \\ \mu \\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\rho = 131.85$ $\rho = 2.54 \text{ D}$ ydroxyben. line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2261 2:2311 2:2364 2:2414 364; $\nu = 0$ = 148.65 G = 2.70 D 4-Hydroxy 4-chloroanil dioxan	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\\ 0.0000\\ \end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu =$ = 123.58 $_{D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2783 2.2821 2.2820 2.2829 321; $\nu =$ = 110.10 $_{B} = 2.32$ I t-Hydroxy 4-fluoroani dioxan 2.2086	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.49714 1.49714 1.49727 1.49733 1.49743 1.49743 1.49743 1.49761 0.350; cm ³ ; 0. benzyl- line in 1.41997	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ 0.722\\ \mu \\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.722\\ \mu \\ 0.0000\\ 0.0000\\ \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54 \text{ D}$ ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2264 2:2414 366; $\nu = 0$ = 148.656 = 2.70 D 4-Hydroxyi dioxan 2:2098	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H)\\ a-H\\ a-H\\ a-H\\ a-H\\ a-H\\ a-H\\ a-H\\ a-H$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = \\ 123 \cdot 58 \\ p = 2 \cdot 46 \\ 1 \\ p \\ droxyber \\ ine in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2859 \\ 2 \cdot 2859 \\ 321; \nu = \\ = \\ 110 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \\ r \\ 4 \cdot fluoroani \\ dioxan \\ 2 \cdot 2086 \\ 2 \cdot 2163 \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49743 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42007	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0.92 \\ \alpha = 4^{-}\\ 0.92 \\ \alpha = 4^{-}\\ 0.92 \\ \alpha = 5^{-}\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5^{-}\\ 0.92 \\ \alpha = 5^{-}\\ 0.92 \\ \mu_{D}\\ (10) \ N-(1 \\ idene) = 0^{-1}\\ 0.0000\\ 0.1015 \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54 \text{ D}$ (ydroxyben: line in diox 2:2102 2:2154 2:2261 2:2364 2:2261 2:2364 2:2261 2:2364 2:2414 364; $\nu = 0$ = 148.65 o = 2.70 D 4-Hydroxy 4-chloroanil dioxan 2:2098 2:2175	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ \ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; v = = = 123.58 $_{D} = 2.46$ I ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2783 2.2783 2.2801 2.2820 2.2859 321; $v = = = 110.10$ $_{B} = 2.32$ I -Hydroxy 4.fluoroani dioxan 2.2086 2.2163 2.2253	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.2ylidene)- zene 1.49714 1.49727 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; 0. 1.49761 0.350; cm ³ ; 0. 1.41997 1.42007 1.42007 1.42007	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ 0.P_{2\alpha}\\ \mu \\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.P_{2\alpha}\\ \mu \\ 0.0000\\ (10) \ N-((idene)-d)\\ 0.0000\\ 0.1015\\ 0.1966\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54$ D ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2261 2.2311 2.2364 2.2414 364; $\nu = 0$ = 148.65 = 2.70 D 4.Hydroxyj 4.chloroanil dioxan 2.2098 2.2175 2.9297	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ ani)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2257\end{array}$	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = \\ 123.58\\ p = 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2783\\ 2.28201\\ 2.28201\\ 2.28201\\ 2.2820\\ 32.2859\\ 321; \nu = \\ = \\ 110.10\\ p = 2.321\\ 1. Hydroxy\\ 4.fluoroani\\ dioxan\\ 2.2086\\ 2.2163\\ 2.2253\\ 0 = 225\end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49749 1.49749 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42035 benzyl- line in	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0.92 \\ \mu \\ (8) \ N-(4-H)\\ ani \\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.92 \\ \mu \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.0000 \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ (ydroxyben: line in diox 2:2102 2:2154 2:2261 2:2261 2:2364 2:2261 2:2364 2:2261 2:2364 2:2414 364; $\nu = 0$ = 148.65 = 2.70 D 4-Hydroxy 4-chloroanil dioxan 2:2105 2:2175 2:2247	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4.4821)\\ 0.5837\\ \alpha=3\\ 0.2207\\ 0.146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.2955\\ 0.$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635 ; $\nu =$ = 123.58 p = 2.46 i ydroxyber ine in benz 2.2725 2.2763 2.2763 2.2801 2.2821 2.2840 2.2859 321; $\nu =$ = 110.10 p = 2.32 i 10.100 m = 2.2086 2.2163 2.2163 2.2253 2.2235	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49723 1.49743 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42007 1.42007 1.42007	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4^{+}\\ 0^{-}0^{-}2\alpha\\ \mu\\ (8)\ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5^{-}\\ 0^{-}0^{-}2\alpha\\ \mu_{D}\\ (10)\ N-(\\ idene)-4^{-}\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54 \text{ D}$ ydroxyben. line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2261 2:2311 2:2364 2:2414 366; $\nu = 0$ = 148.65 G = 2.70 D 4-Hydroxy 4-chloroanil dioxan 2:2098 2:2175 2:2247 2:2324 2:2247	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ \end{array}$	$\begin{array}{c} 2 \cdot 2119\\ 2 \cdot 2155\\ 2 \cdot 2188\\ 2 \cdot 2231\\ 2 \cdot 2259\\ 2 \cdot 2295\\ 635; \ \nu = \\ = 123 \cdot 58\\ p = 2 \cdot 46 \text{ I}\\ ydroxyber\\ me \text{ in benz}\\ 2 \cdot 2725\\ 2 \cdot 2763\\ 2 \cdot 2783\\ 2 \cdot 2783\\ 2 \cdot 2801\\ 2 \cdot 28201\\ 2 \cdot 2859\\ 321; \ \nu = \\ = 110 \cdot 10\\ p_{\text{B}} = 2 \cdot 32 \text{ I}\\ 1 \cdot Hydroxy\\ 4 \cdot fluoroani\\ dioxan\\ 2 \cdot 2086\\ 2 \cdot 2163\\ 2 \cdot 2253\\ 2 \cdot 2253\\ 2 \cdot 235\\ 2 \cdot 2419 \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.49714 1.49714 1.49727 1.49733 1.49743 1.49743 1.49761 0.350; cm ³ ; 0. benzyl- line 1.41997 1.42007 1.42054 1.42054 1.42074	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ 0.722\\ \mu\\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.722\\ \mu_{\rm D}\\ (10) \ N-(1 \\ idene)-4 \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894 \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54 \text{ D}$ ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2214 364; $\nu = 0$ = 148.656 = 2.70 D 4-Hydroxyi dioxan 2:2098 2:2175 2:2247 2:2393	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4x11)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ 0.9N-(4x10)\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.4870\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.1012\\ 0.187$	$\begin{array}{c} 2 \cdot 2119 \\ 2 \cdot 2155 \\ 2 \cdot 2188 \\ 2 \cdot 2231 \\ 2 \cdot 2231 \\ 2 \cdot 2259 \\ 2 \cdot 2295 \\ 635; \nu = \\ = 123 \cdot 58 \\ p = 2 \cdot 46 \\ p \\ y droxyber \\ ine in benz \\ 2 \cdot 2725 \\ 2 \cdot 2763 \\ 2 \cdot 2763 \\ 2 \cdot 2783 \\ 2 \cdot 2859 \\ 2 \cdot 2859 \\ 321; \nu = \\ = 110 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 1 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 10 \cdot 10 \\ 10 \\ 10 \cdot 10 \\ p = 2 \cdot 32 \\ 10 \cdot 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49743 1.49743 1.49753 1.49753 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42007 1.42007 1.42007 1.42054 1.42074 1.42074 1.42074	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0.92 \\ \alpha = 4^{-}\\ 0.92 \\ \mu \\ (8) \ N-(4-H)\\ ani \\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5^{-}\\ 0.92 \\ \mu \\ 0.101\\ 0.101\\ 0.101\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54 \text{ D}$ $\nu = 2.2261$ $\nu = 2.2364$ $\nu = 2.2364$ $\nu = 2.70 \text{ D}$ 4-Hydroxy 4-chloroanil dioxan $\nu = 2.098$ $\nu = 2.2247$ $\nu = 2.2247$ $\nu = 2.2247$ $\nu = 2.2247$ $\nu = 2.2247$ $\nu = 2.2247$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ 0.9205\\ 0.3470\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.5847\end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; v = = = 123.58 $_{D} = 2.46$ I ydroxyber me in benz 2.2725 2.2763 2.2783 2.2783 2.2783 2.2801 2.2820 2.2859 321; $v = = 110.10$ $_{B} = 2.32$ I -Hydroxy 4.fluoroani dioxan 2.2086 2.2163 2.2253 2.2269 2.2253 2.2235 2.2419	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0. 1.49714 1.49714 1.49727 1.49733 1.49749 1.49749 1.49753 1.49761 0.350; cm ³ ; 0. benzyl- line in 1.41997 1.42054	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ 0.92 \\ 0.000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.92 \\ \mu_{\rm D}\\ (10) \ N-(idene)-4 \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.4885\\ 0.5897\end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ $\nu = 131.85$ $\nu_D = 2.54 \text{ D}$ ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2414 364; $\nu = 0$ = 148.65 = 2.70 D 4.Hydroxy 4.chloroanil dioxan 2.2098 2.2175 2.2247 2.2324 2.2393 2.2474 2.2574	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = \\ 123.58\\ p = 2.461\\ ydroxyber\\ ine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.28201\\ 2.28201\\ 2.28201\\ 2.2820\\ 32.2859\\ 321; \nu = \\ = \\ 110.10\\ p = 2.321\\ 1.4ydroxy\\ 4.fluoroani\\ dioxan\\ 2.2086\\ 2.2163\\ 2.2253\\ 2.2335\\ 2.2419\\ 2.2509\\ 2.2583\\ \end{array}$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0.27 1.49714 1.49727 1.49733 1.49749 1.49743 1.49749 1.49761 0.350; cm ³ ; 0.5 benzyl- line in 1.41997 1.42035 1.42054 1.42075 1.42075 1.420	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ oP_{2\alpha}\\ \mu\\ (8) \ N-(4-H)\\ ani \\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ oP_{2\alpha}\\ \mu_{D}\\ (10) \ N-(idene)-(100)\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \end{array}$	2.2189 2.2233 2.2271 2.2316 2.2360 2.2403 507; $\nu = 0$ (ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2261 2.2314 364; $\nu = 0$ = 148.65 = 2.70 D 4-Hydroxy 4-chloroanil dioxan 2.2098 2.2175 2.2247 2.2324 2.2324 2.2324 2.2324 2.2333	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4.821)\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4.821)\\ 0.112\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.5847\\ \alpha=8\\ \end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635 ; $\nu =$ = 123.58 p = 2.46 I ydroxyber ine in benz 2.2725 2.2763 2.2763 2.2820 2.2859 321; $\nu =$ = 110.10 B = 2.32 I 4.Hydroxy 4.fluoroani dioxan 2.22853 2.22163 2.22163 2.2253 2.22355 2.22163 2.2253 2.22355 2.22163 2.2253 2.2253 2.2253 2.2259 2.2509 2.2583 514; $\nu =$	1.42007 1.42025 1.42046 1.42071 1.42087 1.42113 0.617; cm ³ ; D zzylidene)- zene 1.49714 1.49723 1.49743 1.49743 1.49743 1.49753 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42007 1.4207	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4^{+}\\ 0^{P}_{2\alpha}\\ \mu \\ (8) \ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0^{P}_{2\alpha}\\ \mu \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha = 7 \end{array}$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ (ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2214 364; $\nu = 0$ 4-Hydroxy 4-chloroanil dioxan 2:2098 2:2175 2:2247 2:2324 2:2393 2:2474 2:2543 615; $\nu = 0$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8)\ N-(4-H\\ anii)\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.9580\\ 0.5847\\ 0.5847\\ \alpha=8\\ \gamma P_{}\\ \infty=8\\ \gamma P_{}\\ 0.0000\\ 0.5847\\ \alpha=8\\ \gamma P_{}\\ 0.0000\\ 0.000$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; v = = = 123.58 $_{D} = 2.46$ I ydroxyber me in benz 2.2725 2.2763 2.2783 2.2840 2.2859 321; v = = = 110.10 $_{B} = 2.32$ I -Hydroxy 4.fluoroani dioxan 2.2086 2.2163 2.2253 2.2235 2.2253 2.2253 2.2253 2.2253 2.2253 2.2253 2.2253 2.22583 514; v = = = 281.10	$\begin{array}{c} 1.42007 \\ 1.42005 \\ 1.42025 \\ 1.42046 \\ 1.42071 \\ 1.42087 \\ 1.42113 \\ 0.617; \\ cm^3; \\ 0.5133 \\ 0.513333 \\ 0.51333 \\ 0.51333 \\ 0.51333 \\ 0.51333 \\ 0.51333 \\ 0.51333 \\ 0.