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Thermal Properties of Binary Mixtures of Liquid Crystals

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Thermal Properties of Binary Mixtures of Liquid Crystals†

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INTRODUCTION

Binary mixtures of liquid crystals have been studied for a variety of reasons. For many applications a mixture will extend the mesophase temperature region particularly to cover ambient temperatures. Mixtures are sometimes used to investigate the existence of liquid crystalline phases for monotropic substances which cannot be supercooled sufficiently to allow for direct observation.[15,22] A great many studies have used mixtures to determine miscibility of the two liquid crystals and the morphology of the resulting textures.[1-12] Recently mixtures

† Part XXXVI of a series 'Order and Flow in Mesophases'

have been shown to be important as solvents for nuclear magnetic resonance studies and as stationary phases for gas chromatography separations.[27, 18]

In this article a comprehensive review of the literature that reports binary systems where both components are liquid crystals is given. Excluded are lyotropic systems where one component in the presence of another is required to form liquid crystalline system and binary systems in which only one of the components exhibits a mesophase. Althrough a relatively large number of binary systems have been studied, in many cases only the transition temperatures have been determined and these are not included. This review contains only binary systems for which phase diagrams have been determined.

A number of binary mixtures in which one component is a mesophase forming substance and the other a non-mesomorphic substance have been studied by several investigators. It was found that such mixtures form a homegenous mesophase over a certain range of temperature and concentration. Dave and his coworkers have reported a series of papers concerning these binary systems.[35-41]

Schroeder et. al.[42] have also investigated binary of 4-nitrosubstituted anils (non-mesomorphic compounds) and 4,4'-di-n-hexyloxyazoxybenzene (a mesomorphic compound exhibiting a monotropic smectic and enantiotropic nematic phases). Recently some binary systems of rod-like molecules (alkanols, polypeptide and poly-γ-benzyl-l-glutamate) with p-methoxybenzylidene-p'-n-butylaniline have been studied[43].

It is known that much work on binary mixtures is done by applications oriented researchers and much of this has not been available to us. It is also inevitable that there will be omissions from published work, but it is believed that this is a comprehensive review of the systems studied to date.

TABULATION PROCEDURES

The structures, transition temperatures and binary systems studied are listed in Table 1.

a) Column 1 of Table 1: "Compound Number"

This column gives the order numbers (1,2,3,4 . . . .) which represent the compounds. For example, number 1 represents n-$C_5H_{11}O$-  -COOH.

b) Column 2 of Table 1: "Structure"

In this column the compound structure is given. The compound structure is listed in groups based on organic functional group types used for the centeral part of the molecule. These are:

1) Aromatic carboxylic acids and derivates (other than azomethine, azo- and azoxy-compounds),  -COO–.

2) Schiff's base compounds (with only an azomethine group, -CH=N-).

3) Schiff's base compounds (with two or more azomethine groups).
4) Azine compounds (-CH=N-N=CH-).
5) Azo compounds (-N=N-).
6) Schiff's base, azo compounds (-CH=N- and -N=N-).
7) Azoxy compounds ($-N=\overset{\ominus}{N}-$).
8) Schiff's base, azoxy compounds (-CH=N- and $-\overset{\ominus}{N}=N-$).
9) Derivatives of steroids.

Each group is divided into sub-groups, according to the terminal chain lengths. Within a given sub-group, compounds are listed in order of increasing number of carbon atoms; with a fixed number of carbon atoms, the listing is in order of increasing number of hydrogen atoms.

c) Column 3 of Table 1: "Transition Temperatures, °C"

The tabulated transition temperatures in this column are the typical or average values. Where authors have repeated their own earlier measurements, only their later values are reported. The symbols used in this column are as follows:

K_1, K_2, K_3: solid phases 1, 2, and 3
Ch: cholesteric mesophase
N: nematic mesophase
S_A, S_B, S_C, S_D, S_F, S_G: sematic mesophases with special textures.

d) Column 4 of Table 1: "Binary Systems Studied"

This column gives compound numbers used for binary systems studied. The numbers in the parentheses give the Table number followed by the system number for the specific binary systems. For example, 4(6-5) represents compound 4, Table 6, system 5.

Table 2 gives the compound names and compound numbers. The tabulated compound names in this Table are based on an alphabetic order. In naming compounds Chemical Abstracts' rules were used. All names are those from Chemical Abstracts' formula index. In this Table, the compound numbers correspond to those in Table 1.

The measurement methods and some data, such as existance of phase diagrams and study purposes, of each binary system are shown in Table 3 (smectic-smectic systems). Table 4 (nematic-nematic systems), Table 5 (cholesteric-cholesteric systems), and Table 6 (mixed systems) (smectic-nematic, smectic-cholesteric, and nematic-cholesteric system), where the input components are of these mesophase types.

TABLE 1

Compound Numbers, Structures, Transition Temperatures and Binary Systems Studied

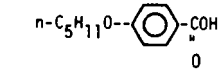
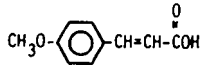
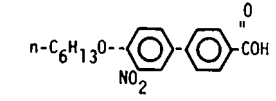
Compound Number	Structure	Transition Temperatures, °C	Binary System Studied
	I. Aromatic carboxylic acids and derivatives (other than Schiff's base, azo and azoxy compounds).		
	p-(Alkoxy) benzoic acids		
1		$K \xrightarrow{124} N \xrightarrow{151} I$	4(6-5)
2	n-$C_6H_{13}O$--	$K \xrightarrow{105} N \xrightarrow{153} I$	125(4-55)
3	n-$C_7H_{15}O$--	$K \xrightarrow{92} S \xrightarrow{98} N \xrightarrow{146} I$	4(3-141)
4	n-$C_8H_{17}O$--	$K \xrightarrow{100.7} S_C \xrightarrow{107.5} N \xrightarrow{147.3} I$	159(3-26), 5(3-28), 133(3-29), 166(3-89), 3(3-141), 1(6-5), 125(6-6)
5	n-$C_{12}H_{25}O$--	$K \xrightarrow{88.5} S_C \xrightarrow{131.1} N \xrightarrow{138.3} I$	146(3-22), 4(3-28), 166(3-90)
6		$K \xrightarrow{173.8} N \xrightarrow{188.3} I$	126(4-6), 125(4-8)
	4'-(Alkoxy) 3'-nitro-4-biplenylcarboxylic acids		
7		$K \xrightarrow{133.4} S_C \xrightarrow{163.3} S_A \xrightarrow{213.5} N \xrightarrow{218.3} I$	92(3-124), 11(3-133), 10(3-138)
8	n-$C_{12}H_{25}O$--	$K \xrightarrow{97.5} S_C \xrightarrow{198.2} S_A \xrightarrow{208.9} I$	152(3-128), 9(3-130), 11(3-131), 10(3-136)

Table 1 (Cont'd)

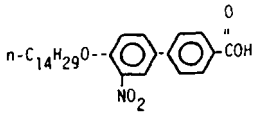
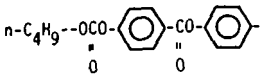
9			$K \xrightarrow{114.5} S_C \xrightarrow{195.0} S_A \xrightarrow{206.5} I$	146(3-77), 152(3-129), 8(3-130), 11(3-132), 10(3-137)
10	n-$C_{16}H_{33}O$--		$K \xrightarrow{126.8} S_C \xrightarrow{171.0} S_D \xrightarrow{197.2} S_A \xrightarrow{201.9} I$	11(3-134), 149(3-135), 8(3-136), 9(3-137), 7(3-138)
11	n-$C_{18}H_{37}O$--		$K \xrightarrow{124.6} S_C \xrightarrow{158.9} S_D \xrightarrow{195} I$	8(3-131), 9(3-132), 7(3-133), 10(3-134)
	Carbonic acids, alkyl ester, ester with p-(Alkoxy)-phenyl p-hydroxybenzoate			
12	n-C_4H_9--OCO-  --OC_2H_5 (See also 13)		$K \xrightarrow{55} N \xrightarrow{86} I$	44(4-26)
13	n-C_4H_9--	"	$K \xrightarrow{48.7} N \xrightarrow{86.3} I$	65(4-52), 108(4-53), 109(4-54)
14	n-C_5H_{11}--	--OC_5H_{11}-n	$K \xrightarrow{45} N \xrightarrow{85} I$	16(4-27), 15(4-29)
15	n-C_5H_{11}--	--OC_6H_{13}-n	$K \xrightarrow{42} N \xrightarrow{74} I$	16(4-28), 14(4-29)
16	n-C_5H_{11}--	--OC_7H_{15}-n	$K \xrightarrow{47} N \xrightarrow{72} I$	14(4-27), 15(4-28)
17	n-C_6H_{13}--	--OC_6H_{13}-n	$K \xrightarrow{44} N \xrightarrow{84} I$	18(4-30)
18	n-C_6H_{13}--	--OC_7H_{15}-n	$K \xrightarrow{36} N \xrightarrow{54} I$	17(4-30)

