

ABSORPTION SPECTRA OF BENZOLOGS OF QUINOLIZINIUM IONS

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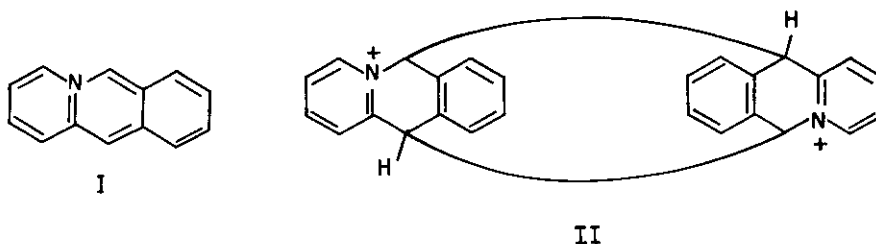
The ultraviolet absorption spectra of quinolizinium ions are reviewed.

In the last two decades a large number of benzologs of quinolizinium salts have been synthesised by various research groups. Their u.v. spectroscopy on the one hand has played an important role in determining the structure of both simple and complex molecules and on the other hand has helped in the study of the reaction mechanism. Of the three benzologs, acridizinium system has been studied extensively.

Acridizinium Salts

The ultraviolet absorption spectra of acridizinium salts consist of 4 intense bands in the region 242-399 nm, the intense colour being due to the band in the region of 399 nm. With the substituents at the different positions, the maximum intensity of the band increases with deepening in colour which clearly indicates a high degree of conjugation. In alcoholic solution acridizinium bromide gives an intense blue-violet fluorescence from which it crystallises as long yellow prisms.

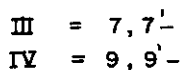
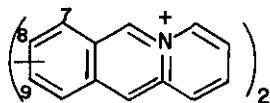
Irradiation of the acridizinium bromide (I) destroys the conjugation characteristic of the acridizinium system in the formation of a dimer (II) and its property of dissociation at slow rate at room temperature, but rapidly on heating was demonstrated by studying the ultra-



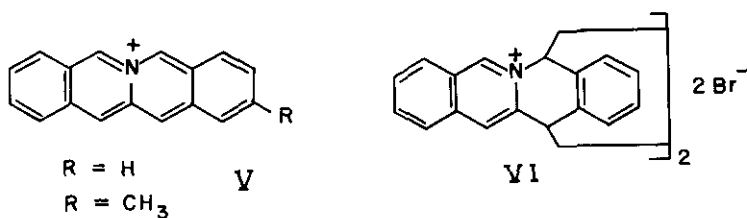
violet spectrum of the reaction mixture ¹.

In the bis-quarternary system, 7,7'-bis(acridizinium bromide) (III) a non-planer molecule resembled closely to that of the simple acridizinium ion in the absorption spectrum, although with a small bathochromic shift, whereas the spectrum of 9,9'-bis(acridizinium bromide) (IV) is more complex and shows significant absorption at higher wave lengths. Both these spectra make

an interesting comparison with that of acridizinium perchlorate².

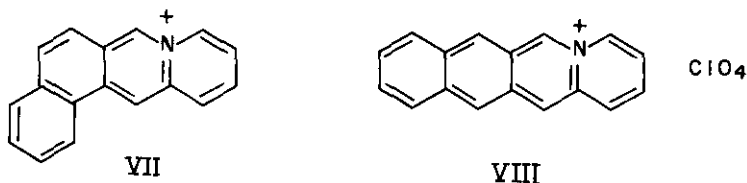


The UV absorption spectra of benz(b)acridizinium bromide (V) and its dimers are quite different in that, the dimer (VI) does not absorb at the longer wave length. This makes it clear that the dimerisation has destroyed the conjugation characteristic of the benz(b)-acridizinium system. The similarity of the spectrum to that of 2-(2-methylbenzyl)-3-methyl-



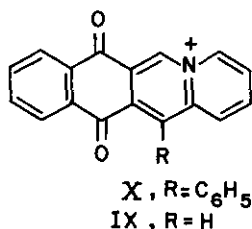
isoquinolonium bromide indicates, that the absorbing groups in the dimer are isolated benzene and isoquinolinium structures, which is apparently due to dimerisation involving an inner rather than a terminal ring³.

The UV spectra has also been used in establishing the structure of benzo(j)acridizinium bromide (VII) based on the annulation principle developed by Clar⁴ for aromatic hydrocarbons.

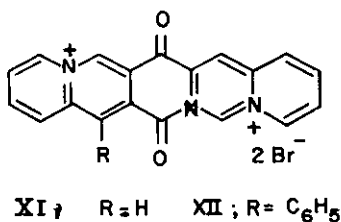


A small increase of 50 \AA^0 in the absorption maxima shown by benzo(j)acridizinium bromide with the assumption that linear annulation has occurred which indicates that formula (VII) is to be preferred over the linear formula (VIII)⁵.

