A Study of the Synthesis and some Reactions of Perimidines

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A study of the preparation of perimidines from 1,8-diaminonaphthalene and carbonyl compounds is presented. The optimum conditions for the reaction of the above diamine with carboxylic acids and esters, acid chlorides, anhydrides and aldehydes are defined.

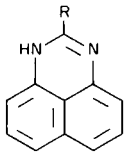
The chemical behavior and a number of previously unreported reactions of perimidines are presented. The latter include *N*-alkylations, reductions, oxidations and acylations.

The synthesis of perimidines (**1**) was first reported by Sachs (1) in 1909. Since then, 2-alkyl and nuclearly polysubstituted perimidines, dihydroperimidines and their quaternary salts have been prepared (2a-c), mainly as dye intermediates, by the reactions of 1,8-diaminonaphthalene (1,8-DAN) and various carbonyl derivatives. A variety of other procedures (3-6) have also been reported but these have been rather limited in scope.

We have prepared a variety of new perimidines for pharmacological screening. During the course of this work, we have had occasion to evaluate and improve some of the known methods, and develop new methods. In addition, the chemical behavior of perimidines toward a number of reagents was studies.

Synthesis of Perimidines.

We have made a study of the reactions of 1,8-DAN with carbonyl derivatives, first reported by Sachs (1). The utility of these reagents in the preparation of perimidines is outlined in Tables I and II and discussed below.



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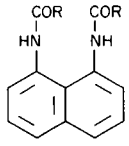

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A. Carboxylic Acids.

We have found excess formic acid to be the best reagent (and solvent) for the preparation of perimidine (**1**, R = H). When higher aliphatic or aromatic acids were used in the absence of solvents, the yields of the perimidines formed were very low and resinous by-products were obtained. However, when aliphatic acids were allowed to react with 1,8-DAN in refluxing 4*N* aqueous hydrochloric acid, good yields of 2-substituted perimidines were obtained. The formation of diamides (**2**) was minimized in this medium. This procedure was also quite satisfactory for the preparation of 2-(hydroxymethyl)-perimidines from suitable α-hydroxy acids such as glycolic and mandelic acids (7). This reaction appears to be subject to steric hindrance as shown by increased reaction time and lower yield obtained from mandelic acid as compared to glycolic acid (see Table I).

Both α- and β-amino acids failed to give appreciable yields of aminoalkyl perimidines with 1,8-DAN, while γ-aminobutyric acids and piperidine-4-carboxylic acid gave less than 5% yields of the corresponding perimidines. The proximity of a positively charged amine group to the carboxylic acid may be the cause of diminished reactivity.

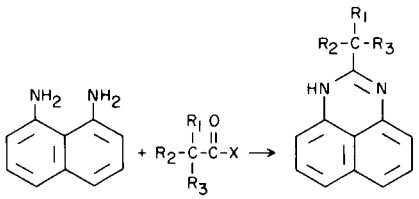
Two α-keto acids, pyruvic and phenylpyruvic acids failed to give identifiable products when treated with 1,8-DAN in 4*N* hydrochloric acid or without solvent. The reactivity of the keto functions towards the diamine may be the cause of the difficulty.

B. Acid Chlorides.

Both aromatic and aliphatic acid chlorides react with 1,8-DAN in inert solvents to give perimidines. The yields were variable (20-60%) and the products were always accompanied by significant amounts of the corresponding diamides. These diamides were not intermediates in perimidine formation. Treatment of *N,N'*-diacetyldiamino-naphthalene (**2**, R = CH_3) with acetyl chloride or acetic anhydride did not give any 2-methylperimidine.

A claim by Buu-Hoi and coworkers (8) that the use of pyridine as solvent in the reaction of acid chlorides and 1,8-DAN gave mainly diamides could not be substantiated. Thus, acetyl chloride gave a 50% yield of 2-methylperimidine and a 15% yield of *N,N'*-diacetyl-1,8-diaminonaphtha-