$	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha = 4 \\ 0.722\\ \mu \\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha = 5 \\ 0.722\\ \mu \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha = 7 \\ 0.722\\ \mu \\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha = 7 \\ 0.722\\ 0.102\\ 0.$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = (0)$ 9 = 131.85 $\nu_D = 2:54 \text{ D}$ ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2214 364; $\nu = (0)$ = 148.65 = 2:70 D 4-Hydroxyj 4-chloroanil dioxan 2:2098 2:2175 2:2247 2:2393 2:2474 2:2393 2:2474 2:2393 2:2474 2:2543 615; $\nu = (0)$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ 0P_{2\infty}\\ \mu\\ (8) \ N-(4-H)\\ anii:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ 0P_{2\infty}\\ 0P_{20}\\ 0.9N-(4-H)\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.5847\\ \alpha=8\\ 0P_{2\infty}\\ 0P_{2\infty}\\ \end{array}$	2.2119 2.2155 2.2188 2.2231 2.2259 2.2295 635; $\nu = = 123.58$ p = 2.46 I ydroxyber ine in benz 2.2725 2.2763 2.2783 2.2820 2.282800 2.28280 2.28280 2.28280 2.282800 2.282800 2.28280000000000	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; D tzylidene)- zene 1.49714 1.49727 1.49733 1.49749 1.49753 1.49761 0.350; cm ³ ; D benzyl- line in 1.41997 1.42007 1.42035 1.42074	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ oP_{2\alpha}\\ \mu\\ (8)\ N-(4-H)\\ anii\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ oP_{2\alpha}\\ \mu\\ D\\ (10)\ N-(idene)-4\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha=7\\ oP_{2\alpha}\\ oP_{2\alpha}\\ oP_{2\alpha}\\ 0.7\\ 0.7\\ 0.7\\ 0.7\\ 0.7\\ 0.7\\ 0.7\\ 0.7$	2.2189 2.2233 2.2231 2.2316 2.2360 2.2403 507; $\nu = 0$ (ydroxyben: line in diox 2.2102 2.2154 2.2206 2.2261 2.2311 2.2364 2.2206 2.2261 2.2314 364; $\nu = 0$ (= 148.65 6 = 2.70 D 4-Hydroxy 4-chloroanil dioxan 2.2175 2.2247 2.2324 2.2393 2.2474 2.2393 2.2474 2.2543 615; $\nu = 0$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ oP_{2\infty}\\ \mu\\ (8) \ N-(4-H\\ \ aniit\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ oP_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ oP_{2\infty}\\ \mu\\ (9) \ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.5847\\ \alpha=8\\ oP_{2\infty}\\ \mu\\ \end{array}$	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = 123\cdot58\\ p = 2\cdot461\\ ydroxyber\\ rine in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.28201\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2820\\ 2.2801\\ 2.2820\\ 2.2820\\ 2.2801\\ 2.2820\\ 2.2820\\ 2.2801\\ 2.2820\\ 2.2801\\ 2.2800\\ 2.280$	$\begin{array}{c} 1.42007 \\ 1.42025 \\ 1.42026 \\ 1.42071 \\ 1.42087 \\ 1.42087 \\ 1.42113 \\ 0.617; \\ cm^3; \\ 0 \\ zzylidene)-zene \\ 1.49714 \\ 1.49727 \\ 1.49743 \\ 1.49743 \\ 1.49743 \\ 1.49743 \\ 1.49753 \\ 1.49761 \\ 0.350; \\ cm^3; \\ 0 \\ \end{array}$	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ 0.928\\ \mu\\ (8)\ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ 0.928\\ \mu_{\rm D}\\ (10)\ N-(\\ idene)-d\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha=7\\ 0.9286\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha=7\\ 0.9286\\ 0.0894\\ 0.0894\\ 0.0897\\ \alpha=7\\ 0.0888\\ 0.0897\\ \alpha=7\\ 0.0888\\ 0.0897\\ \alpha=7\\ 0.0888\\ 0.0889\\ \alpha=7\\ 0.0888\\ 0.0888\\ 0.0888\\ 0.0889\\ \alpha=7\\ 0.0888\\ $	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ $\nu = 131.85$ $\nu = 2.54$ D ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2414 364; $\nu = 0$ = 148.65 = 2.70 D 4:Hydroxy' 4:Hydroxy' 4:Choroanil dioxan 2:2098 2:2175 2:2247 2:2324 2:2393 2:2474 2:2543 615; $\nu = 0$ 615; $\nu = 0$ 615; $\nu = 0$	
$\begin{array}{c} 0.0000\\ 0.1013\\ 0.1938\\ 0.2912\\ 0.3916\\ 0.4821\\ 0.5837\\ \alpha=3\\ \ oP_{2\infty}\\ \mu\\ (8)\ N-(4-H)\\ anil:\\ 0.0000\\ 0.1146\\ 0.1733\\ 0.2307\\ 0.2876\\ 0.3470\\ 0.4038\\ \alpha=3\\ \ oP_{2\infty}\\ \mu\\ (9)\ N-(4\\ idene)-\\ 0.0000\\ 0.1012\\ 0.1959\\ 0.2925\\ 0.3895\\ 0.4870\\ 0.5847\\ \alpha=8\\ \ oP_{2\infty}\\ \mu\\ \mu\end{array}$	$\begin{array}{c} 2.2119\\ 2.2155\\ 2.2188\\ 2.2231\\ 2.2259\\ 2.2295\\ 635; \nu = \\ = \\ 123.58\\ p = 2.461\\ ydroxyber\\ ne in benz\\ 2.2725\\ 2.2763\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.2783\\ 2.28201\\ 2.28001$	1.42007 1.42025 1.42026 1.42071 1.42087 1.42113 0.617; cm ³ ; 0.27 1.49714 1.49714 1.49714 1.49727 1.49733 1.49743 1.49743 1.49743 1.49761 0.350; cm ³ ; 0.27 benzyl- line in 1.41997 1.42054 1.42054 1.42074 1.42074 1.42074 1.42074 1.42074 1.42074 1.42074 1.42074 1.42075 1.42074 1.42075 1.42	$\begin{array}{c} 0.0980\\ 0.1948\\ 0.2903\\ 0.3894\\ 0.4868\\ 0.5819\\ \alpha=4\\ oP_{2\alpha}\\ \mu\\ (8) \ N-(4-H)\\ ani\\ 0.0000\\ 0.0973\\ 0.1963\\ 0.2953\\ 0.3877\\ 0.4864\\ 0.5839\\ \alpha=5\\ oP_{2\alpha}\\ \mu_{D}\\ (10) \ N-(idene)-(10)\\ idene)-(10)\\ 0.0000\\ 0.1015\\ 0.1966\\ 0.2936\\ 0.3894\\ 0.4885\\ 0.5897\\ \alpha=7\\ oP_{2\alpha}\\ oP_{2\alpha}\\ oP_{2\alpha}\\ 0.0000\\ 0.000\\$	2:2189 2:2233 2:2271 2:2316 2:2360 2:2403 507; $\nu = 0$ ($\nu = 131.85$ $\nu_D = 2.54 \text{ D}$ (ydroxyben: line in diox 2:2102 2:2154 2:2206 2:2261 2:2311 2:2364 2:2206 2:2261 2:2314 364; $\nu = 0$ = 148.65 = 2:70 D 4-Hydroxyi 4-chloroanil dioxan 2:2098 2:2175 2:2247 2:2324 2:2393 2:2474 2:2543 615; $\nu = 0$	