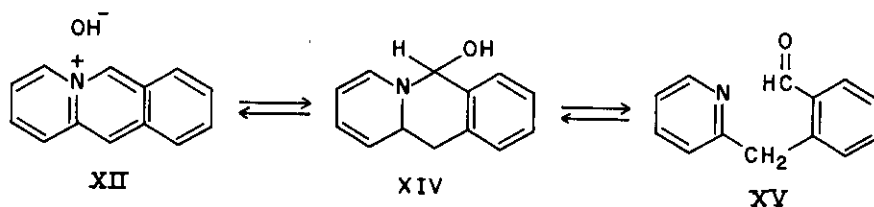
The UV spectrum of 6a-azonianaphthacene quinone (IX) showed a small difference between the spectra of its acidified (yellow) and the neutral (blue) solution and only a significant difference in the case of the phenyl analog (X). The neutral solution of X, when exposed to diffuse day light for only five days changes to yellow-brown and the absorption spectrum is greatly altered⁶.



On the other hand, the spectra of 4a,11a-diazoniapentacene-6,13-quinone dibromide (XI) in the neutral and acidified solutions in methanol indicate that the attack of the solvent under neutral conditions upon the aromatic system of the quinone (XI,XII) must be more extensive than was observed with X⁷.

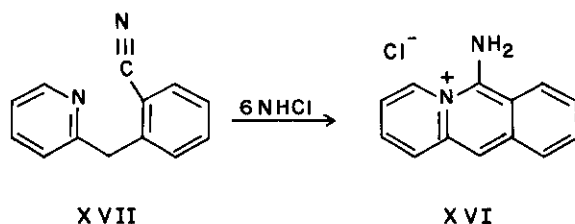


Aston and Montgomery⁸ pointed out on the basis of spectroscopy that in aqueous solution acridizinium hydroxide (XIII) is largely ionic and in equilibrium with only a small amount of the pseudo base (XIV), the UV spectrum of which showed the usual acridizinium peaks plus an additional peak at 417 nm attributed to the pseudo base. Also the existence of the pseudo base in equilibrium with the aldehyde (XV) in basic solution was deduced by studying the



reaction spectrophotometrically.

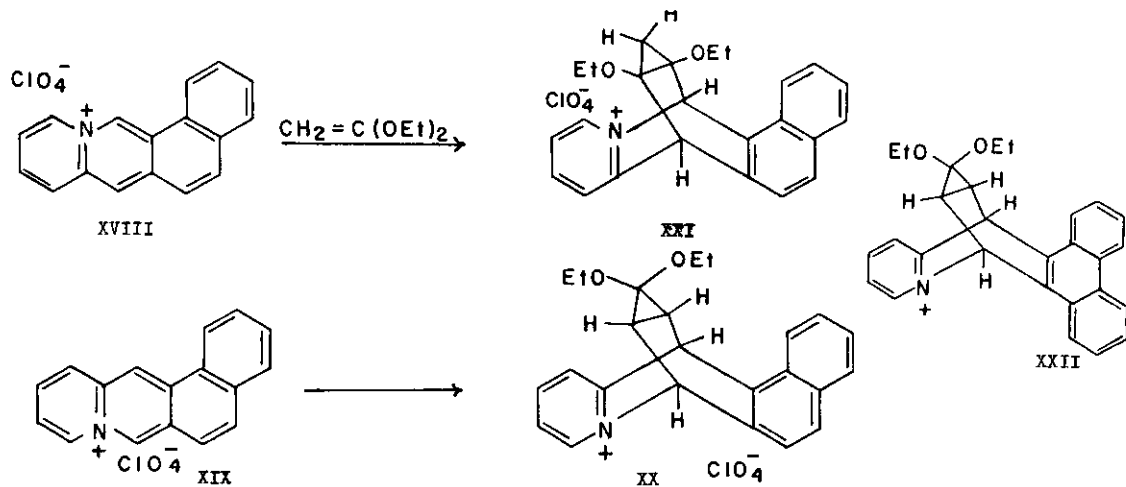
The UV spectrum has also been helpful in determining the structure of 6-aminoacridizinium bromide (XVI) by heating the nitrile (XVII) with 6N hydrochloric acid at 100°, where as the same



nitrile with magnesium iodide followed by cyclisation with concentrated sulphuric acid yielded 6-phenylacridizinium ion, the UV spectrum of which was found to be very similar to that of the isomeric 11-phenylacridizinium cation⁹.

The structure of the adducts arising from the addition of dienophiles to the acridizinium ion was deduced from the UV absorption spectra. The absorption in the region 260-275 nm indicates the expected cycloaddition of the dienophiles across the 9,10 position of the acridizinium ion¹⁰. An adduct with the styrene does not show any absorption below 264 nm, which makes it possible to follow the disappearance of the strong absorption peak at 399 nm. In case of an adduct of azonianaphthacene (XVIII,XIX) with ketens diethylacetal, the addition has been shown to occur across ring A rather than ring B, a conclusion, which has been based on the longer wave length of the UV absorption of XX (372 nm) as compared to (348, 296 nm) in case of XXI and XXII¹⁰⁻¹⁴ respectively.