TABLE I



No.	R_1	R_2	R_3	X	Method	Yield	M.P. °C (Solvent) (a)	Found, % (Calcd., %) C	H	N
9	OH	H	H	OH	B	72	215-216 (Et)	72.53 (72.71)	5.34 (5.09)	14.02 (14.13)
11	OH	C_6H_5	H	OH	B	42	184-185 (b) (Et-W)	78.81 (78.81)	5.15 (5.14)	10.16 (10.21)
12 (c)	SH	H	H	OH	B	14	220-222 (Me)	57.46 (57.48)	4.66 (4.43)	10.99 (11.17)
13	CH_3	CH_3	$CH_2N(CH_3)_2$	H	A	61	131-132 (Et-W)	76.33 (76.37)	8.02 (7.92)	15.76 (15.72)
14	CH_3	CH_3	CH_2CH_2CN	H	A	53	178-179 (Me-W)	77.47 (77.53)	6.41 (6.51)	15.95 (15.96)
15	H	H	n-$C_{10}H_{21}$	OH	B	0				
16	H	H	n-$C_{10}H_{21}$	Cl	C	34	85-87 (B-PE)	82.21 (81.93)	9.60 (9.38)	8.81 (8.69)

(a) Et = Ethanol, Me = Methanol, W = Water, B = Benzene, PE = Petroleum Ether. (b) An erroneous carbon percentage of 79.2 and a m.p. of 152° is reported in the literature (ref. 8). We are unable to explain the discrepancy. (c) Characterized as the hydrochloride salt.

lene. Comparable results were obtained with heptanoyl chloride.

The use of acid chlorides is advantageous when long chain aliphatic acids were used. For example, when lauric acid was used with 1,8-DAN in 4*N* hydrochloric acid, no perimidine was obtained, probably due to the water insolubility of the acid. Lauroyl chloride in benzene gave a 35% yield of 2-undecylperimidine (**1**, R = $C_{11}H_{23}$).

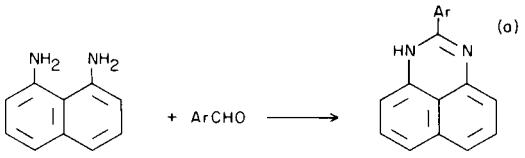
C. Esters and Anhydrides.

Ried (9) has studied the reaction of diesters with 1,8-DAN. We did not investigate esters in detail, but the results obtained with some esters are noteworthy. Diethyl malonate and ethyl acetoacetate reacted with 1,8-DAN without solvent, at reflux, to give compounds with comparable melting points with those reported by Sachs (1). These, however, did not have the 2-carbethoxymethyl- and 2-acetonylperimidine structures assigned by Sachs, but were the corresponding tautomers **3a** and **3b**, respectively. The structures of these products were established by an examination of their infrared and ultraviolet spectra. The latter were not characteristic of normal perimidines, while the former showed bands compatible with vinylogous carbamates (**3a**) and vinylogous amides (**3b**) rather than esters or ketones (see experimental). Hydrogenation of **3b** with platinum gave the alcohol (**4**).

While diethyl oxalate gave 2-carbethoxyperimidine readily (1), ethyl oxamate gave a mixture of perimidine-2-carboxamide and 2-carbethoxyperimidine. This is the only recorded instance of an amide reacting with 1,8-DAN to give a perimidine.

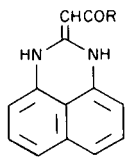
Like acid chlorides, anhydrides gave mixtures of

TABLE II



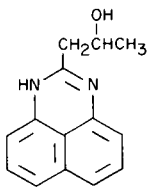
No.	Ar (d)	Yield	M.P. °C (Solvent) (c)	Found, % C	(Calcd., %) H	N
17	C_6H_5	50 (b)	183-184 (Et)			11.75 (11.47)
18	3-Py	20	223-225 (Et)	78.73 (78.35)	4.61 (4.52)	17.18 (17.14)
19	4-Py	69	224-225 (Et)			17.10 (17.14)
20	2-Fur	68	178-179 (ETA)	76.90 (76.91)	4.44 (4.30)	11.89 (11.96)
21 (e)	2-Pyr	18	270 dec. (Me)	66.81 (66.79)	4.54 (4.49)	15.63 (15.58)
22 (e)	2-*N*-Me-Pyr	6	270 dec. (Et)	67.55 (67.73)	5.17 (4.98)	14.63 (14.81)

(a) Method A. (b) Benzoyl chloride (Method C) gave only a 10% yield of 2-phenylperimidine. (c) Et = Ethanol, C = Cyclohexane, Me = Methanol, ETA = Ethyl Acetate. (d) Py = Pyridyl, Fur = Furyl, Pyr = Pyrrolyl. (e) Characterized as the hydrochloride salt.