TABLE 2 (Continued)

100

) N-(Benzylide	ene)-4-	
thyl	aniline in	dióxan	
ഫ്	$2 \cdot 2095$	1.42000	
52	2.2140	1.42036	
07	2.2175	1.42084	
76	$2 \cdot 2215$	1.42134	
99	$2 \cdot 2253$	1.42173	
29	2.2292	1.42210	
94	$2 \cdot 2334$	1.42250	
9	2.040 ·	- 0.616	
$\zeta = 2$	-49, p =	= 0.010,	
0F 200	= 44.10	Cill ^e ,	
μ	$\mathbf{D} = 1 \cdot 4 1$	D	
√-(4- ∶	Methylber	nzylidene)-	
anil	ine in dio	xan	
00	2.2110	1.41987	
42	$2 \cdot 2162$	$1 \cdot 42028$	
92	$2 \cdot 2212$	1.42077	
35	2.2268	1.42124	
91	$2 \cdot 2319$	1.42170	
59	2.2368	1.42207	
90	$2 \cdot 2421$	1.42254	
_ 2.	665· " —	0.652	
	- 69.67	cm ³ .	
$0^{1} 2^{\infty}$	- 1.75	сш, Б	
μ	D = 1.10		
(4-H)	ydroxybe	nzylidene)-	
1-met	thoxyanili	ne in	
	dioxan		
00	2.2134	1.41990	
83	$2 \cdot 2186$	1.42013	
41	2.2235	1.42042	
99	2.2283	1.42068	
72	$2 \cdot 2339$	1.42087	
64	$2 \cdot 2385$	1.42106	
73	$2 \cdot 2444$	1.42141	
_ <u>5</u> .	997	0.710.	
 	-165.00	0.119,	
o <i>⊾</i> ₂∞	= 105.90	ΓCIII [°] ,	
μ_{2}	D = 2.00	D	
(4-H)	ydroxybe	nzylidene)-	
nethy	laniline ir	ı dioxan	
00	2.2142	1.41992	
80	2.2189	1.42014	
48	$2 \cdot 2233$	1.42021	
03	$2 \cdot 2271$	1.42064	
94	2.2316	1.42082	
68	$2 \cdot 2360$	1.42108	
19	$2 \cdot 2403$	1.42130	
= 4.	507: $v =$	0.648:	
P_{om}	= 131.85	cm ³ :	
j= 230 u	n = 2.54	D	
/A 11.		and dona)	
(4-11	yuroxybel	izyndene)-	
ann		Xall	
00	2.2102	1.41998	
73	2.2154	1.42025	
63	2.2206	1.42045	
53	2.2261	1.42072	
77	$2 \cdot 2311$	1.42096	wi
64	2.2364	1.42121	
39	$2 \cdot 2414$	1.42148	
$= 5 \cdot 3$	364; v =	0.720;	an
$P_{2^{\infty}}$	= 148.65	cm³;	sta
$\bar{\mu}_{D}$	= 2.70 d		
N_{-1}	-Hydroxy	vbenzvl-	115
ne)-4	-chloroan	iline in	
	dioxan	***	-
00	9,9000	1.41049	0F
15	2-2090 9.9175	1.41069	
10	2-2170 9,9947	1.41997	
36	2.2291	1.49090	11 71
94 94	2.2324	1.49029 1.49020	wi
94 85	4.7929 9.9444	1.49079	ar
00	4-4414 9.9549	1.42078	ine
J I	4-4040	1.42090	v =
= 7.	615; v =	0.644;	- ب م آم
-	000 25	3 .	- (12)

nn

TABLE 2 100wε nD (11) N-(4-Hydroxybenzylidene)-4-bromoaniline in dioxan 0.0000 $2 \cdot 2079$ 1.419830.1018 2.21451.420050.2013 $2 \cdot 2218$ $1 \cdot 42024$ $2 \cdot 2278$ 0.29481.420480.3941 $2 \cdot 2340$ 1.420680.48932.23971.42088 $2 \cdot 2467$ 0.58841.42109 $\mu_{\rm D}=3.64~{
m d}$ D (13) N-(4-Hydroxybenzylidene)-4-ethoxycarbonylaniline in dioxan 0.00002.21131.419920.0989 $2 \cdot 2192$ 1.420120.1975 $2 \cdot 2266$ 1.420352.23421.420590.29630.3893 $2 \cdot 2414$ 1.420840.4861 $2 \cdot 2487$ 1.421042.25620.58431.42123 $\alpha = 7.723; \ \nu = 0.644;$ $_{0}P_{2^{\infty}} = 311 \cdot 19 \text{ cm}^{3};$ $\mu_{\rm D} = 3.90 \ {\rm d}$ (15) N-(4-Hydroxybenzylidene)-4-cyanoaniline in dioxan 0.0000 $2 \cdot 2101$ 1.419810.10032.23181.420060.1988 $2 \cdot 2529$ 1.420312.2736 1.420620.29620.3910 $2 \cdot 2933$ 1.420750.48682.31341.421040.59242.33631.42132 $lpha = 21.336; \ \nu = 0.721; \ _0P_{2^{\infty}} = 752.52 \text{ cm}^3;$ $\mu_{\mathrm{D}} = 6.07$ D (17) 4-Hydroxystilbene in dioxan 2.21061.419970.0000 0.1010 $2 \cdot 2136$ 1.420080.19272.21651.420242.2198 0.29251.42056 $2 \cdot 2226$ 0.38931.420920.48362.22551.421130.5845 $2 \cdot 2286$ 1.42142 $\alpha = 3.083; \nu = 0.797;$ $_{0}P_{2^{\infty}} = 71.37 \text{ cm}^{3};$ $\mu_{\rm D} = 1.87$ D

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(Continued) 100wε $n_{\rm D}$ (12) (4-Hydroxybenzylidene)-4-iodoaniline in dioxan 0.0000 2.20951.420010.0978 $2 \cdot 2144$ $1 \cdot 42021$ 2.21981.420370.19582.22520.29291.42060 $2 \cdot 2303$ 0.39371.420870.48952.23581.420922.23990.58251.42120 $lpha = 5.282; \ \nu = 0.569;$ $_{0}P_{2\infty} = 248.08 \text{ cm}^{3};$ $\mu_{\rm D} = 3.49 \text{ d}$ (14) N-(4-Hydroxybenzylidene)-4-acetylaniline in dioxan 0.0000 $2 \cdot 2085$ 1.419860.1005 $2 \cdot 2216$ $1 \cdot 42012$ 0.19742.23531.420322.24650.29321.42059 $2 \cdot 2605$ 0.38951.420860.4856 $2 \cdot 2710$ 1.421112.28590.58711.42149 $\alpha = 13.135; \nu = 0.738;$ $_{0}P_{2\infty} = 486.39 \text{ cm}^{3};$ $\mu_{\rm D} = 4.88 \ {
m D}$ (16) N-(4-Hydroxybenzylidene)-4-nitroaniline in dioxan 0.0000 $2 \cdot 2114$ 1.420020.0994 $2 \cdot 2340$ 1.420320.1956 $2 \cdot 2562$ 1.420572.27731.420850.29240.3894 $2 \cdot 2996$ 1.421130.48682·3219 1.421520.58382.34451.42168 $\alpha = 22.717; \nu = 0.825;$ $_{0}P_{2^{\infty}} = 870.37 \text{ cm}^{3};$ $\mu_{\rm D}=6.53~{
m d}$ D

Refractive indices, accurate to 0.00003, were measured ith a precision Abbé refractometer.

Specific volumes of benzene (mean $v = 1.14540 \text{ cm}^3 \text{ g}^{-1}$) nd dioxan (mean $v = 0.97383 \text{ cm}^3 \text{ g}^{-1}$) were obtained by a andard technique.

The results are given in Table 2, the symbols having their ual significance.