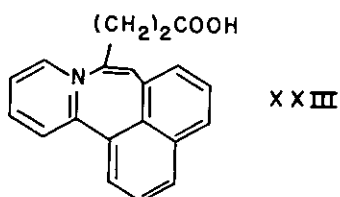
The adduct of acrizinium ion with maleic anhydride had an ultraviolet absorption spectrum resembling that of the acridizinium dimer in that, absorption was confined to 263 nm region. This clearly indicates, that the absorbing groups are isolated pyridine and benzene



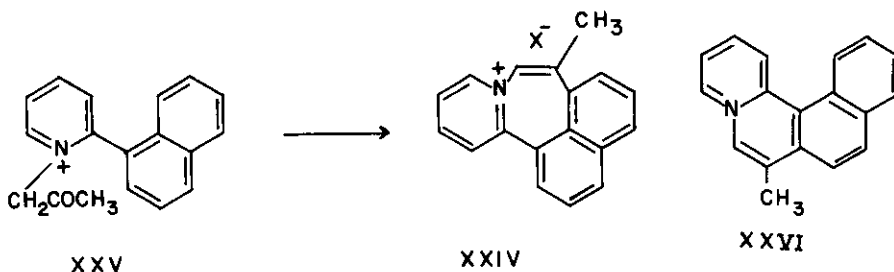
system. If on the other hand the reaction had involved one of the terminal rings, the absorbing group would then be naphthalene or isoquinoline with absorption to be expected at a longer wave length⁴⁴.

Phenanthridizinium Salts

In the phenanthridizinium series the UV spectral data is helpful in the identification of the compound formed from 2-(1-naphthyl)pyridine and methyl δ -bromolevulinate. The product 7-methyl (1,m) morphanthridizinium salt (XXIII) suggested, that in case of simple analogs¹⁵ cyclisation has occurred into the α -position of the naphthalene ring rather than to the β -postion to form a six membered ring¹⁶.

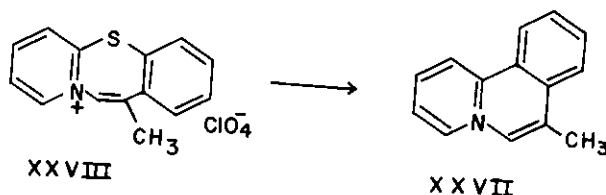


Similarly, the structure of 7-methylbenzo (1,m)morphanthridizinium salt (XXIV) from the cyclisation of 1-acetyl-2-(1-naphthyl)pyridinium bromide (XXV) was established with the help of UV spectroscopy¹⁵. Previously the compound was considered to have a structure

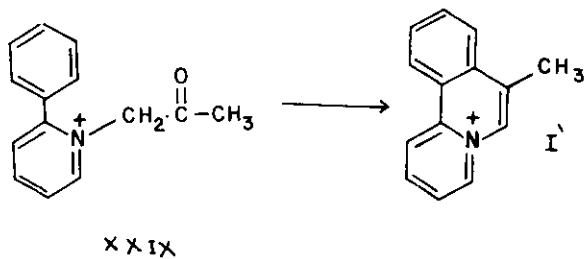


of 7-methylbenzo(k)phenanthridizinium perchlorate (XXVI).

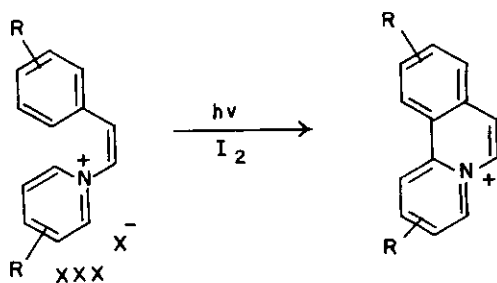
The formation of 7-methylphenanthridizinium perchlorate (XXVII) by extrusion of sulphur from pyrido(2,1-b)benzo(f) (1,3)thiazepinium salt (XXVIII) was shown by studying the thermal reaction spectrophotometrically¹⁷. The reaction was carried out under controlled conditions, with aliquots being examined spectrophotometrically. It was concluded from the complete absorption spectrum that the decrease in optical density is even more evident at shorter wave lengths and at temperature of 100° for about 2 hours with the optical density of 0.916, the yield of product increased to 68%, which is quite evident from the UV absorption spectra of these compounds.



Cyclisation of N-acetyl- α -pyridinium iodide (XXIX) to 7-methylphenanthridizinium iodide was shown to occur by studying its UV spectrum, which made it clear, that cyclisation reaction has resulted in an increase in molecular extinction coefficient and a shift towards longer wave length. These effects would be predicted for a transition from a restricted bi-phenyl type of structure to a planar polycyclic aromatic one¹⁸.



The progress in the formational phenanthridinium salts by irradiation of styrylpyridinium salts (XXX) was also followed by observing the UV absorption spectra of sample



withdrawn at regular intervals and it was found that the optimum reaction time was about 24 hours¹⁹.