3a R = OC_2H_5

3b R = CH_3



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perimidines and diamides. The use of acetic anhydride, however, was the most convenient method for the preparation of 2-methylperimidine (**1**, R = CH_3) (10).

D. Aldehydes.

It has been reported that aromatic and aliphatic aldehydes react with 1,8-DAN in ethanol to give the corresponding dihydroperimidines (11). These in turn may be dehydrogenated with palladium to perimidines (3). We have found that these two steps are best carried out in one reaction by adding the catalyst to the reactants and refluxing the mixture in xylene. Good yields of pure perimidines have been obtained by this procedure. The yields from α-trisubstituted aldehydes (Table I - 61%, 53%) are quite good suggesting that steric hindrance is not an important factor. This procedure was the only procedure to give acceptable yields of 2-aryl (or heterocyclic) perimidines.

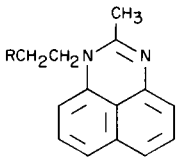
Reactions of Perimidines.

Cyanoethylation (12) and quaternary salt formation (2a) were the only reactions of perimidines previously reported.

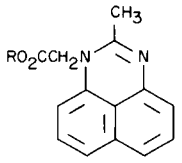
Perimidines can be alkylated in the 1-position in *ca.* 50% yield with a variety of alkylating agents (e. g., *n*-butyl bromide, ethyl bromoacetate, dimethylaminopropyl chloride) using a strong base, such as sodium hydride, in 1,2-dimethoxyethane. In the case of the more

reactive halides, quaternary salt formation is observed. Other base-solvent combinations, such as sodium ethoxide/ethanol or sodium hydride/dimethylformamide led to extensive decomposition.

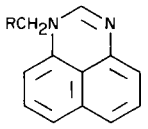
Perimidines unsubstituted in the **1**-position were stable to acid but quite unstable to aqueous base (13). 1-Substituted perimidines were stable to both reagents. Thus, the cyanoethylperimidine (**5a**) can be hydrolyzed with strong acid to the carboxylic acid (**5b**) and the ester (**6a**) can be saponified with base, in good yield, to the corresponding acid (**6b**).



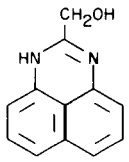
5a R = CN
5b R = CO_2H



6a R = C_2H_5
6b R = H



7a R = $CO_2C_2H_5$
7b R = CH_2OH



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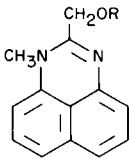
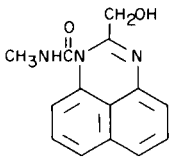


9 R = H, CH_3



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While perimidines were inert to sodium borohydride, lithium aluminum hydride converted them to dihydroperimidines. For example, reduction of ethyl perimidine-1-acetate (**7a**) with lithium aluminum hydride gave 2,3-dihydro-1-(2-hydroxyethyl)perimidine, which was dehydrogenated to **7b**. Perimidines are stable to catalytic hydrogenation. 2-(2-Furyl)perimidine was hydrogenated to 2-(2-furfuryl)perimidine without the accompanying reduction of the azomethine linkage of the perimidine.

Strong oxidizing agents such as hydrogen peroxide, chromium trioxide in acetic acid or potassium permanganate cause perimidines to decompose. The alcohol (**12**) could not be oxidized to the corresponding ketone due to decomposition of the perimidine. It should be noted that 2-(1-hydroxyethyl)benzimidazle can be oxidized (chromic oxide/acetic acid) to 2-acetylbenzimidazole (14).

2-Hydroxyalkylperimidines (such as **8**) can be acylated with acetyl chloride or acetic anhydride at the oxygen rather than nitrogen. However, alkylation with one equivalent of base and alkylating agent occurred primarily on nitrogen (**9**, R = H). A low yield of the corresponding dimethyl derivative (**9**, R = CH_3) was also isolated. The identity of these products was established by examination of their nmr spectra (see experimental) and by the conversion of the former (**9**, R = H) to an acetate ester (IR band at 1740 cm^{-1}) with acetic anhydride. Methyl isocyanate gave the urea **10**, with reaction again occurring on nitrogen as shown by examination of its infrared spectrum (1690 cm^{-1}).

In general, with 1-substituted perimidines a large variety of standard reactions may be performed without disrupting this heterocyclic system.