The molar orientation polarisation at infinite dilution, $P_{2\infty}$, of each solute was calculated from equation (1) in

$${}_{0}P_{2\infty} = 3M_{2}v_{1}[\alpha/(\varepsilon_{1}+2)^{2} - \nu/(n_{1}^{2}+2)^{2}] \qquad (1)$$

hich M_2 = molecular weight of the solute; v_1 , ε_1 , and n_1 e the specific volume, dielectric constant, and refractive dex respectively of the solvent at 298.2 K; $\alpha = (\partial \epsilon / \partial w)_{w=0}$, $= (\partial n^2 / \partial w)_{w=0}$ were calculated from the experimental data by the method of least squares.

Dipole moments, μ , (in Debye units) calculated from

equation (2) are summarised in Table 3 (S.I. unit: 1 D = 3.335640×10^{-30} C m).

$$\mu = 0.012812({}_{0}P_{2\infty} \times T)^{\frac{1}{2}}$$
(2)

TABLE 3

Apparent dipole moments and hydroxy-group stretching frequencies of benzylideneanilines X·C₆H₄·CH=N·C₆H₄·Y at 298.20 \pm 0.02 K

			cν(OH) †/	$_{\rm D}\nu({\rm OH})$ †/	$\mu_{\mathbf{B}}$ †/	$\mu_{\rm D}$ t/	$\mu_{\rm B}$
No.	x	Y	cm-i	cm-i	D	D	(İit.)
(1)	H	н			1.56	1.57	1.57, 4
. ,							1.58,1
							1.56 9
(2)	\mathbf{H}	Me			1.48	1.47	ء 1.53
(3)	Me	Н			1.75	1.75	ء 1∙80
	Me	Me		-			ء 1.58
	Cl	Cl					1.57'
(4)	HO	NMe_2	3603	3304		2.24	
(5)	HO	OMe	3603	3297.5		2.85	
(6)	HO	Bu^{t}	3602	3296		2.46	
(7)	HO	Me	3602	3295	-	$2 \cdot 54$	
(8)	HO	н	3602	$3292 \cdot 5$	2.32	2.70	
(9)	HO	F	3602	3291.5		3.71	
(10)	HO	Cl	3601	3290		3.59	
(11)	HO	Br	3601	3289		3.64	
(12)	HO	I	3601	3289		3.49	
(13)	HO	CO ₂ Et	3601	3286		3.90	
(14)	HO	СО́Ме	3600.5	3283		4.88	
(15)	но	CN	3599	3281.5		6.07	
(16)	HO	NO_2	3598	3278		6.53	
(17)	p-Hy	droxy-	3607.5	3318	-	1.87	
. ,	- sti	lbene					
	Phen	ol	3610·5 ª	3333 »	1.54 \circ	1·86 ª	

 $\dagger B = Benzene; C = carbon tetrachloride; D = dioxan.$ 3610.1 cm⁻¹, ref. 13; 3611 cm⁻¹, L. J. Bellamy and H. E. Hallam, *Trans. Faraday Soc.*, 1959, 55, 220; 3612 cm⁻¹, L. J. Bellamy, G. Eglington, and J. F. Morman, *J. Chem. Soc.*, 1961,

4762. ^b 3315 cm⁻¹, L. J. Bellamy and H. E. Hallam, ref. a; 4702. * S13 cm⁻¹, J. P. B. Sandall, personal communication. * E. V. Goode and D. A. Ibbitson, J. Chem. Soc., 1960, 4265. * Ref. 3.
* F. Feichtmayr and F. Würstlin, Festchrift Carl Wurster zum 60 Geburstag, 1960, 177. J V. de Gaouck and R. J. W. Le Fèvre, J. Chem. Soc., 1938, 741. * E. Hertel and M. Chemella, T. M. 1041. 749. 2800. Schinzel, Z. phys. Chem., 1941, B, 48, 289.

I.r. Spectra.—Measurements were made at 298.20 \pm 0.02 K on a Unicam SP 700C double-beam recording spectrophotometer, fitted with (a) an SP 790 absorbance unit; (b) an SP 770 constant-temperature cell housing connected to a thermostatted water bath; and (c) masks and germanium filters in the cell-housing entrance windows to remove unwanted radiation. The range 4000-3000 cm⁻¹ was investigated with radiation from a tungsten filament lamp, which was dispersed by a Merton-N.P.L. replica grating (blazed at 3333 cm⁻¹, 1st order) and detected by a Mullard lead sulphide cell. The chopper motor, a source of unwanted radiation when hot,²¹ was turned off between experiments.

Solutions in carbon tetrachloride (5 \times 10⁻⁴ mol l⁻¹) and in dioxan (5 \times 10⁻² mol l⁻¹) were examined quantitatively in matched pairs of Infrasil cells of path-length 40 mm and 0.5 mm respectively. Frequencies at the absorbance maxima, reproducible to 0.5 cm⁻¹, were located at the intersection of the bisector of a series of horizontal chords of the band with the band contour, and measured with a vernier scale. In carbon tetrachloride, the bisector was vertical,

indicating band symmetry; in dioxan, slight asymmetry appeared. At the end of each interrupted series of measurements, frequency calibration was carried out, using the atmospheric water vapour bands 22 at 3700-3500 cm⁻¹, and the indene peak 22 at 3297 ± 1.5 cm⁻¹. The control settings shown in Table 4 were used. Fundamental hydroxy-group stretching frequencies $_{C\nu}(OH)$ and $_{D\nu}(OH)$ are recorded in Table 3 (intensities will be reported in a later paper).

	TABLE 4		
	In CCl ₄	$In C_4H_8O_2$	H ₂ O vap.
Chart speed/cm h ⁻¹	200	300	200
Absorbance range	-0.3 to $+0.8$	-0.3 to $+0.8$	Energy
Damping	3	3	3
Scan speed/cm ⁻¹ min ⁻¹	26	78	26
Resolution	3	3	5
Markers/cm ⁻¹	20	20	20
Slit width/mm	Auto	Auto	0.11

DISCUSSION

Dipole Moments.—The moments in dioxan of benzylideneaniline and two para-methyl derivatives [compounds (1)—(3) in Table 3] are the same as the corresponding moments in benzene within experimental error, indicating that solvent effects on the charge distributions in these compounds are quantitatively similar. However, the dipole moment of N-(4-hydroxybenzylidene)aniline [compound (8) of Table 3] is greater in dioxan than in benzene. This effect is attributed to hydrogen bonding of the hydroxy-group to an oxygen atom of a dioxan molecule; the same explanation was offered recently⁴ for the enhanced moments of phenols and 4'-substituted 4-hydroxyazobenzenes in dioxan. A direct comparison of the moments of these two classes with those of hydroxybenzylideneanilines is not significant, because of the influence of the azomethine unit in the latter. The apparent moments [compounds (4)—(16), Table 3] are resultant moments, and may be regarded as compounded vectorially from the component moments of the C(ring)-O, O-H, and Y-C(ring) bonds, and that of the azomethine unit [containing contributions from the C(ring)-C, C-H, C=N and N-C(ring) bonds], allowing for interaction between these moments. The hydroxy-group bond moment, $\mu(O-H)$, in phenols and hydroxyazobenzenes is a useful quantitative index of the strength of hydrogen-bonding to dioxan and the influence of substituent groups.⁴ To see if this is so for the series of compounds in Table 3, and to assess the effect of the azomethine unit, the following vectorial analysis was made.