Table 1 (Cont'd)

p-Alkoxybenzoic acids, p-phenylene ester

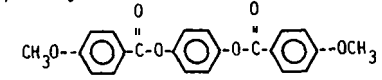
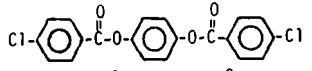
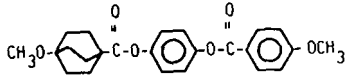
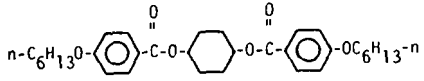
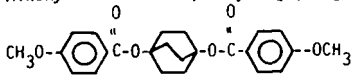
19		K $\xrightarrow{213}$ N $\xrightarrow{297}$ I	29(4-15), 27(4-16), 32(4-17)
20	C_2H_5O-- --OC_2H_5	K $\xrightarrow{226}$ N $\xrightarrow{287}$ I	33(4-18)
21	n-C_3H_7O-- --OC_3H_7-n	K $\xrightarrow{173.5}$ N $\xrightarrow{248}$ I	34(4-19)
22	n-C_4H_9O-- --OC_4H_9-n	K $\xrightarrow{153}$ N $\xrightarrow{241}$ I	35(4-20)
23	n-$C_6H_{13}O$-- --OC_6H_{13}-n	K $\xrightarrow{121.5}$ N $\xrightarrow{211}$ I	36(4-21)
24	n-$C_7H_{15}O$-- --OC_7H_{15}-n	K $\xrightarrow{121}$ N $\xrightarrow{198}$ I	37(4-22)
25	n-$C_8H_{17}O$-- --OC_8H_{17}-n	K $\xrightarrow{118}$ N $\xrightarrow{192}$ I	31(4-25)
26		K $\xrightarrow{226}$ N $\xrightarrow{246}$ I	38(4-23)
27		K $\xrightarrow{189}$ N $\xrightarrow{221}$ I	19(4-16)
28		K $\xrightarrow{122}$ N $\xrightarrow{136}$ I	30(4-24)

Table 1 (Cont'd)

p-Alkoxybenzoic acids, bicyclo[2,2,2] oct-1,4- ylene ester

29			K $\xrightarrow{185}$ N $\xrightarrow{269}$ I	19(4-15)
30	n-C_3H_7 O--	--OC_3H_7-n	K $\xrightarrow{141}$ N $\xrightarrow{190.5}$ I	28(4-24)
31	n-C_8H_{17}O--	--OC_8H_{17}-n	K $\xrightarrow{119}$ N $\xrightarrow{171}$ I	25(4-25)

Terephthalic acids, bis(p-alkoxyphenyl) ester

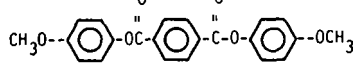
32			K $\xrightarrow{205}$ N $\xrightarrow{277}$ I	19(4-17)
33	--OC_2H_5--	--OC_2H_5	K $\xrightarrow{216}$ N $\xrightarrow{266.5}$ I	20(4-18)
34	n-C_3H_7O--	--OC_3H_7-n	K $\xrightarrow{198}$ N $\xrightarrow{238}$ I	21(4-19)
35	n-C_4H_9O--	--OC_4H_9-n	K $\xrightarrow{183}$ N $\xrightarrow{229}$ I	22(4-20)
36	n-C_6H_{13}O--	--OC_6H_{13}-n	K $\xrightarrow{161}$ N $\xrightarrow{201}$ I	23(4-21)
37	n-C_7H_{15}O--	--OC_7H_{15}-n	K $\xrightarrow{153}$ N $\xrightarrow{188}$ I	24(4-22)

Table 1 (Cont'd)

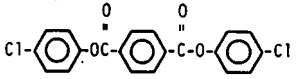
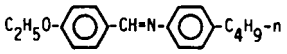
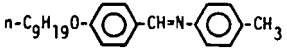
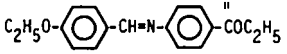
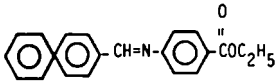
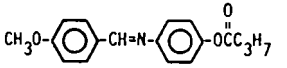
38		K $\xrightarrow{195}$ N $\xrightarrow{226}$ I	26(4-23)
	II. Schiff's base derivatives (with only an azomethine group, -CH=N-)		
39		K $\xrightarrow{36.2}$ N $\xrightarrow{78.5}$ I	125(4-61)
40		K $\xrightarrow{73.8}$ S_A $\xrightarrow{74.2}$ N $\xrightarrow{76.8}$ I; $S_A \rightarrow S_B$ 64.5	73(3-106)
41		$K_2 \rightarrow K_1 \xrightarrow{92.1}$ I; 82.4; $S_A \xleftarrow{77.7}$ N	137(3-48)
42		K $\xrightarrow{121.6}$ S_A $\xrightarrow{131.0}$ I	136(3-35)
	Acyclic acids, p-[(p-alkoxybenzylidene)amino]phenyl ester		
43		K $\xrightarrow{52}$ N $\xrightarrow{110}$ I	44(4-31), 45(4-32), 46(4-33), 47(4-34), 48(4-35), 49(4-36), 50(4-37), 51(4-38), 52(4-39), 53(4-40), 54(4-41), 55(4-42), 56(4-43), 57(4-44), 58(4-45), 59(4-46), 60(4-47), 61(4-48), 62(4-49), 63(4-50), 64(4-51)

Table 1 (Cont'd)

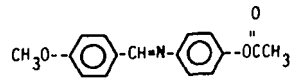
44	CH_3O-- 	-CH=N-	K $\xrightarrow{82}$ N $\xrightarrow{109}$ I	12(4-26), 43(4-31), 125(4-60)
45	C_2H_5O--	"	K $\xrightarrow{109}$ N $\xrightarrow{131}$ I	43(4-32)
46	C_3H_7O--	"	K $\xrightarrow{95}$ N $\xrightarrow{106}$ I	43(4-33)
47	C_4H_9O--	"	K $\xrightarrow{82}$ N $\xrightarrow{113}$ I	43(4-34)
48	$C_5H_{11}O$--	"	K $\xrightarrow{87}$ N $\xrightarrow{105}$ I	43(4-35)
49	CH_3O--	--OCC$_2H_5$	K $\xrightarrow{72}$ N $\xrightarrow{109}$ I	43(4-36)
50	C_2H_5O--	"	K $\xrightarrow{111}$ N $\xrightarrow{134}$ I	43(4-37)
51	C_3H_7O--	"	K $\xrightarrow{97}$ N $\xrightarrow{111}$ I	43(4-38)
52	C_4H_9O--	"	K $\xrightarrow{85}$ N $\xrightarrow{119}$ I	43(4-39)
53	$C_5H_{11}O$--	"	K $\xrightarrow{82}$ N $\xrightarrow{109}$ I	43(4-40)
54	C_4H_9O--	--OCC$_3H_7$	K $\xrightarrow{87}$ N $\xrightarrow{120}$ I	43(4-41)

Table 1 (Cont'd)