EXPERIMENTAL

All melting points are corrected and were taken in a stirred oil bath, unless otherwise specified. Infrared spectra were taken on a Perkin-Elmer Model 21 spectrometer and the ultraviolet spectra on a Cary Model 14 spectrometer. Nmr spectra were determined with a Varian A60 spectrometer, using TMS as an internal standard.

General Methods for the Preparation of Perimidines.

Method A.

Equivalent amounts of 1,8-diaminonaphthalene and the appropriate aldehyde were refluxed for 2-4 hours in xylene in the presence of 10% palladium-on-carbon catalyst (about 10% by weight of the diamine). The reaction mixture was filtered and the filtrate chilled to cause separation of the product. Addition of ether was necessary in some cases to start precipitation. Hydrochloride salts of the products may be prepared by the addition of ethereal hydrogen chloride to the filtrate, above. The products were recrystallized from suitable solvents (see Table II) when necessary.

Method B.

A 10% (w/v) solution of one equivalent of 1,8-diaminonaphthalene and 1.5 equivalents of a carboxylic acid in 4*N* aqueous hydrochloric acid was refluxed for 18-60 hours. The hydrochloride salt of the product perimidine separates from the reaction mixture and may be recrystallized or converted to its free base by treatment with aqueous ammonia.

Method C.

Equivalent amounts of 1,8-diaminonaphthalene and an acid chloride were refluxed for 16 hours in benzene solution. The resulting perimidine hydrochloride and a diamide by-product precipitated and were separated by filtration. Treatment with ammonia gave the free base of the perimidine. The diamide by-products were separated by refluxing this crude product in ethanol. The diamides are insoluble in this medium and can be filtered and recrystallized from dimethylformamide, while the perimidine is recovered from the ethanol solution.

2-Methylperimidine and *N,N'*-Diacetyl-1,8-diaminonaphthalene. (**1** and **2**, R = CH_3).

A. Heating 1,8-diaminonaphthalene in excess acetic anhydride by the method of Whitehurst (10) gave 2-methylperimidine, m.p. 215-216°, in 75-85% yields.

B. To a solution of 10 g. (0.06 mole) of 1,8-diaminonaphthalene in 75 ml. of dry pyridine at 0° was added 10 g. (0.13 mole) of acetyl chloride over a period of 20 minutes. A vigorous exothermic reaction occurred and a solid separated. After 2 hours, the reaction mixture was filtered, the solid was suspended in water and treated with dilute ammonia. The free base was suspended in ethanol and refluxed for 15 minutes. The insoluble portion was filtered and recrystallized from dimethylformamide to give 3.2 g. (15%) of *N,N'*-diacetyl-1,8-diaminonaphthalene as white plates, m.p. 285° dec. (Kofler) (15).

Anal. Calcd. for $C_{14}H_{14}N_2O_2$: C, 69.40; H, 5.83; N, 11.56. Found: C, 69.12; H, 5.71; N, 11.42.

The ethanol-soluble portion of the crude product was concentrated to one-half its volume and cooled to give 5.6 g. (50%) of 2-methylperimidine, m.p. 215-216°.

Ethyl 2(3H)-perimidylideneacetate (**3a**).

1,8-Diaminonaphthalene (34.5 g., 0.22 mole) and diethyl malonate (140 g., 0.88 mole) were combined and heated at reflux for 4 hours. After cooling, the separated solid was collected and recrystallized twice from ethanol to give 11.6 g. (21%) of off-white crystals, m.p. 151-153°; ν max (potassium bromide), 1660 cm^{-1} (C=O of vinylogous carbamate); λ max (methanol), 233 (ϵ, 38,400), 309 (ϵ, 15,000), 328 mμ (ϵ, 14,200).

Anal. Calcd. for $C_{15}H_{14}N_2O_2$: C, 70.85; H, 5.55; N, 11.02. Found: C, 70.75; H. 5.76; N, 11.06.

2(3H)-Perimidylidene-2-propanone (**3b**).

A 146 g. sample (0.93 mole) of 1,8-diaminonaphthalene was combined with 464 g. (3.56 moles) of freshly distilled ethyl acetoacetate and the mixture was refluxed for 0.5 hour, then cooled. The separated solid was removed and recrystallized from ethanol to give 132 g. (64%) of a white solid, m.p. 258-260° (Mel Temp), (15); ν max (potassium bromide), 1650 (C = O of vinylogous amide), 1620 cm^{-1} (C=C); λ max (methanol), 233 (ϵ, 41,000), 322 mμ (ϵ, 52,600).

