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Studies on Azole Compounds. II[1]. Reaction of Oxazole N-Oxides with Phenylisocyanate to give Imidazole Derivatives

Yoshinobu Goto, Noriko Honjo and Motoyoshi Yamazaki

Faculty of Pharmaceutical Sciences, Fukuoka University[2]

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The reactions of 4-methyloxazole N-oxides substituted in the 2-position (Ia—d) with phenylisocyanate were studied. The oxazole N-oxides were easily attacked on the 2-position by the nitrogen of phenylisocyanate, followed by ring-cleavage and re-cyclization to give 5-hydroxy-4-methylene-1,2,5-trisubstituted 4,5-dihydroimidazoles (IIa—d). The structures of IIa—d were determined by their chemical behavior and spectral data.

In the preceding paper,[1] it has been shown that the 2-position of oxazole N-oxides is extraordinarily sensitive to cyanide and hydroxide ions, even in the case of occupying the 2-position with substituents.

As a part of our studies on azole compounds, the present investigation was carried out to examine the chemical behavior of oxazole N-oxide derivatives under the treatment with phenylisocyanate. As was expected, the 4-methyloxazole N-oxides substituted in the 2-position (Ia—d) were easily attacked on the 2-position by the nitrogen of phenylisocyanate, followed by ring cleavage and recyclization to give imidazole derivatives.

Many reports have been published on the reactions of aromatic amine oxides with phenylisocyanate.[3] However, there are a few reports on the reaction of azole N-oxides. Takahashi and Kano[4] reported that the reaction of 1-methylbenzimidazole 3-oxides with phenylisocyanate gave 2-anilino-1-methylbenzimidazole, on the contrary 6-anilino-1,2-dimethylbenzimidazole was obtained by the reaction of 1,2-dimethylbenzimidazole 3-oxide being occupied with methyl group on the 2-position (*cf.* Chart 1).

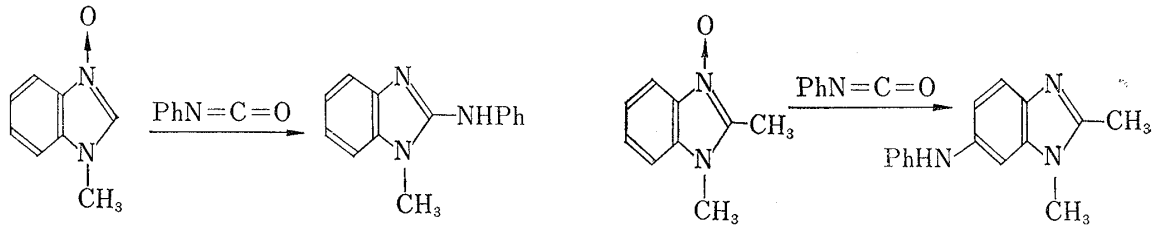

Chart 1

In 1915, Diels and Riley[5] were first to examine the reaction of oxidoöxazole (Ib-A) with phenylisocyanate and they assigned the structure IIb-A or IIb-B (Chart 2) to the reaction product. In the same study, Ib-A was assumed to have an epoxide structure, however it was determined to be oxazole N-oxide (Ib) by its chemical behavior and infrared (IR) and ultra-

1) Part I: Y. Goto and M. Yamazaki, *Chem. Pharm. Bull.* (Tokyo), **18**, 756 (1970).
2) Location: *Nanakuma, Fukuoka.*
3) E. Ochiai, "Aromatic Amine Oxides," Elsevier Publishing Co. Amsterdam, 1967, pp. 256—258.
4) *a*) S. Takahashi and H. Kano, *Chem. Pharm. Bull.* (Tokyo), **12**, 1290 (1964); *b*) *Idem, ibid.*, **14**, 1219 (1966).
5) O. Diels and D. Riley, *Ber.*, **48**, 897 (1915).

violet (UV) spectra lately.[6] Cornforth and Cornforth[7] ascribed oxazole N-oxide structure to oxidoöxazole and the structure IIb-C to the above reaction product without any direct proofs for these structures. The chemical behavior and the spectral data of IIb cannot be explained in terms of these three proposed structures IIb-A, IIb-B or IIb-C.