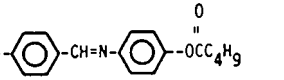
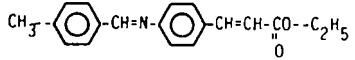
55	C_4H_9O--  --OCC_4H_9		$K \xrightarrow{75} N \xrightarrow{112} I$	43(4-42)
56	$C_5H_{11}O$--	--OCC_4H_9	$K \xrightarrow{83} N \xrightarrow{105} I$	43(4-43)
57	C_3H_7O--	--OCC_5H_{11}	$K \xrightarrow{85} N \xrightarrow{108} I$	43(4-44)
58	C_4H_9O--	"	$K \xrightarrow{80} N \xrightarrow{114} I$	43(4-45)
59	$C_5H_{11}O$--	"	$K \xrightarrow{82} N \xrightarrow{111} I$	43(4-46)
60	C_3H_7O--	--OCC_6H_{13}	$K \xrightarrow{67} N \xrightarrow{116} I$	43(4-47)
61	C_4H_9O--	"	$K \xrightarrow{71} N \xrightarrow{98} I$	43(4-48)
62	$C_5H_{11}O$--	"	$K \xrightarrow{89} N \xrightarrow{104} I$	43(4-49)
63	C_4H_9O--	--OCC_7H_{15}	$K \xrightarrow{70} N \xrightarrow{110} I$	43(4-50)
64	$C_5H_{11}O$--	--$OC\ C_9H_{19}$	$K \xrightarrow{82} N \xrightarrow{106} I$	43(4-51)
65	CH_3O--	--OC- 	$K \xrightarrow{113.5} N \xrightarrow{151.4} I$	13(4-52)

Table I (Cont'd)

p-[(p-Alkylbenzilidene)amino]cinnamic acids, alkyl ester

66			$K \xrightarrow{94} S_B \xrightarrow{106.5} S_A \xrightarrow{118} I$	73(3-33)
67		$--C_2H_5$	$K \xrightarrow{143.3} S_B \xrightarrow{181.9} S_A \xrightarrow{211.2} N \xrightarrow{217} I$	73(3-105),119(3-114)
68		$--C_3H_7$-n	$K \xrightarrow{110\text{-}114} S_A \xrightarrow{125} N \xrightarrow{139} I$	73(3-83)
69			$K_1 \rightarrow K_2 \xrightarrow{192.9} N \xrightarrow{304} I$; $S_A \xrightarrow{182.8}$	74(3-63)

p-[(p-Alkoxybenzylidene)amino]cinnamic acids, alky ester

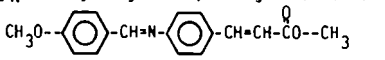
70			$K_2 \rightarrow K_1 \xrightarrow{160.5} N \xrightarrow{181.7} I$; $S_A \xrightarrow{137.1}$	73(3-84)
71	CH_3O--	$--C_2H_5$	$K_2 \rightarrow K_1 \xrightarrow{107} S_A \xrightarrow{117.6} N \xrightarrow{138.5} I$; $\xrightarrow{80} S_B \xrightarrow{91}$	73(3-10), 135(3-96)
72	C_2H_5O--	$--CH_3$	$K_2 \rightarrow K_1 \xrightarrow{132.7} S_A \xrightarrow{164.5} N \xrightarrow{194.5} I$; $S_B \xrightarrow{127.0}$	73(3-104)

Table 1 (Cont'd)

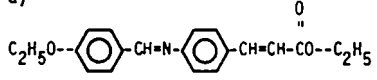
73			$K \xrightarrow{81.4} S_B \xrightarrow{119.3} S_A \xrightarrow{157.3} N \xrightarrow{160.2} I$	136(3-4), 131(3-5), 135(3-6), 71(3-10), 82(3-31), 81(3-32), 63(3-33), 84(3-81), 166(3-82), 68(3-83), 70(3-84), 133(3-85), 134(3-86), 86(3-103), 72(3-104), 67(3-105), 40(3-106), 89(3-107), 90(3-108), 113(3-109), 115(3-110), 168(3-119) 79(3-125), 120(3-139)
74	C_2H_5O--		$K \xrightarrow{160.4} S_A \xrightarrow{164.6} N \xrightarrow{242} I$	69(3-63), 146(3-71)
75	n-$C_8H_{17}O$--	--C_5H_{11}-iso	$K \xrightarrow{80.2} S_B \xrightarrow{84.8} S_C \xrightarrow{102.6} S_A \xrightarrow{127.7} I$	79(3-127)
76	n-$C_9H_{19}O$--	--C_5H_{11}-n	$K \xrightarrow{77.6} S_B \xrightarrow{94.6} S_C \xrightarrow{102.7} S_A \xrightarrow{137.2} I$	
77	n-$C_{10}H_{21}O$--	--C_5H_{11}-n	$K \xrightarrow{73.8} S_B \xrightarrow{97.0} S_C \xrightarrow{105.6} S_A \xrightarrow{136.8} I$	
78	n-$C_{10}H_{21}O$--	--C_5H_{11}-iso	$K \xrightarrow{76.4} S_C \xrightarrow{100.1} S_A \xrightarrow{122.4} I$; $S_C \rightarrow S_B$ 75.4	
79	n-$C_{12}H_{25}O$--	--C_5H_{11}-n	$K \xrightarrow{73.9} S_B \xrightarrow{95.0} S_C \xrightarrow{106.7} S_A \xrightarrow{134.3} I$	73(3-125), 135(3-126), 75(3-127)

Table 1 (Cont'd)

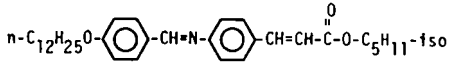
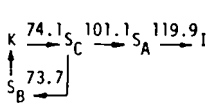
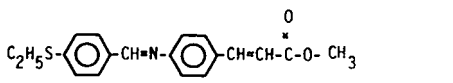
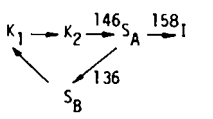
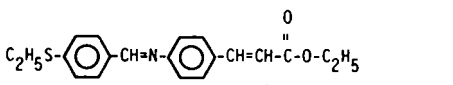
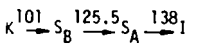
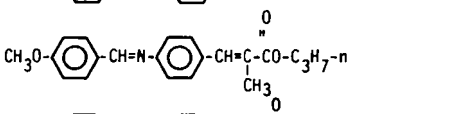
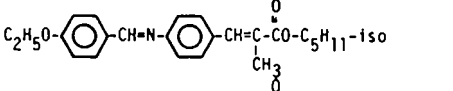
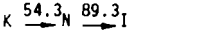
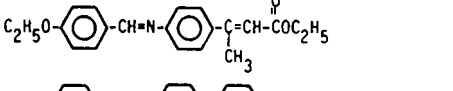
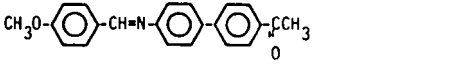
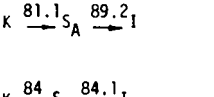
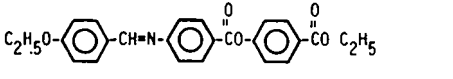
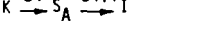
80			
81			73(3-32), 153(3-69)
82			73(3-31), 135(3-87), 159(3-88)
83			112(4-11), 106(4-12)
84			73(3-81)
85			137(3-42)
86			73(3-103), 116(3-113), 89(3-115), 119(3-116),
87			165(3-58)

Table 1 (Cont'd)

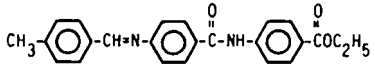
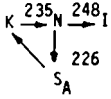
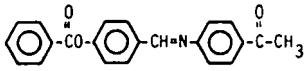
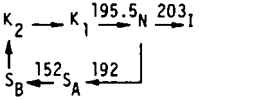
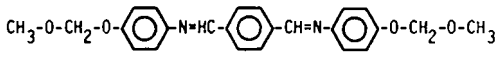
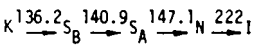
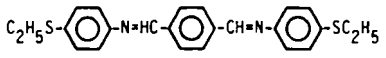
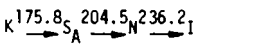
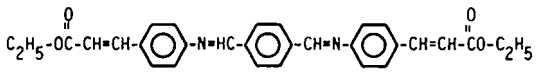
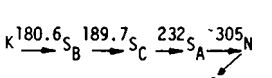
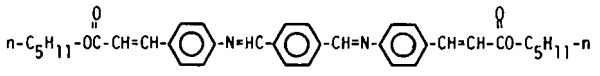
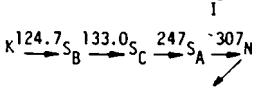
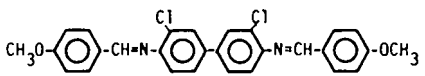
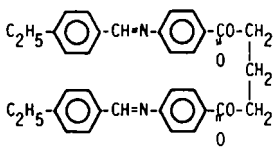
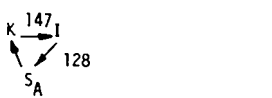
88			138(3-44)
89			73(3-107), 86(3-115)
	III. Schiff's base derivatives (with two azomethine groups)		
90			73(3-108), 119(3-117), 168(3-120), 169(3-121), 92(3-122)
91			
92			90(3-122), 7(3-124)
93			
94			125(4-14)
95			136(3-37)