Anal. Calcd. for $C_{14}H_{12}N_2O$: C, 74.99; H, 5.38; N, 12.49. Found: C, 74.98; H, 5.56; N, 12.34.

2-(2-Hydroxy-1-propyl)-perimidine (**4**).

A 40 g. sample of 2(3*H*)-perimidylidene-2-propanone was hydrogenated as a suspension in 400 ml. of glacial acetic acid in the presence of 4 g. of platinum oxide at an initial pressure of 50 psi at room temperature. After the hydrogen uptake stopped (4 hours), the catalyst was filtered and the filtrate was neutralized with ammonia and extracted with chloroform. Concentration of the chloroform extracts gave a yellow solid, which on recrystallization (twice) from ethyl acetate, gave 20.2 g. (50%) of yellow crystals, m.p. 151-151.5°; ν max (chloroform), 3414 (-OH) 1630 cm^{-1} (C=N); λ max (methanol), 234 (ϵ, 30,400), 329 mμ (ϵ, 12,900).

Anal. Calcd. for $C_{14}H_{14}N_2O$: C, 74.31; H, 6.24; N, 12.38. Found: C, 74.43; H, 6.57; N, 12.37.

Ethyl 2-Methylperimidine-1-acetate (**6a**).

To a suspension of sodium hydride (4.8 g. of 50% suspended on mineral oil, 0.1 mole) in 75 ml. of 1,2-dimethoxyethane was added 17 g. (0.093 mole) of 2-methylperimidine in 400 ml. of 1,2-dimethoxyethane. In 0.5 hour, 94% of the theoretical amount of hydrogen was evolved. Ethyl bromoacetate (17 g., 0.1 mole) was added and the mixture was stirred for 4 hours at room temperature. After concentration to one-fourth its volume, the solution was filtered and the filtrate was diluted with water and cooled. The separated solid was collected and recrystallized twice from ethyl acetate-hexane to give 13.7 g. (55%) of the product, m.p. 132-133°; ν max (chloroform), 1720 (C=O of ester), 1615 cm^{-1} (C=N). λ max (methanol), 233 (ϵ, 34,200), 327 mμ (ϵ, 14,600).

Anal. Calcd. for C H N O : C, 71.62; H, 6.01; N, 10.44. Found: C, 71.42; H, 6.04; N, 10.37.

2-Methylperimidine-1-acetic acid (**6b**).

A 28 g. sample (0.1 mole) of ethyl 2-methylperimidine-1-acetate was hydrolyzed by refluxing with 4.1 g. of sodium hydrixode in 250 ml. of aqueous ethanol for 3.5 hours. After concentration of the solution and dilution with water, it was acidified to *p*H 5 and the separated solid was collected, washed with hot water and dried at 140°/0.2 mm. for 4 days to give 20.7 g. (83%) of a yellow solid, m.p. 250-251°; ν max (potassium bromide), 1660 cm^{-1} (C=O of acid); λ max (methanol), 231 (ϵ, 29,700), 327 mμ (ϵ, 13,700).

Anal. Calcd. for $C_{14}H_{12}N_2O_2$: C, 69.99; H, 5.03; N, 11.66. Found: C, 70.09; H, 4.99; N, 11.29.

3-(2-Methylperimidine)-1-propionitrile (**5a**).

2-Methylperimidine (47 g., 0.26 mole) was suspended in 400 ml. of acrylonitrile and a sodium ethoxide solution (from 0.8 g. of sodium and 15 ml. of ethanol) was added to the suspension dropwise and with stirring. After the exothermic reaction subsided, the resulting homogeneous solution was refluxed for 1.5 hours, concentrated to one-half its volume and diluted with benzene. The separated solid (acrylonitrile polymer) was collected, the filtrate was concentrated and the residual oil crystallized from ethyl acetate twice to give 24 g. (40%) of yellow prisms, m.p. 145-146°; ν max (chloroform), 2255 cm^{-1} (C≡N); λ max (methanol), 234 (ϵ, 34,600), 328 mμ (ϵ, 14,400).

Anal. Calcd. for $C_{15}H_{13}N_3$: N, 17.86. Found: N, 17.77.

2-Methylperimidine-1-propionic Acid Hydrochloride Hemihydrate. (**5b**).