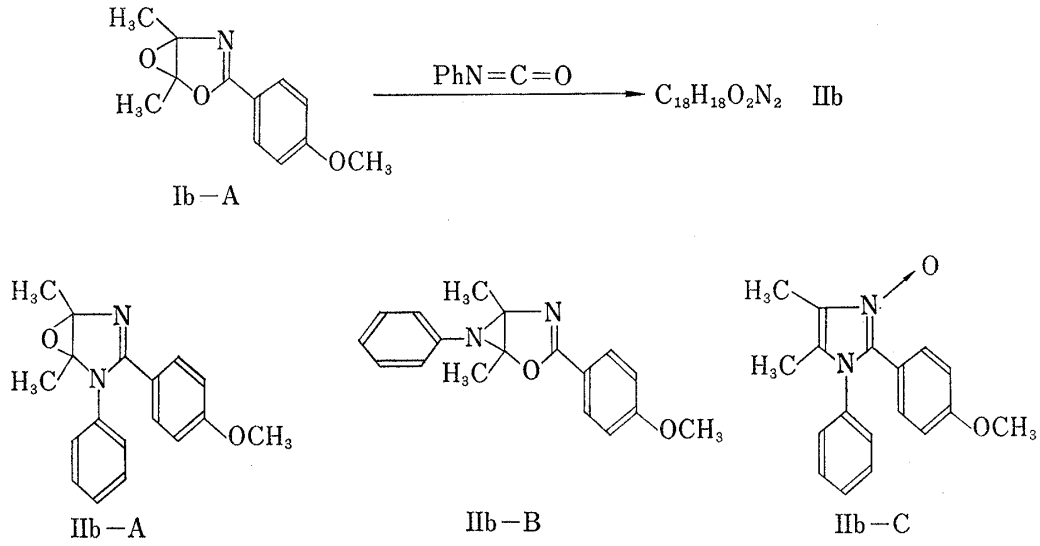

Chart 2

After phenylisocyanate was added to the chloroform solution of 4,5-dimethyl-2-phenyloxazole N-oxide (Ia), the resulting mixture was allowed to stand for fifteen minutes at room temperature. From the reaction mixture, a crystalline substance $C_{17}H_{16}ON_2$ (IIa) was obtained.

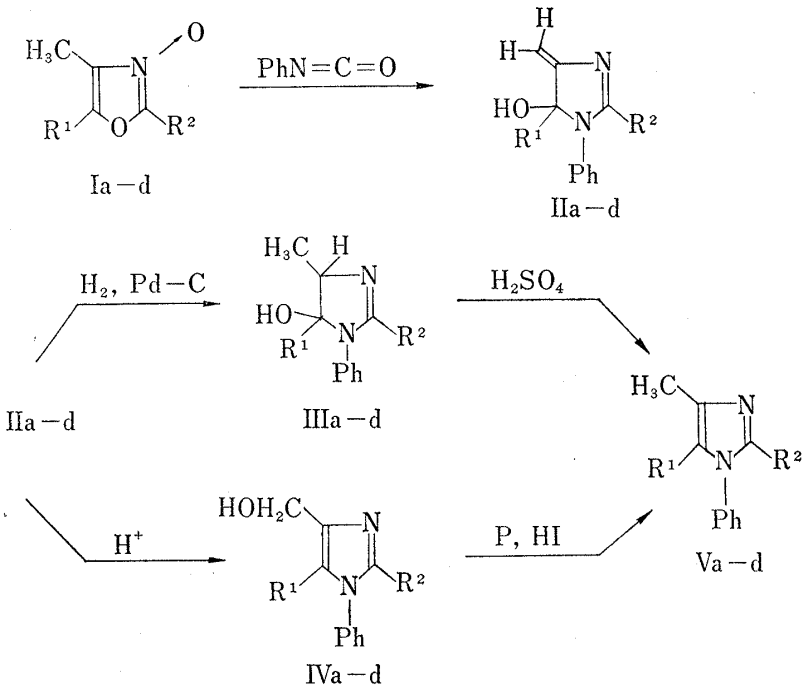

Chart 3

6) Y. Goto, M. Yamazaki and M. Hamana, Abstracts of Papers, 88th Annual Meeting of the Pharmaceutical Society of Japan, Tokyo, April, 1968, p. 122.
7) J.W. Cornforth and R.H. Cornforth, *J. Chem. Soc.*, **1947**, 96.