Table 1 (Cont'd)

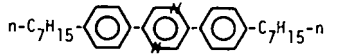
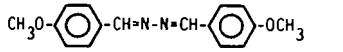
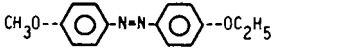
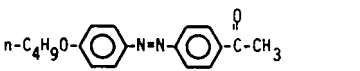
96		$K \xrightarrow{79} S_G \xrightarrow{102.7} S_F \xrightarrow{113.8} S_C \xrightarrow{144} S_A \xrightarrow{210} I$	97(3-140)
97		$K \xrightarrow{110} S_C \xrightarrow{177} S_A \xrightarrow{185} I$	96(3-140)
	IV. Azine compounds (-CH=N-N=CH-)		
98		$K \xrightarrow{170.0} N \xrightarrow{183.2} I$	125(4-58), 126(4-59)
	IV. Azo compounds, (-N=N-)		
	4-Alkoxy-4'-alkoxyazobenzenes		
99		$K \xrightarrow{134.5} I$; $N \rightarrow 132.2$	125(4-2), 100(4-4), 126(4-5)
100	C_2H_5O-- --OC_2H_5	$K \xrightarrow{160.2} I$; $N \rightarrow 156.1$	99(4-4), 126(4-7)
101	CH_3O-- --OC_3H_7-n	$K \xrightarrow{113.1} I$; $N \rightarrow 110.0$	102(4-3)
102	C_2H_5O-- --OC_3H_7-n	$K \xrightarrow{144.2} I$; $N \rightarrow 139.6$	101(4-3)
	p-[(p-Alkoxyphenyl)azo]acetophenones		
103		$K \xrightarrow{109.1} S_A \xrightarrow{112.5} N \xrightarrow{122.2} I$	136(3-40)

Table 1 (Cont'd)

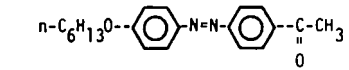
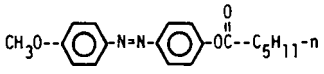
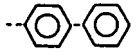
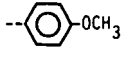
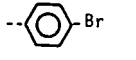
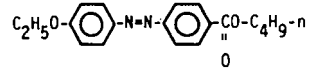
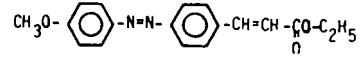
104		$K \xrightarrow{102.4} S_A \xrightarrow{119.4} N \xrightarrow{120.4} I$	105(3-47), 116(3-62)
105	$n\text{-}C_{12}H_{25}O\text{--}$ "	$K \xrightarrow{106} S_A \xrightarrow{116} I$	136(3-38),104(3-47), 166(3-61)
	4-Alkylcarboxylic acid, p-[(p-alkoxyphenyl)azo]phenyl ester		
106		$K \xrightarrow{66.6} N \xrightarrow{106.6} I$	112(4-10), 83(4-12)
107	$CH_3O\text{--}$ 	$K_2 \rightarrow K_1 \xrightarrow{206} N \xrightarrow{355} I$; $S_A \xrightarrow{172}$	165(3-64)
108	$C_2H_5O\text{--}$ $\text{--}C_5H_{11}\text{-}n$	$K \xrightarrow{63.1} N \xrightarrow{116.9} I$	13(4-53)
109	$C_2H_5O\text{--}$ $\text{--}(CH_2)_8\text{-}CH{=}CH_2$	$K \xrightarrow{58.4} N \xrightarrow{106} I$	13(4-54)
110	$CH_3\overset{\overset{O}{\|}}{C}\text{--}$ 	$K_2 \rightarrow K_1 \xrightarrow{188.0} N \xrightarrow{303} I$; $S_A \xrightarrow{155.3}$	111(3-43)
111	$C_2H_5O\overset{\overset{O}{\|}}{C}\text{--}$ 	$K \xrightarrow{152.1} S_A \xrightarrow{194} N \xrightarrow{257} I$	110(3-43), 156(3-53)
112		$K \xrightarrow{63.5} N \xrightarrow{66.8} I$; $S_A \xrightarrow{60.5}$	137(3-49), 106(4-10), 83(4-11)
113		$K \xrightarrow{117.7} S_A \xrightarrow{124.2} N \xrightarrow{142.8} I$	73(3-109)

Table 1 (Cont'd)

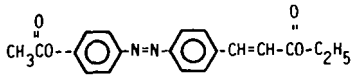
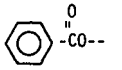
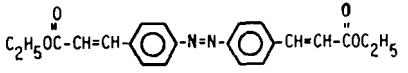
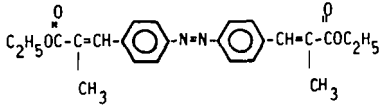
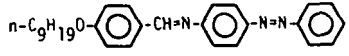
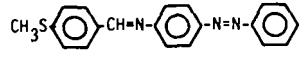
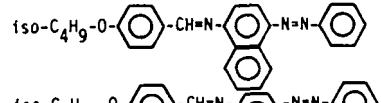
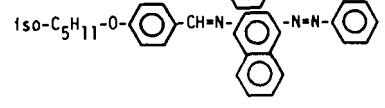
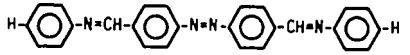
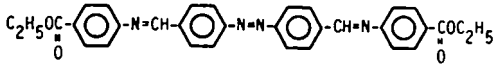
114		$K \xrightarrow{138.3} S_A \xrightarrow{153.2} N \xrightarrow{162.2} I$	115(3-112)
115		$K \xrightarrow{120.8} S_A \xrightarrow{148.2} N \xrightarrow{158.0} I$	73(3-110), 116(3-111) 114(3-112)
116		$K \xrightarrow{140.3} S_A \xrightarrow{178.9} N \xrightarrow{222} I$	104(3-62), 115(3-111), 86(3-113)
117		$K \xrightarrow{156.0} S_A \xrightarrow{240} I$	136(3-36)
118		$K_3 \rightarrow K_2 \rightarrow K_1 \xrightarrow{118.4} I$; $K_3 \xrightarrow{102.1} S_A$; $K_1 \xrightarrow{106.1} N$	156(3-65)
	VI. Schiff's base, azo compounds (-CH=N and -N=N-)		
119		$K \xrightarrow{107.4} S_B \xrightarrow{124.4} S_A \xrightarrow{156.2} N \xrightarrow{162.1} I$	67(3-114), 86(3-116) 90(3-117)
120		$K \xrightarrow{111.1} N \xrightarrow{113.8} I$; $K \xrightarrow{104.6} S_B$	73(3-139)
121		$K \xrightarrow{106} I$; $N \xrightarrow{22} K$	122(4-13)
122		$K \xrightarrow{110} I$; $N \xrightarrow{78} K$	121(4-13)

Table 1 (Cont'd)

123		$K \xrightarrow{218} S_A \xrightarrow{228} N \xrightarrow{305} I$	165(3-60)
124		$K \xrightarrow{206.5} S_A \xrightarrow{309} N > \xrightarrow{360} I$	170(3-54)

VII. Azoxy Compounds (-N=N-)

4,4'-Bis(alkoxy)azoxybenzenes

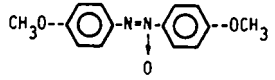
125			$K \xrightarrow{119.5} N \xrightarrow{136.5} I$	126(4-1), 99(4-2), 6(4-8), 129(4-9), 94(4-14), 2(4-55), 127(4-56), 128(4-57), 98(4-58), 44(4-60), 39(4-61), 4(6-6), 130(6-7), 173(6-10)
126	C_2H_5O--	--OC_2H_5	$K \xrightarrow{136.9} N \xrightarrow{167.5} I$	125(4-1), 99(4-5), 4(4-6), 100(4-7), 98(4-59), 131(6-3), 136(6-4), 173(6-8), 180(6-9)
127	n-C_3H_7O--	--OC_3H_7-n	$K \xrightarrow{118.3} N \xrightarrow{124.0} I$	125(4-56)
128	n-C_4H_9O--	--OC_4H_9-n	$K \xrightarrow{105.8} N \xrightarrow{136.6} I$	125(4-57), 135(6-1) 131(6-2)
129	n-$C_6H_{13}O$--	--OC_6H_{13}-n	$K \xrightarrow{81} N \xrightarrow{129} I$	125(4-9)
130	n-$C_7H_{15}O$--	--OC_7H_{15}-n	$K \xrightarrow{73.1} S_C \xrightarrow{95.1} N \xrightarrow{123.9} I$	153(3-17), 159(3-18), 135(3-27), 125(6-7)