Solvents

- a- Ethanol
- b- Methanol
- c- Acetonitrile
- d- Water

Compound	Solv.	Absorption maxima max nm/ λ log _e	Absorption minima max nm/ λ log _e	Ref.
Acridizinium Perchlorate	a	242, 261, 379.5, 399 (4.68; 3.90; 4.01; 3.93)	311, 396, 398.5 (3.15; 3.88; 3.81)	33
4-Methylacridizinium perchlorate	a	200, 243, 250 sh, 364, 381 (4.38; 4.52; 4.50; 3.90; 3.81)	214, 313, 372.5, 391	28
7-Methylacridizinium perchlorate	a	250, 366, 388.5, 408 (4.78; 3.99; 4.0; 3.95)	316.5, 377.5, 399.5 (3.21; 3.89; 3.88)	33
9-Methylacridizinium perchlorate	a	244.5, 379, 398 (4.71; 3.09; 3.93)	314, 392 (3.08; 3.90)	33
11-Phenylacridizinium perchlorate	a	245, 365, 383, 404 (4.52; 3.99; 3.98; 3.91)	317, 375, 393 (3.20; 3.90; 3.78)	40
6-Phenylacridizinium perchlorate	a	248, 285 sh, 345 sh (363; 386; 406) (4.63; 4.0; 3.70) (3.93; 3.96; 3.91)	331 (3.94)	9
7-Phenylacridizinium perchlorate	a	249, 365, 386 (4.79; 4.45; 4.380)	255, 311, 380 (4.62; 3.86; 4.37)	2
11-Methylacridizinium Perchlorate	a	243, 250, 365, 382 (4.61; 4.60; 4.04; 4.0)	247, 313, 372, 391 (4.58; 3.08; 3.93; 3.82)	40
6-Cyanoacridizinium perchlorate	a	(364, 395, 408, 432)		39
6-Aminoacridizinium perchlorate	a	235 sh, 241, 257 sh 340 sh, 380, 405, 427 (4.55; 4.56; 4.25; 3.68 4.06; 4.04; 3.88)		9 9
11-Benzylacridizinium perchlorate	a	240, 250, 366, 382, 404 (4.45; 4.46; 3.82; 3.83; 3.75)		37
7,7-bis(Acridizinium Bromide)	a	440, 263, 383, 406 (4.27; 4.24; 4.32; 4.74)	315, 372, 392 (3.55; 4.13; 4.14)	2

Compound	solv.	Absorption maxima max nm./ log _e	Absorption minima Max.nm./ log _e	Ref.
9,9-bis(Acridizinium Bromide)	a	(243, 266, 308, 310, 366, 410, 431)	255, 279, 307, 347, 374, 417	2
		(4.74; 4.60; 4.78; 4.77; 4.15; 4.38; 4.42)	(4.52; 4.51; 4.76; 3.95; 4.11; 4.34)	2
8,8-bis(Acridizinium Bromide)	a	242, 318-26 sh, 367, 380 sh, 397 sh.	331	2
		(4.70; 3.95; 4.26; 4.18; 3.60)	(3.94)	
9,9-Methylenebis-(acridizinium Bromide)	a	244, 250 sh, 277 sh, 362, 374 394	318, 366, 385	2
		(4.96; 4.93; 4.74; 4.42; 4.50; 4.41)	(372; 4.38; 4.28)	
9,9-Ethylenebis-(acridizinium Bromide)	a	245, 252, 362, 376, 393, 395	249, 304, 368, 388	2
		(4.79; 4.80; 4.52; 4.20; 4.26; 4.12)	(4.78; 3.34; 4.17; 4.03)	
Benz(a)acridizinium Bromide	a	260, 279, 296, 309, 346, 364 383, 403, 475, 507	239, 265, 287, 304, 338 355, 370, 391	42
13-Phenylbenz(a)-acridizinium perchlorate	a	261.5, 311.5, 387, 406	242, 289, 344, 369	35
		(4.56; 4.15; 4.34; 4.23)	(4.42; 4.20; 3.8; 4.08)	
10-Methoxy-13-phenylbenz(a)-acridizinium perchlorate		223, 269, 311.5, 400, 421		
		(4.59; 4.55; 3.93; 4.03)		
9-Methyl-13-phenylbenz(a)-acridizinium perchlorate	a	224, 266, 314.5 396, 405	247, 293, 346.5, 404	35
		(4.53; 4.54; 4.31; 3.76; 3.84)	(4.42; 4.56; 4.31; 4.51)	
7-Phenylbenz(h)-acridizinium perchlorate	a	231, 275, 305.5, 339, 388	250, 294, 313.5, 339, 388	35
		(4.07; 4.071; 4.14; 3.54; 3.98)	(4.07; 4.07; 4.14; 3.54; 3.98)	
7-Methylbenz(h)-acridizinium perchlorate	a	231, 276, 307, 320, 361, 379,400	248, 290, 312.5, 337, 366	35
		(4.39; 4.50; 4.16; 4.23; 3.50; 4.17 4.37)	388 (3.97; 3.92; 4.10; 3.55; 3.80; 3.91)	
15-phenyldibenz(a,h)-acridizinium Bromide	a	278.5, 306.5, 390, 411	254, 285.5, 346.5, 401	35
		(4.42; 4.56; 4.31; 4.51)	(4.29; 4.41; 3.78; 4.12)	
Benzo(j)acridizinium perchlorate	a	227, 276, 321.5, 364, 384,405.5	248, 289.5, 310, 336.5	5
		(4.52; 4.57; 4.55; 3.91; 3.89)	(4.07; 4.14; 3.87; 3.76;3.71)	