On the hydrogenation of IIa with palladium on charcoal at atmospheric pressure, one mole of hydrogen was absorbed to give $C_{17}H_{18}ON_2$ (IIIa). When IIa was treated with hydrochloric acid, this isomerized easily to IVa. The treatment of IIIa with sulfuric acid gave 4,5-dimethyl-1,2-diphenylimidazole (Va) prepared by the technique of Lions and Ritchie[8] for the preparation of 1,2,4,5-tetrasubstituted imidazoles. Compound IVa was also converted to Va by the reduction with phosphorus and hydriodic acid.[9]

On the basis of these chemical behavior and the spectral data which will be discussed later, the structure of IIa, IIIa, IVa and Va shown in Chart 3 were determined.

As Figure 1 shows, in the UV spectrum of IIa, the absorption due to a phenyloxazole ring disappears and the absorption maximum is shifted toward longer wave lengths, as compared with the absorption spectrum of Ia. The structure of the hydrogenated compound IIIa may be explained satisfactorily on the basis of the shape of the absorption spectrum which shows the absorption maximum at 228 mμ and the shoulder at longer wave length side (265 mμ) of the main absorption band. The shape of the spectrum of the isomerized compound IVa is very similar to that of Va.

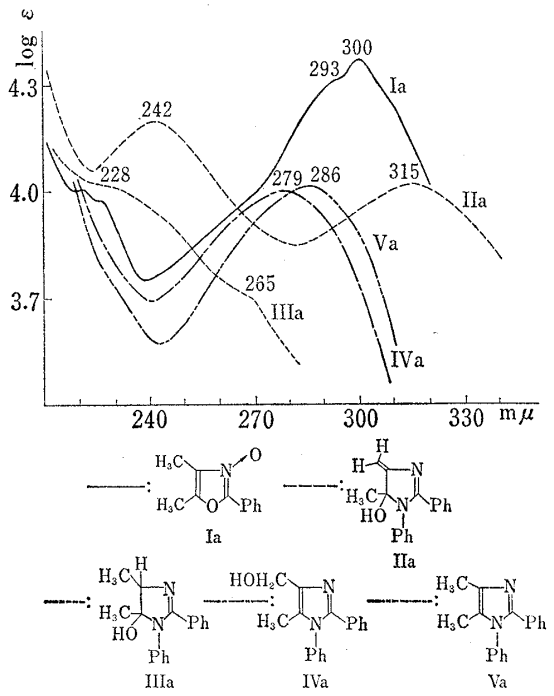

Fig. 1. UV Spectra of Ia, IIa, IIIa, IVa and Va in EtOH

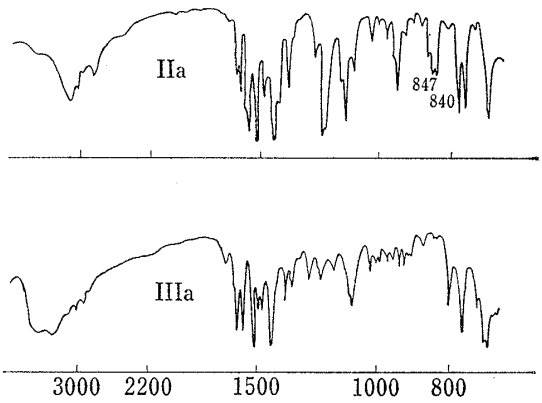

Fig. 2. IR Spectra of IIa and IIIa (KBr Disc)

In the IR spectrum of IIa, the absorption due to the out-of-plane bending vibration of a terminal methylene at 847 or 840 cm^{-1} is observed,[10] however it disappears in the spectrum of IIIa. It may be that IIa and IIIa have the closed ring structures, because of the absence of a carbonyl band.