Table 1 (Cont'd)

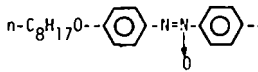
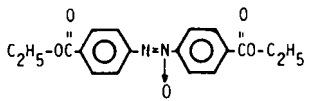
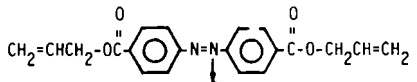
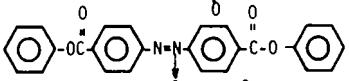
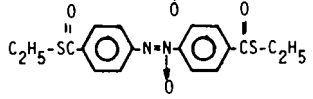
131		$K \xrightarrow{78.5} S_C \xrightarrow{108.4} N \xrightarrow{126.2} I$	132(3-1), 133(3-2), 135(3-3), 73(3-5), 128(6-2), 126(6-3),
132	n-C_9H_{19}O-- --OC_9H_{19}-n	$K \xrightarrow{74.5} S_C \xrightarrow{112.1} N \xrightarrow{121.1} I$	131(3-1)
133	n-$C_{10}H_{21}$O-- --O$C_{10}H_{21}$-n	$K \xrightarrow{77.5} S_C \xrightarrow{120.5} N \xrightarrow{123.4} I$	131(3-2), 159(3-19), 153(3-23), 4(3-29), 73(3-85), 166(3-91)
134	n-$C_{11}H_{23}$O-- --O$C_{11}H_{23}$-n	$K \xrightarrow{80.3} S_C \xrightarrow{121.2} I$	135(3-30), 73(3-86)
135	n-$C_{12}H_{25}$O-- --O$C_{12}H_{25}$-n	$K \xrightarrow{80.8} S_C \xrightarrow{121.9} I$	131(3-3), 73(3-6),146(3-8), 136(3-9), 140(3-11), 130(3-27), 134(3-30), 82(3-87), 71(3-95), 79(3-126), 128(6-1)
136		$K \xrightarrow{113.7} S_A \xrightarrow{122.5} I$	76(3-4), 135(3-9), 140(3-12), 137(3-34), 42(3-35), 117(3-36), 95(3-37), 105(3-38), 139(3-39), 103(3-40), 166(3-41), 126(6-4)
137		$K \xrightarrow{88.6} S_A \xrightarrow{93.8} I$	136(3-34), 85(3-42), 41(3-48), 112(3-49)
138		$K \xrightarrow{206.4} S_A \xrightarrow{217} N \xrightarrow{281} I$	88(3-44), 140(3-45), 165(3-51), 154(3-52)
139		$K \xrightarrow{124.6} S_A \xrightarrow{174} N \xrightarrow{236} I$	136(3-39)

Table 1 (Cont'd)

4,4'-Azoxycinnamic acids, dialkyl ester

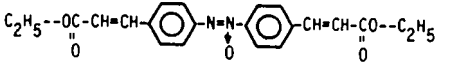
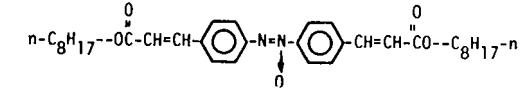
140			$K_2 \rightarrow K_1 \overset{135.7}{\rightarrow} S_A \overset{267}{\rightarrow} I$; $S_C \overset{100.4}{\leftarrow}$	135(3-11), 136(3-12), 147(3-13), 138(3-45), 166(3-46)
141	n-C_3H_7--	--C_3H_7-n	$K \overset{120.7}{\rightarrow} S_A \overset{252.3}{\rightarrow} I$	166(3-96)
142	n-C_4H_9--	--C_4H_9-n	$K \overset{111.2}{\rightarrow} S_C \overset{115.3}{\rightarrow} S_A \overset{222.1}{\rightarrow} I$	166(3-97)
143	n-C_5H_{11}--	--C_5H_{11}-n	$K \overset{99.4}{\rightarrow} S_C \overset{142.9}{\rightarrow} S_A \overset{203.0}{\rightarrow} I$	166(3-98)
144	iso-C_5H_{11}--	--C_5H_{11}-iso	$K \overset{142.2}{\rightarrow} S_C \overset{156.9}{\rightarrow} S_A \overset{187.8}{\rightarrow} I$	146(3-24)
145	$CH_3CH_2\underset{CH_3}{\underset{\vert}{C}}HCH_2$--	--$CH_2\underset{CH_3}{\underset{\vert}{C}}HCH_2CH_3$	$K_1 \overset{136.2}{\rightarrow} I$; $K_2 \overset{135.6}{\leftrightarrow} S_A \overset{133.6}{\rightarrow}$	146(3-70)
146	n-C_6H_{13}--	--C_6H_{13}-n	$K \overset{95.1}{\rightarrow} S_C \overset{156.1}{\rightarrow} S_A \overset{188.7}{\rightarrow} I$	136(3-7), 135(3-8), 147(3-16), 159(3-20), 153(3-21), 144(3-24), 158(3-66), 160(3-67), 161(3-68), 145(3-70), 74(3-71), 166(3-72), 9(3-77), 156(3-78), 157(3-79), 155(3-80), 167(3-92)
147	n-C_7H_{15}--	--C_7H_{15}-n	$K \overset{92}{\rightarrow} S_C \overset{160.0}{\rightarrow} S_A \overset{182.5}{\rightarrow} I$	140(3-13), 152(3-14), 150(3-15), 146(3-16), 5(3-22), 166(3-76)

Table 1 (Cont'd)

148		K $\xrightarrow{92.4}$ S_C $\xrightarrow{162.3}$ S_A $\xrightarrow{175.3}$ I	166(3-99), 168(3-118)
149	$n\text{-}C_9H_{19}$-- --C_9H_{19}-n	K $\xrightarrow{94.3}$ S_C $\xrightarrow{161.6}$ S_A $\xrightarrow{170.7}$ I	166(3-100), 10(3-149)
150	$n\text{-}C_{10}H_{21}$-- --$C_{10}H_{21}$-n	K $\xrightarrow{97.6}$ S_C $\xrightarrow{159.0}$ S_A $\xrightarrow{165.2}$ I	147(3-15), 166(3-73)
151	$n\text{-}C_{11}H_{23}$-- --$C_{11}H_{23}$-n	K $\xrightarrow{97.3}$ S_C $\xrightarrow{156.1}$ S_A $\xrightarrow{160.2}$ I	166(3-101)
152	$n\text{-}C_{12}H_{25}$-- --$C_{12}H_{25}$-n	K $\xrightarrow{101.6}$ S_C $\xrightarrow{152.8}$ S_A $\xrightarrow{156.2}$ I	147(3-14), 166(3-74), 166(3-102), 8(3-128), 9(3-129)
153	$n\text{-}C_{16}H_{33}$-- --$C_{16}H_{33}$-n	K $\xrightarrow{107.1}$ S_C $\xrightarrow{133.0}$ S_A $\xrightarrow{135.0}$ I	130(3-17), 146(3-21), 133(3-23), 159(3-25), 81(3-69), 166(3-75)
154	 -- -- 	K $\xrightarrow{193.0}$ S_A $\xrightarrow{214}$ N $\xrightarrow{300}$ I	138(3-52)