A 10 g. sample of 2-methylperimidine-1-propionitrile (0.042 mole) was refluxed for 3 hours in 100 ml. of 18% hydrochloric acid. After cooling, the separated solid was collected and recrystallized twice from ethanol-ether to give 9.4 g. (76%) of the product as a hemihydrate hydrochloride, m.p. >290° dec. (Mel. Temp) (15); ν max (potassium bromide), 1712 cm^{-1} (C=O of acid); λ max (methanol), 235 (ϵ, 31,000), 329 mμ (ϵ, 14,400).

Anal. Calcd. for $C_{15}H_{14}N_2O_2 \cdot HCl \cdot \frac{1}{2}H_2O$: C, 60.10; H, 5.38; N, 9.34; H_2O, 3.05. Found: C, 59.85; H, 5.10; N, 9.44; H_2O, 1.7 ± 0.6.

1-Perimidineethanol (**7b**).

To a suspension of 4.3 g. (0.11 mole) of lithium aluminum hydride in 250 ml. of ether was added 9.6 g. (0.04 mole) of ethyl perimidine-1-acetate (m.p. 110-111°, prepared from perimidine and ethyl bromoacetate, as described for compound **6a**) in 60 ml. of tetrahydrofuran. The resulting mixture was stirred at room temperature for 24 hours then decomposed with water and filtered. Concentration of the filtrate gave an oil which crystallized and was recrystallized from benzene to give 5.5 g. (69%) of 2,3-dihydro-1-perimidineethanol, m.p. 81-83°; ν max (potassium

bromide), 3250 cm^{-1} (-OH); λ max (methanol), 233 (ε, 39,700), 333 (ε, 11,100); 344 mμ (ε, 10,800).

Anal. Calcd. for $C_{13}H_{14}N_2O$: C, 72.87; H, 6.59; N, 13.08. Found: C, 73.02; H, 6.58; N, 13.40.

A 10.3 g. sample of 2,3-dihydro-1-perimidineethanol was dehydrogenated by stirring at room temperature in ethanol for 55 hours in the presence of 4 g. of 10% palladium-on-carbon catalyst. The reaction mixture was heated to reflux and filtered, the filtrate was evaporated to leave a solid which was recrystallized from benzene-ethyl acetate to give 5.8 g. (56%) of 1-perimidineethanol was greenish yellow plates, m.p. 206-207°; ν max (potassium bromide), 3160 cm^{-1} (-OH); λ max (in ethanol), 234 (ε, 33,300), 322 mμ (ε, 15,100).

Anal. Calcd. for $C_{13}H_{12}N_2O$: C, 73.56; H, 5.70; N, 13.20. Found: C, 73.69; H, 5.76; N, 12.96.

2-(2-Tetrahydrofuryl)perimidine.

A 10 g. sample of 2-(2-furyl)perimidine (**25**) was hydrogenated in a mixture of 120 ml. of ethanol and 35 ml. of concentrated hydrochloric acid at room temperature at an initial pressure of 35 psi, in the presence of 0.5 g. of platinum oxide for 6 hours. After filtration of the catalyst, the solution was concentrated, diluted with water, made basic with ammonia and extracted with chloroform. Concentration of the chloroform extracts gave an oil which crystallized and was recrystallized from ethyl acetate-cyclohexane to give 3.4 g. (34%) of yellow crystals, m.p. 155-156°; ν max (chloroform), 3500 cm^{-1} (N-H); λ max (methanol), 235 (ε, 37,000), 330 mμ (ε, 13,000).

Anal. Calcd. for $C_{15}H_{14}N_2O$: C, 75.60; H, 5.92; N, 11.76. Found: C, 75.56; H, 6.00; N, 11.80.

(2-Perimidyl)methyl acetate (**9**, R = CH_3CO).

A 10 g. sample of perimidine-2-methanol was dissolved in 100 ml. of acetic anhydride by warming to 40°. This solution, after 10 minutes deposited a solid. The mixture was treated with water and made basic with ammonia, then extracted with chloroform. Concentration of the extracts left a solid which was recrystallized from ethyl acetate-hexane, to give 6.3 g. (51%) of yellow crystals, m.p. 154-155°; ν max (potassium bromide), 1720 cm^{-1} (C=O of an ester); λ max (methanol), 234 (ε, 35,300), 330 mμ (ε, 13,400).

Anal. Calcd. for $C_{14}H_{12}N_2O_2$: N, 11.66. Found: N, 11.91.

1-Methyl-2-(hydroxymethyl)perimidine, (**9**, R=H).