Compound	Solv.	Absorption maxima max nm./ log _e	Absorption minima max nm./ log _e	Ref.
Benzo(h)acridizinium perchlorate	a	232.5, 274, 305, 317, 358, 376, 395 (4.54; 4.58; 4.33; 4.39, 3.93; 4.22; 4.34)	248, 289.5, 310, 336.5, 361, 384 (4.04; 4.20; 4.28; 3.64, 3.92; 4.03)	5
Dibenzo(h,j)acridizinium Perchlorate	a	236, 255, 280, 307, 339, 374, 394 (4.50; 4.45; 4.45; 4.60; 4.08; 4.03, 4.10)	250, 267, 285.5, 322.5, 361.5, 383.5 (4.42; 4.37; 4.39; 4.06, 3.86; 3.94)	5
Dibenzo(b,h)acridizinium Bromide	a	294, 305, 346, 404, 426, 464 (4.56; 4.68; 4.85; 4.27 4.11; 4.30; 3.59)	223, 269, 290, 337, 376, 408, 457 (4.40; 4.36; 4.67; 4.22, 3.76; 4.11; 3.54)	30
Dibenzo(b,j)acridizinium Bromide	a	256, 287, 345, 360, 410 433, 462 (4.70; 4.65; 4.48; 4.53; 4.25; 4.40; 3.67)	230, 267, 326, 352, 378 430, 456 (4.46; 4.45; 4.31; 4.45, 3.76; 4.18; 3.18)	30
6-Methyl-11-phenylacridizinium perchlorate	a	249, 370, 389, 410, (4.65; 4.11; 4.09; 4.05)	318, 325, 400 (3.24; 3.98; 3.90)	40
7-Methyl-11-phenylacridizinium perchlorate	a	252, 371, 391, 412 (4.57; 4.00; 4.00; 3.97)	247, 382, 403 (4.61; 4.15; 3.90)	40
9-Methyl-11-phenylacridizinium perchlorate	a	247, 382, 403 (4.61; 4.15; 3.96)	317, 395 (3.15, 3.94)	40
2-Methylbenz(b)acridizinium Bromide	a	240, 257, 289, 340, 398, 420 (4.12, 4.06, 4.28, 3.59, 3.43)	252, 262, 317, 368 404, 448, 478 (4.05, 4.04; 3.57; 3.88; 3.40; 3.11; 3.45)	5
8,9-Methylenedioxyacridizinium Bromide	a	258, 377, 396		34
7,8-Methylenedioxyacridizinium Bromide	a	318, 387, 402	294, 354	34
2,3-Methylenedioxyacridizi- nium Chloride		256, 304, 400, 421, 448, 478 (4.52, 4.62, 3.84, 4.13, 3.71, 3.42)	270, 378, 407, 440, 465 (4.2; 3.45; 3.8; 3.67; 3.3)	30

Compound	Solv.	Absorption maxima max nm. / log _e	Absorption Minima max nm. / log _e	Ref.
9,10-Methylenedioxybenz(a)- acridizinium perchlorate	a	299,262,284,328,340	244,275,300,335,363	42
3-Methoxyacridizinium Bromide	a	264,285,338,400,423 (4.53;4.60;4.23;3.95;4.37)	228,269,325,384,387 4.15;4.48;4.14;3.50;3.87)	30
8-Methoxyacridizinium perchlorate	a	356,394,410		34
8-Hydroxyacridizinium Bromide	a	364,394,410		34
2,3-Dimethoxyacridizinium chloride	c	257,304,400,427,456,485 (4.49;4.67;3.97;4.28; 3.75;3.42)	232,271,380,408,446,475 (4.15;4.32;3.59;3.94; 3.72;3.34)	30
3,10-Dimethyl 4a-azoniapentaphene perchlorate	c	211,253,256,sh,286,298, 340,353,364,384 (4.64;4.02;4.01;4.24;4.70; 4.51;4.56;4.38;4.51;3.64; 3.61)		30
3,4-Dimethoxyacridizinium chloride	a	280,355,413,436 (4.68;4.48;4.12;4.13)	230,315,400,420 (4.45;4.37;4.07;4.12)	23
5,6-Dihydroxyacridizinium Bromide	b	245,347,363 (4.07;4.05;4.08)		29
5,6-Diacetoxyacridizinium bromide	b	248,283,357,382,402 (4.79;4.09;4.01;3.97;3.95)		29
5,8-Dihydroxyacrididizinium bromide	b	248,375 (4.41;3.73)		29
5,8-Diacetoxyacridizinium bromide	b	250,364 (4.78;3.73)		29
7,8-Dimethoxyacridizinium Bromide	a	260,302,372,438	290,342,407	34
6-Methyl-8,9-dimethoxyacridi- zinium bromide	a	368,382,401		38
6-Ethyl-8-ethoxy-9-methoxy- acridizinium perchlorate	a	370,384,404		38
6-Ethyl-8,9-diethoxyacridizinium perchlorate	a	370,385,405		38