Orientation of the Benzylideneaniline Moment.-In these and subsequent calculations, the following structural information was taken into account.

Attempts to isolate cis-benzylideneanilines have failed.²³ Smith has pointed out ²⁴ that the dipole moments of the dimethyl- and dichloro-compounds (Table 3) are virtually the same as that of the parent,

 ²¹ C. G. Cannon, personal communication.
 ²² I.U.P.A.C., 'Tables of Wavenumbers for the Calibration of Infrared Spectrometers,' Butterworths, London, 1961.

 ²³ van Alpen, *Rec. Trav. chim.*, 1942, **61**, 875; F. Krohnke, *Ber.*, 1938, **71**, 2593.
 ²⁴ J. W. Smith, 'Electric Dipole Moments,' Butterworths,

London, 1955.

indicating that the C-Me (or C-Cl) dipoles are antiparallel, and showing that each compound is the transisomer. In chloro-derivatives of salicylideneaniline, which are stabilised trans by intramolecular hydrogenbonding, $\angle C(ring)NC = \angle NCC(ring) = 122^\circ$, and the rings are parallel to within 1° of their respective normals.²⁵ The suggestion ²⁵ that repulsive interactions between non-bonded atoms are relieved by twisting of the rings out of the C-C=N-C plane is supported by the recent X-ray data of Bürgi and Dunitz²⁶ for transbenzylideneaniline and two para-derivatives; the aniline rings are twisted by 40-55°, the benzylidene rings being twisted in the opposite sense by 8-14°. The bond angles are $\angle C(\text{ring})NC = 119.9^{\circ} \text{ and } 120.6^{\circ}; \angle NCC(\text{ring})$ $= 122.7^{\circ}$ and 120.2° , for benzylideneaniline, and N-(4-methylbenzylidene)-4-nitroaniline, respectively. Since the crystal reflectance spectra are similar to the solution spectra, these authors 26 consider that the stable conformations of the free molecules are not too different from those found in the crystalline state. Accordingly, these results are relevant in the present vectorial analysis, in which the planarity of C-C=N-C, and the equality $\angle C(\operatorname{ring})NC = \angle NCC(\operatorname{ring})$, are assumed.

In evaluating the angle of inclination (α) of the C=N dipole axis to the N-C(ring) axis in benzylideneaniline, it was assumed, in accord with Marsden and Sutton,²⁷ that the moment of the latter was unperturbed by the introduction of a *para*-methyl substituent. The angle $(\alpha = 70^{\circ} 46')$ has been calculated from the moments in benzene of benzylideneaniline (A; $\mu_{\rm B} = 1.56$ D), N-(benzylidene)-4-methylaniline (MeA; $\mu_{\rm B} = 1.48$ D), and toluene (PhMe; $\mu_{\rm B} = 0.37$ D), from equation (3).

$$\mu^{2}_{\text{MeA}} = \mu^{2}_{\text{A}} + \mu^{2}_{\text{PhMe}} + 2\mu_{\text{A}}\mu_{\text{PhMe}}\cos\left(180^{\circ} - \alpha\right) \quad (3)$$

Similarly, the angle of inclination ($\beta = 64^{\circ} 46'$) of the C=N dipole axis to the C(ring)-C axis has been deduced from μ_A , μ_{PhMe} , and the moment in benzene of N-(4methylbenzylidene)aniline (Me'A; $\mu_B = 1.75$ D), by use of equation (4). If it is assumed that the N-C(ring) and

$$\mu^{2}_{Me'A} = \mu^{2}_{A} + \mu^{2}_{PhMe} + 2\mu_{A}\mu_{PhMe}\cos\beta \qquad (4)$$

C(ring)-C axes are parallel, the best value for the angle of inclination in benzene is the mean (5). Analogous

$$\theta = [(\alpha + \beta)/2] = 67^{\circ} \, 46' \tag{5}$$

calculations with the corresponding moments in dioxan [compounds (1)-(3) in Table 3] yield $\alpha = 67^{\circ} 42'$, $\beta = 66^{\circ} 38'$. The mean [equation (6)] in dioxan is close

$$\theta = [(\alpha + \beta)/2] = 67^{\circ} \, 10' \tag{6}$$

to that in benzene, indicating that there is no significant difference between the orientations of the azomethine group moment in these two solvents. To test the

validity of θ in equation (5), the moment of N-(benzylidene)-4-chloroaniline (I; X = H, Y = Cl) in benzene has been predicted from the moments of chlorobenzene (1.58 D) and N-(benzylidene)aniline $(1.56 \text{ D}; \theta = 67^{\circ} 46')$ in benzene, from equation (7), which yields $\mu_{\text{pred}} = 2.61$ D,

$$\mu^{2}_{\text{pred}} = (1.56)^{2} + (1.58)^{2} + 2(1.56)(1.58)\cos 67^{\circ} 46' \quad (7)$$

in satisfactory agreement with the observed value,28 $\mu_{obs} = 2.58$ D, and the general finding that interaction moments in chloro-compounds are small, and do not increase markedly with increasing length of the attached conjugated system.^{24,29}

Hydroxy-group Bond Moments.-In extending the preceding results to predict the moments of phenolic benzylideneanilines, allowances must be made for rotation of the OH group about the C(ring)-O axis.³⁰ For two dipole vectors μ_1 , μ_2 making fixed angles θ_1 , θ_2 respectively with an axis about which mutual free rotation occurs, the predicted root-mean-square moment (assuming all mutual orientations around the axis to be equally probable) is ²⁴ given by equation (8). From

$$\mu_{\text{pred}} = (\mu_1^2 + \mu_2^2 - 2\mu_1\mu_2\cos\theta_1\cos\theta_2)^{\frac{1}{2}} \quad (8)$$

equation (8), the moment in benzene ($\mu_{pred} = 2.21$ D) of N-(4-hydroxybenzylidene)aniline has been predicted from the moment of N-(benzylidene)aniline ($\mu_1 = 1.56$ D, $\theta_1 = 67^{\circ} 46'$), and that of phenol ($\mu_2 = 1.54$ D, $\theta_2 =$ $180^{\circ} - 87^{\circ} 47'$) in benzene, the angle $(87^{\circ} 47')$ between the directions of the C-OH group moment and the O-C(ring) bond reported previously being adopted.29 The agreement between $\mu_{pred} = 2.21$ D and $\mu_{obs} = 2.32$ D is only fair; the effective value of at least one of the dipole vectors must differ from that in the parent benzylideneaniline or phenol molecule. In a parallel situation, the enhanced moment of 4-hydroxyazobenzene $(\mu_{\rm B} = 1.66 \text{ D})$ over that of phenol $(\mu_{\rm B} = 1.54 \text{ D})$ can be interpreted 4 in terms of an increased mesomeric release from the oxygen atom to the more extended conjugated system in the azo-compound. A useful index of this change, and additional changes upon hydrogen-bonding. is the hydroxy-group bond moment, $\mu(O-H)$, necessary to explain the observed moment.⁴

Calculation of $\mu(O-H)$. The influence of substitution upon the hydrogen-bonding tendency of the OH group in N-(4-hydroxybenzylidene)-4-substituted anilines has been assessed by evaluating μ (O-H) values necessary to explain the observed moments in dioxan.