To a sodium hydride suspension (2.4 g. of 50% on mineral oil, 0.05 mole) in 250 ml. of 1,2-dimethoxyethane was added 2-perimidine methanol (10 g., 0.05 mole) and the mixture was stirred at room temperature for 3 hours. Methyl iodide (7.1 g., 0.05 mole) was then added and after 2 hours, the mixture was concentrated, then diluted with water. The separated solid was filtered and recrystallized from ethyl acetate to give 6.0 g. (57%) of 1-methyl-2-(hydroxymethyl)perimidine as yellow crystals, m.p. 165-167°; ν max (chloroform), 1630 cm^{-1} (C=N); λ max (methanol), 234 (ε, 35,400), 331 mμ (ε, 14,700). Nmr (deuteriochloroform) singlet at δ 2.90 (3 protons, N-CH_3), singlet at δ 4.24 (2 protons, O-CH_2-Ar).

Anal. Calcd. for $C_{13}H_{12}N_2O$: C, 73.56; H, 5.70; N, 13.20. Found: C, 73.18; H, 5.48; N, 13.14.

The mother liquors from the reaction mixture were concentrated and the residual oil was chromatographed on activity III neutral alumina. Fractions eluted with 2% chloroform in ether were combined and recrystallized from cyclohexane to give 1-methyl-2-(methoxymethyl)perimidine as yellow prisms, m.p. 86-88°; ν max (methanol), 234 (ε, 35,300), 332 mμ (ε, 14,200). Nmr (deuteriochloroform) singlet at δ 3.05 (3 protons N-CH_3), singlet at δ 3.41 (3 protons, O-CH_3), singlet at δ 4.18 (2 protons, -O-CH_2-Ar).

Anal. Calcd. for $C_{14}H_{14}N_2O$: C, 74.31; H, 6.24; N, 12.38. Found: C, 74.22; H, 6.31; N, 12.52.

2-Hydroxymethyl-*N*-methylperimidine-1-carboxamide (**10**).

A mixture of 5 g. (0.025 mole) of (2-perimidyl)methanol, 3 ml. of methylisocyanate and 2 ml. of pyridine was mixed in 75 ml. of benzene and the resulting mixture was refluxed for 18 hours. After cooling, the separated solid was collected and recrystallized from ethyl acetate-ethanol to give 3.3 g. (60%) of yellow crystals, m.p. 192-193°; ν max (potassium bromide), 1690 cm^{-1} (C=O of a urea); λ max (methanol), 234 (ε, 34,500), 330 mμ (ε, 13,400).

Anal. Calcd. for $C_{14}H_{13}N_3O_2$: N, 16.46. Found: N, 16.24.

2-*n*-Undecylperimidine.

A solution of 8 g. (0.05 mole) of 1,8-diaminonaphthalene and 22 g. (0.1 mole) of lauryl chloride in 160 ml. of benzene was refluxed for 3.5 hours, then cooled. The separated solid was filtered, suspended in water and stirred with ammonia. The new solid was filtered and recrystallized from petroleum ether-benzene to give 5.5 g. (35%) of yellow crystals, m.p. 85-87°; λ max (methanol), 234 (ε, 31,700), 328 mμ (ε, 13,400).

Anal. Calcd. for $C_{22}H_{30}N_2$: C, 81.93; H, 9.38; N, 8.69. Found: C, 82.21; H, 9.60; N, 8.81.

Perimidine-2-carboxamide.

An intimate mixture of ethyl oxamate (89.0 g., 0.76 mole) and 1,8-diaminonaphthalene (31.6 g., 0.2 mole) was melted and heated at 100° for 2 hours. The resulting red solid was triturated with hot ethyl acetate and the undissolved solid was collected by filtration and recrystallized from ethanol to give 4.3 g. (10%) yield of red plates, m.p. 243-245°; ν max (potassium bromide), 1700 cm^{-1} (C=O of an amide); λ max (methanol), 233 (ε, 40,800), 332 (ε, 11,200), 344 mμ (ε, 13,300).

Anal. Calcd. for $C_{12}H_9N_3O$: C, 68.23; H, 4.30; N, 19.90. Found: C, 68.47; H, 4.39; N, 20.10.

The mother liquors of the reaction mixture contained perimidine-2-carboxamide and 2-carbethoxyperimidine as shown by thin layer chromatography on alumina plates with chloroform as the solvent.

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