Compound	Solv.	Absorption maxima max. nm. / log _e	Absorption minima max nm. / log _e	Ref.
7,10-Dimethoxy-11-phenyl- acridizinium perchlorate	a	250,323 sh, 409,454 (5.08; 3.31; 4.02; 3.84)	245,294, 400,450,482	21
9,10-Dimethoxybenz(a)acridi- zinium perchlorate	a	259,317, 332,473,504	245,294, 400,450,482	42
10-Methoxy-13-phenylacridizinium perchlorate	a	223,269, 311.5, 400,421 (4.59; 4.55; 3.93; 4.03)	243,289, 384, 408 (4.07; 4.37; 3.72; 3.91)	35
10-Methoxybenz(a)acridizinium bromide	a	270,296, 309, 323, 345, 397, 417	243,286, 319, 370, 380, 405	42
8-Methoxy-11-phenylacridizinium perchlorate	a	259,298, 344, 363, 400, 420 (4.46; 4.23; 3.81; 4.04; 4.0; 3.75)	287, 335, 350, 385, 405 (4.20; 3.72; 3.78; 3.64; 3.70)	40
5,6-Dihydroxy-8-phenylacridizi- nium perchlorate	b	340 sh, 356, 372, 400 (4.90; 4.18; 4.65; 4.06)		29
5,6-Diacetoxy-8-phenylacridizinium perchlorate	c	240,250, 366, 390, 410 (4.64; 4.56; 4.12; 3.92; 3.88)		29
4a,7a-Diazoniapentacene-6,13- dione dibromide	d	253,383 (4.78; 4.36)		29
4a,11a-diazoniapentacene-6,13- dione dibromide	b	224,251, 377 (4.66; 4.70; 4.41)		29
6,7-Dihydroxy-4a,8a-diazonia- pentaphene dibrimide	b	245,262, 363, 380 (4.51; 4.42; 4.61; 4.60)		29
7,8-Dihydroxy-5a,8a-diazonia- heptaphene bisperchlorate	d	248,269, 300 sh, 440 (4.52; 4.54; 4.34; 4.43)		29
Indolo(2,3-a)acridizinium perchlorate	a	209,255, 280, 288 sh, 346, 401,443 (4.29; 4.44; 4.19; 4.17; 4.24; 3.83)		36
8,13-Dimethyl-13-H-indolo- (2,3-a)acridizinium perchlorate	a	202,230, 255, 273, 285 sh (332 sh, 345, 410, 440,) (4.4, 4; 64; 4.63; 4.40; 4.31; 4.37; 4.0; 4.11; 3.93)		32
3-Methoxyindolo(2,3-a)acridizi- nium perchlorate	b	258,268 sh, 330, 405, 440 (4.36; 4.33; 4.29; 3.82; 3.49)		36

Compound	Solv.	Absorption maxima max nm. / log _e	Absorption minima max. nm. / log _e	Ref.
3,4-Dimethoxyindolo(2,3-a)acridinium perchlorate	c	260,290,350,385,480 (4.53;4.37;4.50;4.11;3.90)		36
6a-Azonianaphthacene quinone bromide (Acidified 10 ⁻³ M)	b	237,248 sh,312 sh,358,372 (4.54;4.37;3.81;4.05)		6
6a-Azonianaphthacene quinone perchlorate	c	253,336 sh,337 (4.55;4.14;4.16)		6
After exposure to light for 5 days	b	228,243 sh (4.70;4.67)		6
Freshly prepared quinone bromide	b	247,322,sh,322 sh,372 sh (4.47;3.68;4.11;4.13)		6
Freshly prepared quinone perchlorate	b	253,363 sh,377 (4.54;4.18;4.15)		6
2,3,10,11-Tetramethoxybenz(a)acridinium chloride	a	278,309,322,417	250,286,318,370	31
2,3,9,10-Tetramethoxybenz(a)-acridinium bromide	a	246,285,355,464	268,306,344,404	31
2,3-Dimethoxy-9,10-methylene-dioxybenz(a)acridinium chloride	a	248,275,327,358,492	262,304,340,417	31
2,3-Dimethoxy-10,11-methylene-dioxybenz(a)acridinium chloride	a	276,309,322,413	250,285,317,367	31
2,3,10-Trimethoxybenz(a)acridinium chloride	a	277,312,332,435	250,286,318,370	31
2,3,9,10-Bismethylenedioxybenz(a)acridinium chloride	a	248,356,490	264,294,337,418	31
11,11-Dimethyl-6,11-dihydroacridinium perchlorate	a	264 (3.78)		37
7,13-Dihydrobenz(h)acridinium bromide	a	267 (3.75)		37
11-Benzyl-11-methyl-6,11-dihydroacridinium bromide	a	266 (3.77)		37
Beatain of 10-sulphoacridinium bromide	a	200 sh,228,sh,236,254 sh, 330,353,376,396 (4.18;4.14;4.19;3.88;2.99 3.24;3.20;3.13)		41

Compound	Solv.	Absorption maxima max. nm. / log _e	Absorption minima max. nm. / log _e	Ref.
10-Phenylsulphonyl acridizinium bromide	a	237,255 sh, 360,382,402 (4.11;3.64;3.38;3.28;3.06)		41
6-Methyl-12-phenyl-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	272,265 sh (3.76;3.74)		43
11-Methyl-12-phenyl-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	270,266 sh (3.73;3.71)		43
6,11,12,15-Tetrahydro 6,11,3,4-furanoacridizinium-13,15-dione bromide	a	263 (3.62)	241.5 (3.38)	44
cis-12,13-dicarboxy-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.58)	241.5 (3.33)	44
trans-12,13-dicarbomethoxy-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.73)	242 (3.49)	44
trans-12,13-dicarbomethoxy-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	264 (3.60)	244 (3.38)	44
cis-12,13-dicarbomethoxy-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	262 (3.78)	241 (3.51)	44
cis-12,13-dicarbomethoxy-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.76)	241 (3.49)	44
12- or 13-cyano-6,11-dihydro-6,11-ethanoacridizinium perchlorate	a	261 (3.68)	239 (3.41)	44
anti-12,13,15,16-Tetrahydro(6,11,3,4)furanoacridizinium 13,15-dione dibromide	a	263 (3.75)	241 (3.54)	10
anti,anti-12,13-dicarboxy-6,11-ethanoacridizinium perchlorate	a	263 (3.75)	241 (3.54)	10