4,4'-Azoxybis(α-methylcinnamic acids), dialkyl ester

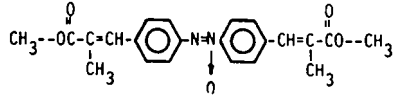
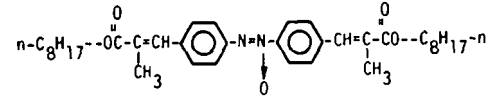
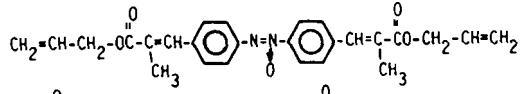
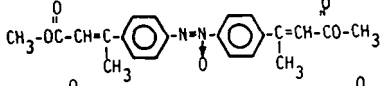
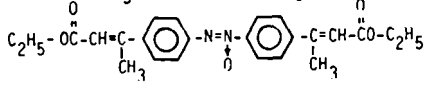
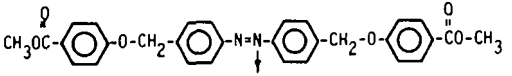
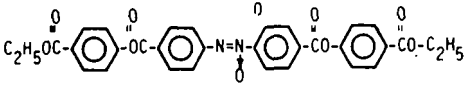
155		K$_2$ $\rightarrow$ K$_1$ $\xrightarrow{145.4}$ N $\xrightarrow{176.5}$ I; K$_2$ $\rightarrow$ S_A $\xrightarrow{135.6}$	146(3-80)
156	C_2H_5-- --C_2H_5	K $\xrightarrow{107.2}$ S_A $\xrightarrow{134.1}$ N $\xrightarrow{139.2}$ I	162(3-50), 111(3-53), 118(3-65), 146(3-78)
157	$n\text{-}C_3H_7$-- --C_3H_7-n	K $\xrightarrow{71.1}$ S_A $\xrightarrow{128.4}$ N $\xrightarrow{130.4}$ I	146(3-79)

Table 1 (Cont'd)

158		K $\xrightarrow{61.1}$ S_A $\xrightarrow{87.3}$ I	146(3-66)
159		K $\xrightarrow{75.6}$ S_G $\xrightarrow{84.4}$ I	130(3-18), 133(3-19), 146(3-20), 153(3-25), 4(3-26), 82(3-88)
160		K $\xrightarrow{70.1}$ S_A $\xrightarrow{125.4}$ I	146(3-67)
161		K $\xrightarrow{106.1}$ S_A $\xrightarrow{118.1}$ I	146(3-68)
162		$K_2 \rightarrow K_1 \xrightarrow{99.1} I$; $K_2 \rightarrow S_A \xrightarrow{82} I$	156(3-50)
163		K $\xrightarrow{177}$ S_A $\xrightarrow{192}$ N^- $\xrightarrow{260}$ I	164(3-56), 166(3-57)
164		K $\xrightarrow{167}$ S_A $\xrightarrow{315}$ N^- $\xrightarrow{350}$ I	163(3-56)

VIII. Schiff's base, azoxy compounds (-CH=N- and -N(→O)=N-)

N,N'-[Azoxybis-(p-phenylenemethylidyne)]-bis(alkylanilines)

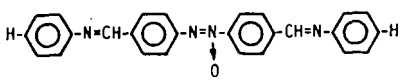
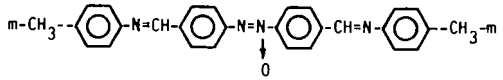
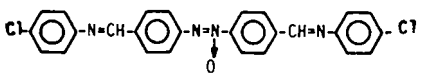
165		K $\xrightarrow{190.5}$ S_A $\xrightarrow{234}$ N^- $\xrightarrow{300}$ I	138(3-51), 87(3-58), 171(3-59), 123(3-60), 107(3-64), 167(3-93)

Table 1 (Cont'd)

166			$K \xrightarrow{142.1} S_A \xrightarrow{167.3} N \xrightarrow{169.8} I$; $S_C \xrightarrow{124.5}$	136(3-41), 140(3-46), 163(3-57), 104(3-61), 146(3-72), 150(3-73), 152(3-74), 153(3-75), 147(3-76), 73(3-82), 4(3-89), 5(3-90), 133(3-91) 141(3-96), 142(3-97), 143(3-98), 148(3-99), 149(3-100), 151(3-101), 152(3-102)
167	p-CH_3--	--CH_3-p	$K_2 \xrightarrow{187} K_1 \xrightarrow{193} N \xrightarrow{>350} I$; $S_C \xrightarrow{192.4}$	146(3-92), 165(3-93) 171(3-94)
168	CH_3-O-CH_2O--	--O-CH_2-O-CH_3	$K \xrightarrow{136.9} S_B \xrightarrow{153.3} S_C \xrightarrow{207.3} S_A \xrightarrow{\sim 290} N \xrightarrow{\sim 290} I$	148(3-118), 73(3-119), 90(3-120), 169(3-123)
169	n-$C_4H_9OCH_2O$--	--$OCH_2OC_4H_9$-n	$K \xrightarrow{108.0} S_B \xrightarrow{133.5} S_C \xrightarrow{\sim 206} S_A \xrightarrow{\sim 276} N$; $I \xrightarrow{284}$	90(3-121), 168(3-123)
170	C_2H_5OC--	--COC_2H_5	$K \xrightarrow{156} S_A \xrightarrow{305} N \xrightarrow{\sim 360} I$	124(3-54), 171(3-55)
171			$K \xrightarrow{192.8} S_A \xrightarrow{202} N \xrightarrow{>360} I$	170(3-55), 165(3-59), 167(3-94)

IX. Derivatives of steroids

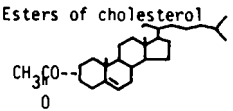
172	Esters of cholesterol 	176(5-3)

Table 1 (Cont'd)

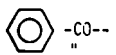
173	n-C_2H_5CO-- O	K $\xrightarrow{101}$ Ch $\xrightarrow{117}$ I	126(6-8), 125(6-10)
174	n-C_8H_{17}CO-- O	K $\xrightarrow{78}$ Ch $\xrightarrow{92}$ I	176(5-4)
175	n-$C_{10}H_{21}$CO-- O	K $\xrightarrow{92}$ I $\uparrow$ $\downarrow$ 88 S $\xleftarrow{80}$ Ch	176(5-1)
176	n-$C_{13}H_{27}$CO-- O	K $\xrightarrow{70.5}$ S $\xrightarrow{78}$ Ch $\xrightarrow{83}$ I	175(5-1), 177(5-2), 172(5-3), 174(5-4)
177	n-$C_{17}H_{35}$CO-- O	K $\xrightarrow{82}$ I $\uparrow$ $\downarrow$ 77 S $\xleftarrow{72}$ Ch	176(5-2), 178(5-5) 179(5-6)
178	$CH_3(CH_2)_7CH{=}CH(CH_2)_7$CO-- O	K $\xrightarrow{50.6}$ I $\uparrow$ $\downarrow$ 45.1 S $\xrightarrow{39.05}$ Ch	177(5-5), 179(5-7)
179	$CH_3(CH_2CH{=}CH)_3(CH_2)_7$CO-- O	K $\xrightarrow{41.3}$ I $\uparrow$ $\downarrow$ 45.1 S $\xleftarrow{32.6}$ Ch	177(5-6), 178(5-7)
180	 -CO-- O	K $\xrightarrow{149.5}$ Ch $\xrightarrow{178.8}$ I	126(6-9)

TABLE 2
Names and Compound Numbers

Name	Compound Number
Acetic acid, p-[(p-butoxybenzylidene)amino]phenyl ester	47
Acetic acid, p-[(p-ethoxybenzylidene)amino]phenyl ester	45
Acetic acid, p-[(p-methoxybenzylidene)amino]phenyl ester	44
Acetic acid, p-[(p-pentoxybenzylidene)amino]phenyl ester	48
Acetic acid, p-[(p-propoxybenzylidene)amino]phenyl ester	46
P-Anisalazine	98
p-Anisic acid, bicyclo[2,2,2]oct-1,4-ylene ester	29
p-Anisic acid, p-phenylene ester	19
p-Anisic acid, ester with 4'-[(p-hydroxyphenyl)azo]acetophenone	110
p-Azoanisolephenetole	99
4,4'-Azobis(α-methylcinnamic acid), diethyl ester	118
N,N'-[Azobis(p-phenylenemethylidyne)]dianiline	123
4,4'-[Azobis(p-phenylenemethylidynenitrilo)]dibenzoic acid, diethyl ester	124
4,4'-Azocinnamic acid, diethyl ester	117
4,4'-Azodiphenetole	100
4,4'-Azoxybenzoic acid, diallyl ester	137
4,4'-Azoxybenzoic acid, diethyl ester	136
4,4'-Azoxybenzoic acid, diphenyl ester	138
4,4'-Azoxybis(α-methylcinnamic acid), diallyl ester	160
4,4'-Azoxybis(α-methylcinnamic acid), diethyl ester	156
4,4'-Azoxybis(β-methylcinnamic acid), diethyl ester	162
4,4'-Azoxybis(α-methylcinnamic acid), dihexadecyl ester	159
4,4'-Azoxybis(α-methylcinnamic acid), dimethyl ester	155
4,4'-Azoxybis(β-methylcinnamic acid), dimethyl ester	161