The nuclear magnetic resonance (NMR) spectrum of IIa shows the characteristic signals[11] of two protons arising from the terminal methylene as a singlet at τ 4.67 (1H) and 5.24 (1H) respectively, therefore it is considered that 4- or 5-methyl group of the starting oxazole N-oxide transformed into a terminal methylene group. On the other hand, the

8) F. Lions and E. Ritchie, *J. Proc. Roy. Soc. N. S. Wales*, **74**, 365 (1941) (*Chem. Abstr.*, **35**, 2890[8] (1941)).
9) R.G. Jones, *J. Am. Chem. Soc.*, **71**, 383 (1949).
10) L.J. Bellamy, "The Infrared Spectra of Complex Molecules," Methuen, London, 1958, p. 51.
11) J.A. Marshall and N. Cohen, *Tetrahedron Letters*, **1964**, 1997.

spectrum of IId, prepared from the reaction of 5-ethyl-4-methyl-2-phenyloxazole N-oxide with phenylisocyanate, shows the existence of an ethyl group. It can be concluded from this spectrum that the transformation from methyl into methylene in the above reaction is from 4- but not from 5-methyl group of the corresponding oxazole N-oxide. The NMR spectra of IIIa, IVa and Va are also shown in Figure 3 and these can be explained satisfactorily in terms of their structures (Chart 3) respectively.

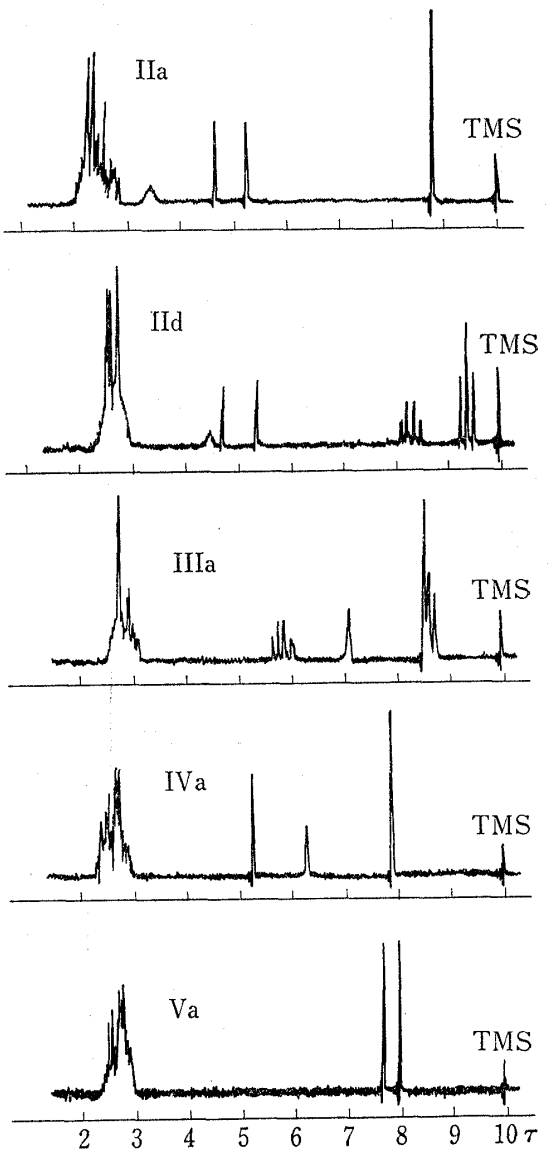

Fig. 3. NMR Spectra of IIa, IId, IIIa, IVa and Va (In $CDCl_3$, 60 Mc)