A C-O-H valency angle of 115° in phenol, a dipole moment of phenol in dioxan of 1.86 D, and an angle of 83° 44' between the directions of the C-OH group moment and the O-C(ring) bond being assumed, the moments associated with the O-H and C-O bonds have been derived previously 4 as 2.04 D and 0.66 D respectively.

²⁵ J. Bregman, L. Leiserowitz, and K. Osaki, J. Chem. Soc., 1964, 2086; J. Bregman, L. Leiserowitz, and G. M. J. Schmidt, J. Chem. Soc., 1964, 2068.

H. B. Bürgi and J. D. Dunitz, Chem. Comm., 1969, 472.
 R. J. B. Marsden and L. E. Sutton, J. Chem. Soc., 1936, 599.

²⁸ A. L. McClellan, 'Tables of Experimental Dipole Moments,' W. H. Freeman and Co., London, 1963.

 ²⁹ E. V. Goode and D. A. Ibbitson, *J. Chem. Soc.*, 1960, 4265.
 ³⁰ Ref. 9; L. Pauling, 'Nature of the Chemical Bond,' Cornell Univ. Press, New York, 2nd edn., 1948, p. 323.

Since the moment of 4-hydroxystilbene in dioxan ($\mu_D =$ 1.87 D) is the same as that of phenol, within experimental error, $\mu(O-H)$ and $\mu(C-O)$ in the former can be assumed to equal the values in phenol. Further, both in 4hydroxystilbene and the hydroxybenzylideneanilines (I), a carbon atom of the inter-ring bridge is directly attached to the para-position in phenol; consequently, it is a reasonable approximation to assume that $\mu(C-O) =$ 0.66 D in each class. In the vector calculations, the following assumptions were made: (1) a C-O-H valency angle of 115° ; (2) a C-O bond moment of 0.66 D; (3) the aromatic rings are planar, and disposed trans, with bond axes of bonds directly attached to the rings mutually parallel; (4) a C=N group moment of 1.57 D, inclined at $67^{\circ} 10'$ [equation (6)] to the N-C(ring) axis direction; (5) values of the moments of the monosubstituted benzene derivatives, µ(PhX), in benzene, remaining unaltered in dioxan, of dimethylaniline,²⁸ 1.57; anisole,³¹ 1.30; t-butylbenzene,29 0.53; toluene,24 0.37; fluorobenzene,²⁴ 1.48; chlorobenzene,²⁴ 1.58; bromobenzene,²⁴ 1.56; iodobenzene,²⁴ 1.40; ethyl benzoate,³² 1.93; acetophenone,33 2.96; benzaldehyde,24 2.92; cyanobenzene,²⁴ 4.03; and nitrobenzene,²⁴ 4.01.

For the angular substituents $(Y = NMe_2, OMe_2)$ CO_2Et , COMe, and CHO) the angles, α , which the substituent group moments make with a direction parallel to the Y-C(ring) axis were calculated, in accord with Marsden and Sutton,²⁷ from the moments of PhY; the mono-methyl-, -fluoro- or -chloro-benzene, PhZ; and the para-disubstituted compound, Z·C₆H₄·Y; the results are in Table 5.

TABLE 5

Angles of inclination (α) of group moments to the substituent \longrightarrow C(ring) axis

Y	$\mu(PhY)$	Z	$\mu(PhZ)$	$\mu(Z \cdot C_6 H_4 \cdot Y)$	α
OMe	1.30 a	F	1·48 »	2.09 0	82° 41′
COMe	2.96 .	Me	0.37 0	3.23 •	134° 22′
CO,Et	1.93 ª	Cl	1.580	2·24 d	101° 23′
NMe,	1.57 0	Me	0.37 b	1.301	38° 18′
сно	2.92 0	Me	0.37 0	3·30 ø	180° 00′
a Ref.	31. ^b Ref	. 24. •	Ref. 33.	⁴ Ref. 32.	• Ref. 28.
Ref. 2	7. 9 J. N.	Pearce	and L.	F. Berhenke,	J. Phys.

Chem., 1935, 39, 1005.

Values of $\mu(O-H)$ were calculated vectorially on the basis of the model shown in the Figure, free rotation of the dipole vectors being assumed about the appropriate substituent-C(ring), N-C(ring), and O-C(ring) axes, from equations (9)—(11), in which $\mu_{\rm H}$ is a resultant

$$\mu_{\rm H}^{\ 2} = \left[\mu_{\rm OH} \cos 65^{\circ} - \mu_{\rm CO} + 1.57 \cos 67^{\circ} 10' - \right. \\ \left. \mu_{\rm Phy} \cos \alpha \right]^2 \tag{9}$$

$$\overline{\mu_{V}^{2}} = (\mu_{OH} \sin 65^{\circ})^{2} + (1.57 \sin 67^{\circ} 10')^{2} + (\mu_{PhY} \sin \alpha)^{2} \quad (10)$$

$$\mu^2_{\rm obs} = \mu_{\rm H}^2 + \overline{\mu_{\rm V}^2} \tag{11}$$

moment of the molecule, parallel to the O-C(ring) axis; $\overline{\mu_{\nabla}^2}$ a mean-square moment perpendicular to this axis; ³¹ C. G. Le Fèvre and R. J. W. Le Fèvre, J. Chem. Soc., 1950, 1829.

J. Chem. Soc. (B), 1971

 μ_{PhY} the moment of the monosubstituted benzene derivative; $(1.57 \text{ D}, 67^{\circ} 10')$ the moment and inclination for the azomethine group in dioxan; $\mu_{CO} = 0.66$ D; μ_{obs} is the observed moment in dioxan, and μ_{OH} the required bond moment. For the inclined substituent group moments, angle α is taken from Table 5; α is 0° for the Me and Bu^t groups, and 180° for the remaining groups with moments directed parallel to the Y-C(ring) axis.

When values of $\mu(O-H)$ are plotted against Hammett's substituent constants, σ , an essentially linear trend is apparent. The regression equation of $\mu(O-H)$ on σ , derived by assuming no error in σ , is $\mu(O-H) = 2.25 + 100$ 0.892σ , with a mean deviation 0.17 D. The corresponding results for *para*-substituted phenols in dioxan were ⁴ μ (O-H) = 2·12 + 0·671 σ , mean deviation 0·05 D. Relevant numerical data are in Table 6.

It must be stressed that since the hydroxy-group bondmoments rest on a number of assumptions, their absolute values are of dubious significance, and interest resides in the relative values of $\mu(O-H)$.

Although the mean deviation for the hydroxybenzylideneanilines is rather high, corresponding to considerable scatter of experimental points about the regression line.