Compound	Solv.	Absorption maxima max nm./ log _e	Absorption minima max nm./ log _e	Ref.
anti,anti-12,13-dicarbome- thoxy-6,11-dihydro-6,11- ethanoacridizinium perchlorate	a	260 (3.71)	249 (3.49)	10
anti,anti-12,13-Dicarboethoxy- 6,11-dihydro-6,11-ethanoacridi- zinium perchlorate	a	263 (3.73)	240 (3.49)	10
anti,syn,-12,13-Dicarboxy-6,11- dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.70)	240 (3.47)	10
anti,syn-12,13-Carbomethoxy- 6,11-dihydro-6,11-ethanoacridi- zinium perchlorate	a	263 (3.76)	240 (3.46)	10
anti,syn-12,13-Dicarboethoxy- dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.70)	242 (3.49)	10
Syn,syn,12,13-Dicarboxy-6,11- dihydro-6,11-ethanoacridizinium perchlorate	a	263 (3.70)	242 (3.50)	10
Syn,syn-12,13-Dicarbomethoxy- 6,11-dihydro-6,11-ethanoacridi- zinium perchlorate	a	264 (3.60)	240 (3.50)	10
Syn,syn-12,13-Dicarboethoxy-6,11- dihydro-6,11-ethanoacridizinium perchlorate	a	262 (3.60)	244 (3.38)	10
<u>PHENANTHRIDIZINIUM SALTS</u>				
Phenanthridizinium perchlorate	a	217,222,237,256 sh,269, 278,323,337,354, (4.29;4.32;4.28;4.08;4.23; 4.28;3.70;4.01;4.14)		20
7-Methylphenanthridizinium perchlorate	a	220 sh,280,300 sh,330, 340,360 (4.5;4.4;4.0;4.1)	230,254,290,350 (4.3;4.2;3.8;3.7)	22
8-Methylphenanthridizinium perchlorate	a	272 sh,285,325,341,357 (4.47;3.79;3.89;4.08)		19

Compound	Soiv.	Absorption maxima max nm./ log _e	Absorption minima max nm./ log _e	Ref.
9-Methylphenanthridizinium Perchlorate	a	219 sh, 225, 242, 272, 278 sh, 308 sh, 323, 338, 354 (4.33; 4.38; 4.35; 3.76; 3.83; 4.11; 4.26)		20
10-Methylphenanthridizinium perchlorate	a	263, 275 sh, 285, 329, 344, 361 (4.18; 4.31; 3.66; 3.98; 4.13)		19, 20
11-Methylphenanthridizinium perchlorate	a	220, 274, 330, 344, 360 (4.62; 4.69; 3.77; 3.97; 4.06)		20
7-Phenylphenanthridizinium bromide	a	290, 330, 350, 360		16
10-Chlorophenanthridizinium perchlorate	a	250 sh, 265 sh, 280, 330, 345, 363 (4.14; 3.55; 3.80; 3.90)		1717
8-Benzoxyphenanthridizinium Perchlorate	a	260 sh, 271 sh, 281, 324, 339, 355 (4.49; 3.84; 4.05; 4.13)		1919
1,7-Dimethylphenanthridizinium Perchlorate	a	238, 274, 279, 333 sh, 348, 364 (4.48; 4.37; 4.42; 3.71; 4.05; 4.18)		15
7,10-Dimethylphenanthridizinium bromide	a	225, 242, 285, 329, 345, 363	229.5; 272, 332, 333, 352	29
3,7-Dimethylphenanthridizinium Perchlorate	a	230 sh, 238, 259, 269, 278 324, 339, 356 (4.45; 4.50; 4.30; 4.36; 4.32; 4.37; 4.06; 4.19)	255, 262, 275, 298 sh, 317, 330, 347 (4.28; 4.30; 4.31; 3.89; 3.70; 3.70; 3.79)	21
7,9-Dimethylphenanthridizinium Bromide	a	227, 240, 273, 325, 341, 357		22
7,11-Dimethylphenanthridizinium Bromide	a	239, 285, 332, 347, 364		22
2,7-Dimethylphenanthridizinium perchlorate	a	223, 237, 255 sh, 268, 277 324, 339, 356 (4.42; 4.50; 4.28; 4.34; 4.40; 3.76; 4.08; 4.17)	227, 262, 272, 316, 328, 349 (4.40; 4.26; 4.33; 3.62; 3.71; 3.82)	21
2,7,10-Trimethylphenanthridi- zinium perchlorate	a	226, 243, 282, 330, 346, 362 (4.46; 4.57; 4.36; 3.70; 4.04; 4.16)	230, 269, 320, 354	21