Table 2 (Cont'd)

4,4'-Azoxybis(α-methylcinnamic acid), dioctyl ester	158
4,4'-Azoxybis(α-methylcinnamic acid), dipropyl ester	157
N,N'-[Azoxybis(p-phenylenemethylidyne)]bis[4-(butoxy-methoxy)aniline]	169
N,N'-[Azoxybis(p-phenylenemethylidyne)]bis(p-chloroaniline)	171
N,N'-[Azoxybis(p-phenylenemethylidyne)]bis[4-(methoxy-methoxy)aniline]	168
N,N'-[Azoxybis(p-phenylenemethylidyne)dianiline	165
N,N'-[Azoxybis(p-phenylenemethylidyne)di-m-toluidine	166
N,N'-[Azoxybis(p-phenylenemethylidyne)]di-p-toluidine	167
4,4'-[Azoxybis(p-phenylenemethylidynenitrilo)]dibenzoic acid, diethyl ester	170
4,4'-Azoxybis(thiobenzoic acid)diethyl ester	139
4,4'-Azoxycinnamic acid, bis(2-methylbutyl)ester	145
4,4'-Azoxycinnamic acid, dibutyl ester	142
4,4'-Azoxycinnamic acid, didecyl ester	150
4,4'-Azoxycinnamic acid, didodecyl ester	152
4,4'-Azoxycinnamic acid, diethyl ester	140
4,4'-Azoxycinnamic acid, diheptyl ester	147
4,4'-Azoxycinnamic acid, dihexadecyl ester	153
4,4'-Azoxycinnamic acid, dihexyl ester	146
4,4'-Azoxycinnamic acid, dinonyl ester	149
4,4'-Azoxycinnamic acid, dioctyl ester	148
4,4'-Azoxycinnamic acid, dipentyl ester	143
4,4'-Azoxycinnamic acid, diisopentyl ester	144
4,4'-Azoxycinnamic acid, diphenyl ester	154
4,4'-Azoxycinnamic acid, dipropyl ester	141
4,4'-Azoxycinnamic acid, diundecyl	151

Table 2 (Cont'd)

4,4'-Azoxydianisole	125
4,4'-Azoxydibenzoic acid, diester with ethyl p-hydroxybenzoate	164
4,4'-Azoxydiphenetole	126
α,α'-(Azoxydi-p-phenylene)di-p-anisic acid	163
Benzoic acid, ester with 4'-[(p-hydroxybenzylidene)-amino]acetophenone	89
Benzoic acid, p-[(p-methoxybenzylidene)amino]phenyl ester	65
4-Biphenylcarboxylic acid, p-[(p-methoxyphenyl)azo]phenyl ester	107
4,4'-Bis(butoxy)azoxybenzene	128
4,4'-Bis(decyloxy)azoxybenzene	133
4,4'-Bis(dodecyloxy)azoxybenzene	135
4,4'-Bis(p-methoxybenzylideneamino)-3,3'-dichlorobiphenyl	94
4,4'-Bis(heptyloxy)azoxybenzene	130
2,5-Bis(4-heptylphenyl)-pyrazine	97
4,4'-Bis(hexyloxy)azoxybenzene	129
4,4'-Bis(nonyloxy)azoxybenzene	132
4,4'-Bis(Octyloxy)azoxybenzene	131
4,4'-Bis(propoxy)azoxybenzene	127
4,4'-Bis(undecyloxy)azoxybenzene	134
p-Butoxybenzoic acid, p-phenylene ester	22
p-iso-Butoxybenzylidene-1-aminonaphthalene-4-azobenzene	121
p-[(p-Butoxyphenyl)azo]acetophenone	103
Butyric acid, p-[(p-butoxybenzylidene)amino]phenyl ester	54
Butyric acid, p-[(p-methoxybenzylidene)amino]phenyl ester	43
Carbonic acid, butyl ester, ester with p(ethoxy)phenyl p-hydroxybenzoate	12, 13
Carbonic acid, hexyl ester, ester with p-(heptyloxy)-phenyl p-hydroxybenzoate	18
Carbonic acid, hexyl ester, ester with p-(hexyloxy)-phenyl p-hydroxybenzoate	17
Carbonic acid, pentyl ester, ester with p-(heptyloxy)-phenyl p-hydroxybenzoate	16

Table 2 (Cont'd)

Carbonic acid, pentyl ester, ester with p-(hexyloxy)-phenyl p-hydroxybenzoate	15
Carbonic acid, pentyl ester, ester with p-(pentyloxy)phenyl p-hydroxybenzoate	14
p-Chlorobenzoic acid, p-phenylene ester	26
Cholesterol acetate	172
Cholesterol benzoate	180
Cholesterol linoleate	179
Cholesterol myristate	176
Cholesterol nonanoate	174
Cholesterol oleate	178
Cholesterol propionate	173
Cholesterol stearate	177
Cholesterol undecanoate	175
Decanoic acid, p-[(p-butoxybenzylidene)amino]phenyl ester	64
p-(Dedecyloxy)benzoic acid	5
p-[(p-Decyloxybenzylidene)amino]cinnamic acid, pentyl ester	77
p-[(p-Decyloxybenzylidene)amino]cinnamic acid, isopentyl ester	78
p-[(p-Dodecyloxybenzylidene)amino]cinnamic acid, pentyl ester	79
p-[(p-Dodecyloxybenzylidene)amino]cinnamic acid, isopentyl ester	80
4'-(Dodecyloxy)-3'-nitro-4-biphenylcarboxylic acid	8
p-[(p-Dodecyloxyphenyl)azo]acetophenone	105
p-Ethoxybenzoic acid, p-phenylene ester	20
p-[(p-Ethoxybenzylidene)amino]benzoic acid, ethyl ester	41
p-[(p-Ethoxybenzylidene)amino]benzoic acid, ester with ethyl p-hydroxybenzoate	87
p-[(p-Ethoxybenzylidene)amino]benzoic acid, trimethylene ester	95
p-[(p-Ethoxybenzylidene)amino]cinnamic acid, ethyl ester	73
p-[(p-Ethoxybenzylidene)amino]cinnamic acid, methyl ester	72

Table 2 (Cont'd)

p-[(p-Ethoxybenzylidene)amino]cinnamic acid, phenyl ester	74
p-[(p-Ethoxybenzylidene)amino]-α-methyl cinnamic acid, isopentyl ester	84
p-[(p-Ethoxybenzylidene)amino]-β-methylcinnamic acid, ethyl ester	85
N-(p-Ethoxybenzylidene)-p-butylaniline	39
p-[(p-Ethoxyphenyl)azo]benzoic acid, butyl ester	112
4-Ethoxy-4'-propoxylazobenzene	102
p-[[p-(Ethylthio)benzylidene]amino]cinnamic acid, ethyl ester	82
p-[(p-(Ethylthio)benzylidene)amino]cinnamic acid, methyl ester	81
Heptanoic acid, p-[(p-butoxybenzylidene)amino]phenyl ester	61
Heptanoic acid, p-[(p-pentoxybenzylidene)amino]phenyl ester	62
Heptanoic acid, p-[(p-propoxybenzylidene)amino]phenyl ester	60
p-(Heptyloxy)benzoic acid	3
p-Heptyloxybenzoic acid, p-phenylene ester	24
4'-(Hexadecyloxy)-3'-nitro-4-biphenylcarboxylic acid	10
Hexanoic acid, p-[(p-butoxybenzylidene)amino]phenyl ester	58
Hexanoic acid, p-[(p-ethoxyphenyl)azo]phenyl ester	108
Hexanoic acid, p-[(p-methoxyphenyl)azo]phenyl ester	106
Hexanoic acid, p-[(p-propoxybenzylidene)amino]phenyl ester	57
Hexanoic acid, p-[(p-pentoxybenzylidene)amino]phenyl ester	59
p-(Hexyloxy)benzoic acid	2
p-Hexyloxybenzoic acid, trans-1,4-cyclohexylene ester	28
p-Hexyloxybenzoic acid, p-phenylene ester	23
4'-(Hexyloxy)-3'-nitro-4'-biphenylcarboxylic acid	7
p-[(p-Hexyloxyphenyl)azo]acetophenone	104
p-[(p-Hydroxyphenyl)azo]benzoic acid, ethyl ester, p-bromobenzoate	111
p-[(p-Hydroxyphenyl)azo]cinnamic acid, ethyl ester, acetate	114
p-[(p-Hydroxyphenyl)azo]cinnamic acid, ethyl ester, benzoate	116
p-[(p-Hydroxyphenyl)azo]cinnamic acid, ethyl ester, ethyl carbonate	115
p-[(p-Methoxybenzylidene)amino]cinnamic acid, ethyl ester	71