TABLE	6
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Hydroxy-group	bond	moments	of	phenols	and	N-(4-
hydroxyben	zylider	e)-4-substi	tute	danilines	in di	oxan

			N-(4-H	Iydroxy- lidene)-		
			ani	ilines	Phe	nols a
			μ(O	-H)/D	μ(O-	-H)/D
No.	4-Substnt.	<i>apara</i>	Obs.	Calc. [†]	Obs.	Calc. [†]
(4)	NMe ₂	-0.600	1.33	1.71		'
(5)	OMe	-0.268	$2 \cdot 26$	2.01		
(6)	$\mathbf{Bu^t}$	-0.197	$2 \cdot 16$	2.07		
(7)	Me	-0.170	2.23	$2 \cdot 10$	2.01	2.01
(8)	н	0.000	2.30	$2 \cdot 25$	2.04	2.12
(9)	F	0.062	2.56	2.31	2.22	2.16
(10)	C1	0.227	2.33	2.45	2.31	2.27
λ	Br	0.232	$2 \cdot 41$	2.46	2.25	2.28
(12)	I	0.276	2.36	2.50		
(13)	CO.Et	0.678	2.93	2.86		
(14)	COMe	0.874	2.76	3.03	2.65	2.71
(15)	CN	1.000	2.98	3.14	2.85	2.79
	CHO	1.126		0	2.80	2.88
(16)	NO_2	1.270	3.59	3.38	3.01	2.97
	† Calcula	ated from t	he regres	sion equat	ions.	

^a Ref. 4.

the trend suggests a dependence of the hydroxy-group bond moment upon the electrical character of the substituent, $\mu(O-H)$ increasing with increasing electronattracting power of the substituent, as reported for phenols and 4-hydroxyazobenzenes.4

Hydroxy-group Stretching Frequencies.—In carbon tetrachloride solution, the OH stretching frequency $_{0}$ (OH) of the parent N-(4-hydroxybenzylidene)aniline [Table 3, compound (8)] is appreciably less than that of phenol (3610.1 cm⁻¹); ¹³ the extended conjugation arising from introduction of the Ph·N=CH- substituent into

³² E. Bergmann and A. Weizmann, J. Amer. Chem. Soc.,

^{1935, 57, 1755.} ³³ J. B. Bentley, K. B. Everard, R. J. B. Marsden, and L. E.

phenol has an effect corresponding to the presence of an electron-attracting substituent of the ethoxycarbonyl type, and resembles the influence of the Ph·N=N-substituent in 4-hydroxyazobenzenes.⁴ In contrast, extended conjugation in *trans-p*-hydroxystilbene, which is approximately planar, results in $_{O^V}(OH) = 3607 \cdot 5 \text{ cm}^{-1}$, only slightly less than $_{O^V}(OH)$ of phenol. The greater frequency reduction in the azo- and azomethine compounds may be determined by the higher electronegativity of the nitrogen atoms which replace the carbon atoms of the stilbene bridge, and not solely by the length of the conjugated system.

 $_{\rm OV}({\rm OH})$ values for the derivatives of N-(4-hydroxybenzylidene)aniline differ little from that of the parent compound, the maximum change (4 cm⁻¹) arising for the nitro-group, which induces a shift of 15.6 cm⁻¹ from $_{\rm GV}({\rm OH})$ of phenol. Thus, the electronic influence of the substituent is transmitted to the hydroxy-group, but it is attenuated in comparison with the *para*-substituted phenols. This effect could be partially attributed to the pronounced twist of the aniline ring ²⁶ out of the C-N=C-C plane by 40—55°, so diminishing conjugation between Y·C₆H₄·N= and the phenolic ring. However, the distance of the substituent from the OH group is also important, since similar attenuation occurs in the hydroxyazobenzenes,⁴ which are planar ²⁶ and should suffer no restriction of conjugation.

In dioxan solution, $_{D}\nu(OH) \ll _{O}\nu(OH)$ for the parent compound, the large shift being characteristic of solutesolvent hydrogen bonding. For N-(4-hydroxybenzylidene)aniline, $\Delta v(OH) = 309.5$ cm⁻¹, which is appreciably greater than for phenol (277.5 cm⁻¹), implying enhanced mesomeric release by the oxygen atom in the hydrogen-bonded complex of the former compound, but slightly less than in the complex⁴ of 4-hydroxyazobenzene $[\Delta v(OH) = 316 \text{ cm}^{-1}]$. The additional frequency shifts in the N-(4-hydroxybenzylidene)anilines on substitution are larger than the corresponding shifts in carbon tetrachloride solution, but smaller than corresponding shifts in phenols: e.g., the nitro-group produces shifts in dioxan of 14.5 cm⁻¹ and 86 cm⁻¹ respectively. These effects are apparent on comparing the slopes of the regression lines of ν (OH) upon σ shown in Table 7.

If it is assumed that the relative frequency shift

between carbon tetrachloride and dioxan is a measure of the enthalpy change on association, the dependence of the O-H bond moment on the strength of hydrogenbonding, already demonstrated for phenols and hydroxy-azobenzenes,⁴ is again illustrated by plots of μ (O-H)

TABLE 7

Regression equations of $\nu(OH)$ upon σ

		Mean
Series	Equation	deviation/cm ⁻¹
$4-\mathbf{Y} \cdot \mathbf{C_6}\mathbf{H_4} \cdot \mathbf{N} = \mathbf{C}\mathbf{H} \cdot \mathbf{C_6}\mathbf{H_4} \cdot \mathbf{O}\mathbf{H}$	$_{\rm C}\nu({\rm OH}) = 3601.8 -$	0.27
	2·46σ	0.00
	$D\nu(OH) = 3293.5 - 19.7 - 19.$	0.88
4 -Y•C ₆ H₄•OH	$_{\rm O}\nu({\rm OH}) = 3610.7 -$	0.73
	12·5σ	~ .
	$_{\rm D}\nu({\rm OH}) = 3330 - 70.4\sigma$	5.4

against $\Delta \nu(OH)/_{O}\nu(OH)$. The regression equations are (12) and (13) for the N-(4-hydroxybenzylidene)anilines

$$\mu(\text{O-H}) = 0.306[10^{3}\Delta\nu(\text{OH})/_{\text{O}}\nu(\text{OH})] - 23.92 \quad (12)$$

$$\mu(\text{O-H}) = 0.0414[10^{3}\Delta\nu(\text{OH})/_{C}\nu(\text{OH})] - 1.05 \quad (13)$$

and phenols respectively, with mean deviations 0.16 D and 0.05 D. It has been pointed out that relatively large changes in hydrogen-bond strength occur on *para*-substitution in phenol, with correspondingly significant bond moment changes, whereas a range of 4'-substituents in 4-hydroxyazobenzenes alter μ (O-H) considerably but have little effect on the hydrogen-bond strength.⁴ The present results for N-(4-hydroxybenzylidene)anilines show that these compounds conform to the same pattern as the hydroxyazobenzenes. Further attention will be given to this point in Part II, concerned with a series of N-(4-substituted benzylidene)-4-hydroxyanilines (I; Y = OH).

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