Compound	Solv.	Absorption maxima max nm. / log _e	Absorption minima max nm. / log _e	Ref.
2,7,11-Trimethylphenanthridi- zinium perchlorate	a	227 sh, 240, 283, 330, 345, 362 (4.44; 4.55; 4.49; 3.75; 3.98; 4.06)	258, 322, 334, 353 (4.07; 3.70; 3.73; 3.86)	21
9-tert.butyl-7-methylphenan- thridizinium perchlorate	a	225, 237, 271, 300, 322, 337, 335 (4.44; 4.12; 4.39; 3.84; 3.84; 3.84; 4.08; 4.20)	205, 229, 253, 315, 327, 344 (4.05; 4.36; 4.24; 3.76 3.76; 3.82)	21
1,3-Dimethylphenanthridizinium perchlorate	a	265 sh, 273, 280, 332, 346, 363 (4.42; 4.43; 3.79; 4.08; 4.24)		19
1,3-Diphenylphenanthridizinium perchlorate	a	255 sh, 275 sh, 393, 360, 375 (4.46; 3.96; 4.16; 4.23)		19
8,9-Dibenzoxyphenanthridizi- nium perchlorate	a	275 sh, 281, 310 sh, 323, 338, 355 (4.46; 3.96; 4.16; 4.23)		19
8,10-Dibenzoxyphenanthridizinium perchlorate	a	283, 303, 327, 345, 361 (4.34; 4.18; 4.09; 3.82; 3.88)		19
7-Methylbenzo(k)phenanthridi- zinium perchlorate	a	204, 227, 259, 308, 351, 369, 388 (4.41; 4.41; 4.45; 4.42; 4.00; 4.02; 4.09)		15
3,7-Dimethylbenzo(k)phenanthridi- zinium perchlorate	a	213, 241, 273, 321, 349, 368, 387 (4.11; 4.50; 4.72; 4.42; 3.73; 3.99; 4.12)		15
5-Methylbenzo(i)phenanthridi- zinium perchlorate	a	231, 243, 271, 318, 348, 368, 387 (4.36; 4.42; 4.66; 4.45; 3.73; 3.99; 4.08)		15
5,9-Dimethylbenzo(i)phenanthri- dizinium perchlorate	a	213 sh, 241, 273, 321, 349, 368, 387 (4.11; 4.50; 4.72; 4.47; 3.73; 3.99; 4.12)	253, 295, 343, 357, 377 (4.45; 4.19; 3.69; 3.67; 3.84)	15
1-Hydroxy-7-methylphenanthridi- zinium perchlorate	a	230, 283, 309, 342, 357, 375	256, 304, 331, 345, 365	27

Compound	Solv.	Absorption maxima max. nm. / log _e	Absorption minima max nm. / log _e	Ref.
11-Hydroxy-2,3,9,10-tetramethoxyphenanthridizinium perchlorate	b	220,240 sh, 244,275 sh, 305,312,337 (4.05; 4.12; 4.13; 4.12 4.34; 4.33; 4.08)	367 sh, 415, 438 (3.71; 3.69; 3.78)	27
2,3-Methylenedioxy-12-methoxy-9-methylbenzo(a)phenanthridizinium perchlorate	b	226,245,284,403,424 (4.47; 4.57; 4.41; 4.42; 4.44)	232,260,343,409 (4.39; 4.35; 3.43; 4.20)	24
14-Methoxy-11-methyldibenzo(a,c)-phenanthridizinium perchlorate	b	228,257,292,430 (4.36; 4.57; 4.52; 4.07)	225,231,282,355 (4.35; 4.39; 4.46; 3.58)	24
13,14-Dimethoxy-11-methyl(a,c)-phenanthridizinium perchlorate	b	229,256,292,414 (4.45; 4.57; 4.59; 4.19)	223,239,266,323 (4.39; 4.41; 4.46; 3.72)	24
7-(β-Carboxyethyl)phenanthridizinium perchlorate	b	228,242,274,325,340,355 (1.42; 4.44; 4.48; 3.48; 3.84; 4.07; 4.20)	232,256,318,330,347 (4.36; 4.33; 3.76; 3.77; 3.83)	16
7-(β-Carboxymethyl)phenanthridizinium perchlorate	b	255,238,269,282,326,340,355 (4.32; 4.40; 4.30; 4.34; 3.67; 3.94; 4.06)		16
7-(β-Carboxymethyl)-10-methylphenanthridizinium perchlorate	b	228,243,263,285,332 sh, 347,362 (4.38; 4.54; 4.35; 4.39; 3.56; 3.97; 4.10)	229,256,271,322,353 (4.36; 4.33; 4.32; 3.54, 3.87)	16
<u>BENZO(c)QUINOLIZINIUM SALTS:</u>				
Benzo(c)quinolizinium picrate	b	227,222,300,347,364 (4.27; 4.48; 3.67; 4.11; 4.2)		23
1,2-Dimethylbenzo(c)quinolizinium fluoroborate	a	410 (20,000)		23

Compound	Solv.	Absorption maxima max nm./ log _e	Absorption minima max nm./ log _e	Ref.
1-Methyl-2-phenylbenzo(c)- quinolizinium Fluoroborate	a	398 (20,000)		23
1-Methyl-2-ter.butylbenzo(c)- quinolizinium Fluoroborate	a	380 (20,000)		23
1-2-Diphenyl-5-methylbenzo(c)- quinolizinium Fluoroborate	a	420 (16,000)		23
1,2,3,4-Tetrahydrobenzo(c) - quinolizinium Chloride	a	240, 312, sh, 320 (4.43; 3.94; 3.98)		25
10-Nitrobenzo(c)quinolozinium Perchlorate	a	252, 287, 236, 350, 368 (3.92; 3.78; 4.04; 4.14; 4.46)		25
10-Aminobenzo(c)quinolizinium Bromide	a	247, 328, 440 (4.41; 4.26; 3.76)		25
10-Acetamidobenzo(c) - quinolizinium Bromide	a	232, 240, 256, 352, 368 (4.23; 4.25; 4.29; 3.89; 4.01)		25
10-Amino-1,2,3,4-tetrahydro- benzo(c)quinolizium perchlorate	a	262, 290, 380 (4.38; 3.69; 4.11)		25
Betain of Benzo(c)quinolizinium Chloride	a	230, 256, 300 sh, 336, 350 368 (4.18; 4.47; 3.75; 3.78; 4.03; 4.13)		25

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