Table 2 (Cont'd)

p-[(p-Methoxybenzylidene) amino] cinnamic acid, methyl ester	70
p-[(p-Methoxybenzylidene) amino]-α-methylcinnamic acid, propyl ester	83
4'-[p-(p-Methoxybenzylidene) amino] phenylacetophenone	86
4-Methoxybicyclo [2,2,2,] octane-1-carboxylic acid, p-hydroxy-phenyl ester p-anisate	27
4-Methoxycinnamic acid	6
p-[(p-Methoxyphenyl)azo] cinnamic acid, ethyl ester	113
4-Methoxy-4'-propoxyazobenzene	101
p-[p-[(p-Methylbenzylidene) amino] benzamido] benzoic acid, ethyl ester	88
p-[(p-Methylbenzylidene) amino] cinnamic acid, ethyl ester	66
N-[p-(Methylthio) benzylidene]-p-(phenylazo) aniline	120
p-[(p-Nonyloxybenzylidene) amino] cinnamic acid, pentyl ester	76
N-[p-(Nonyloxy) benzylidene]-p-(phenylazo) aniline	119
N-[p-(Nonyloxy) benzylidene]-p-toluidine	40
4'-(Octadecyloxy)-3'-nitro-4-biphenyl carboxylic acid	11
Octanoic acid, p-[(p-butoxybenzylidene) amino] phenyl ester	63
p-Octyloxybenzoic acid, bicyclo [2,2,2] oct-1,4-ylene ester	31
p-(Octyloxy) benzoic acid	4
p-Octyloxybenzoic acid, p-phenylene ester	25
p-[(p-Octyloxybenzylidene) amino] cinnamic acid, isopentyl ester	75
p-(Pentyloxy) benzoic acid	1
p-iso-Pentyloxybenzylidene-1-aminonaphthalene-4-azo benzene	122
2-(4-Pentylphenyl)-5-(4-pentyloxy)-pyrimidine	96
p-[(p-Phenylbenzylidene) amino] benzoic acid, ethyl ester	42
p-[(p-Phenylbenzylidene) amino] cinnamic acid, ethyl ester	67
p-[(p-Phenylbenzylidene) amino] cinnamic acid, phenyl ester	69
p-[(p-Phenylbenzylidene)amino] cinnamic acid, propyl ester	68
4,4'-[p-Phenylenebis(methylidynenitrilo)] dicinnamic acid, diethyl ester	92
4,4'-[p-Phenylenebis (methylidynenitrilo)] dicinnamic acid, dipentyl ester	93

Table 2 (cont'd)

N,N'-(p-phenylenedimethylidyne) bis [p-(ethylthio) aniline]	91
N,N'-(p-phenylenedimethylidyne) bix (α-methoxy-p-anisidene)	90
Propionic acid, p-[(p-butoxybenzylidene) amino] phenyl ester	52
Propionic acid, p-[(p-ethoxybenzylidene) amino] phenyl ester	50
Propionic acid, p-[(p-methoxybenzylidene) amino] phenyl ester	49
Propionic acid, p-[(p-pentoxybenzylidene) amino] phenyl ester	53
Propionic acid, p-[(p-proproxybenzylidene) amino] phenyl ester	51
p-Propoxybenzoic acid, bicyclo[2,2,2] oct-1,4-ylene ester	30
p-Propoxybenzoic acid, p-phenylene ester	21
Terephthalic acid, bis (p-butoxyphenyl) ester	35
Terephthalic acid, bis (p-chlorophenyl) ester	38
Terephthalic acid, bis (p-ethoxyphenyl) ester	33
Terephthalic acid, bis (p-heptyloxyphenyl) ester	37
Terephthalic acid, bis (p-hexyloxyphenyl) ester	36
Terephthalic acid, bis (p-methoxyphenyl) ester	32
Terephthalic acid, bis (p-propoxyphenyl) ester	34
4'-(Tetradecyloxy)-3'-nitro-4-biphenylcarboxylic acid	9
10-Undecenoic acid, p-[(p-ethoxyphenyl) azo] phenyl ester	109
Valeric acid, p-[(p-butoxybenzylidene) amino] phenyl ester	55
Valeric acid, p-[(p-pentoxybenzylidene) amino] phenyl ester	56

TABLE 3

Smectic – Smectic Binary Systems

System	Measurement Method	Phase Diagram	Comments	References
1	Microscopy	X	Miscibility studies	1
2	"		"	1
3	"	X	"	1
4	"		"	2
5	"		"	2
6	"		"	2,6
7 ↓ 10	Microscopy	X	"	2
11 ↓ 16	Microscopy		Miscibility studies	2
17 ↓ 33	Microscopy	X	Miscibility studies	3
34 ↓ 84	Microscopy	X	Miscibility studies	4
85	Microscopy	X	Miscibility studies	2,5
86 ↓ 92	Microscopy	X	Miscibility studies	5
93 ↓ 95	Microscopy	X	Miscibility studies	6
96 ↓ 102	Microscopy	X	Miscibility studies	7
103 ↓ 117	Microscopy	X	Miscibility studies	8
118 ↓ 127	Microscopy	X	Miscibility studies	9
128 ↓ 138	Microscopy	X	Miscibility studies	10
139	Microscopy	X	Miscibility studies	11
140	"	X	"	12
141	"	X		13

TABLE 4

Nematic – Nematic Binary Systems

System	Measurement Method	Phase Diagram	Comments	References
1	Microscopy	X	Miscibility studies	1, 14, 16
	Melting point apparatus	X	Used as solvents for gas chromatography studies	21
	DTA and DSC	X	Transition heats and entropies studies	28
2 ↓ 5	Microscopy	X		15
6	Microscopy	X	Miscibility studies	16
7	"	X	"	16
8	"	X	"	17
9	Melting point apparatus		Used as solvents for gas chromatography studies	18
		X		13
	DTA and DSC	X	Transition heats and entropies studies	28
10	Microscopy	X		19
11	"	X		19
12	"	X		19
13		X	Structure observations	20
14	Melting point apparatus	X	Used as solvents for gas chromatography studies	21
15	Microscopy & Melting point apparatus	X		22
16	"	X		22
17 ↓ 25	Microscopy & Melting point apparatus	X		23
26	Microscopy	X	Electrooptic studies	24
	"	X	Used as solvents for NMR studies	27
27 ↓ 30	Melting point apparatus	X		25
31 ↓ 51	Microscopy & DTA		Every system shows the same eutectic composition of 2 moles of lower melting and 1 mole of higher melting component	26
52 ↓ 54	Microscopy	X	Used as solvents for NMR studies	27
55		X		13
56	DTA & DSC	X	Transition heats and entropies studies	28
57	"	X	"	28
58 ↓ 61	"	X	"	29

TABLE 5

Cholesteric – Cholesteric Binary Systems

System	Measurement Method	Phase Diagram	Comments	Reference
1	DSC	X	Transition heats	30
2	"	X	"	30
3	"	X	"	31
4	"	X	"	31
5	"	X	"	32
6	"	X	"	32
7	"	X	"	32

TABLE 6

Smectic – Nematic, Smectic – Cholesteric and Nematic – Cholesteric Binary Systems

System	Measurement Method	Phase Diagram	Comments	Reference
1	Microscopy	X	Miscibility studies	1
2	"	X	"	1
3	"	X	"	1
4	"	X	"	33
5	"	X	"	13
6	"	X	"	13
7	DTA and DSC	X	Transition heats and entropies studies	29
8	Microscopy	X	Miscibility studies	16
9	"	X	Miscibility studies	16
10	"	X	Texture studies	34

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