As shown in Figure 4,[12] the mass spectrum of IIa showed peakes at the following positions, *m/e* 264 (molecular ion), 249, 221, 180, 172, 144, 118, 104 and 77. The *m/e* 249 and 221 were formed by the loss of a methyl and an acetyl radical from the molecular ion respectively (metastable peaks at *m/e* 234.9 and 185.0). The fragment ions at *m/e* 180, 144, 118 and 104 are common in all four compounds IIa, IIIa, IVa and Va and their structures are assumed as $C_6H_5\overset{+}{N}{\equiv}CC_6H_5$, $H_2C{=}C{=}C(CH_3)\overset{+}{N}C_6H_5$, $C_6H_5\overset{+}{N}{\equiv}CCH_3$ and $C_6H_5C{\equiv}\overset{+}{N}H$ respectively. The spectrum of IIIa shows that the *m/e* 248 ion was produced by the elimination of H_2O from the molecular ion and furthermore the *m/e* 233 and 207 ions should come from the *m/e* 248 ion from which methyl radical and acetonitrile eliminated respectively. The peaks at *m/e* 223, 174 and 131 can be regarded as being produced by the cleavage of IIIa shown in Figure 4. The mass spectrum of Va is very similar to that of IIIa except for the peaks at *m/e* 266, 223, 174 and 131. The mass spectrum of IVa shows the characteristic fragmentation of aryl carbinol, that is, the loss of OH and CHO radicals from the molecular ion resulted in the formation of the fragment ions at *m/e* 247 and 235 in the same manner as with benzyl alcohol[13] (metastable peaks at *m/e* 231.1 and 209.2). From the occurrence of the fragment ion at *m/e* 180, which appears in all spectra described above, it can be concluded that the nitrogen of phenylisocyanate entered the 2-position of the oxazole ring, being already occupied with the phenyl group.

In conclusion, we can safely say from the chemical behavior and spectral data that the reasonable structures of compounds IIa, IIIa, IVa and Va are 5-hydroxy-5-methyl-4-methylene-1,2-diphenyl-4,5-dihydro-, 5-hydroxy-4,5-dimethyl-1,2-diphenyl-4,5-dihydro-, 4-hydroxymethyl-5-methyl-1,2-diphenyl- and 4,5-dimethyl-1,2-diphenyl-imidazole respectively.

12) All compositions of ions, being under discussion, were established by high resolution measurements.
13) *a*) S. Meyerson, P.N. Rylander, E.L. Eliel and J.D. McCollum, *J. Am. Chem. Soc.*, **81**, 2606 (1959); *b*) *Idem*, *ibid.*, **83**, 2481 (1961); *c*) J.S. Shannon, *Australian J. Chem.*, **15**, 265 (1962).

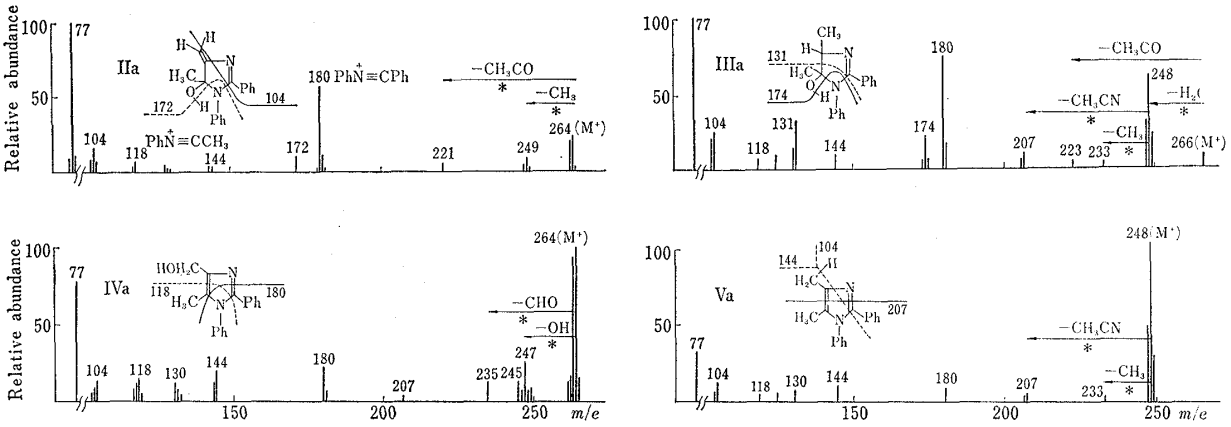

Fig. 4. Mass Spectra of IIa, IIIa, IVa and Va

On the basis of these data described above, the formation of IIa can be rationalized according to the following scheme shown in Chart 4. As a first step, the addition of the carbonyl group of phenylisocyanate to the oxygen of oxazole N-oxide (Ia) occurs, and then the 2-position of oxazole N-oxide is attacked by the nitrogen of phenylisocyanate, followed by the opening of the oxazole ring and recyclization to give IIa.

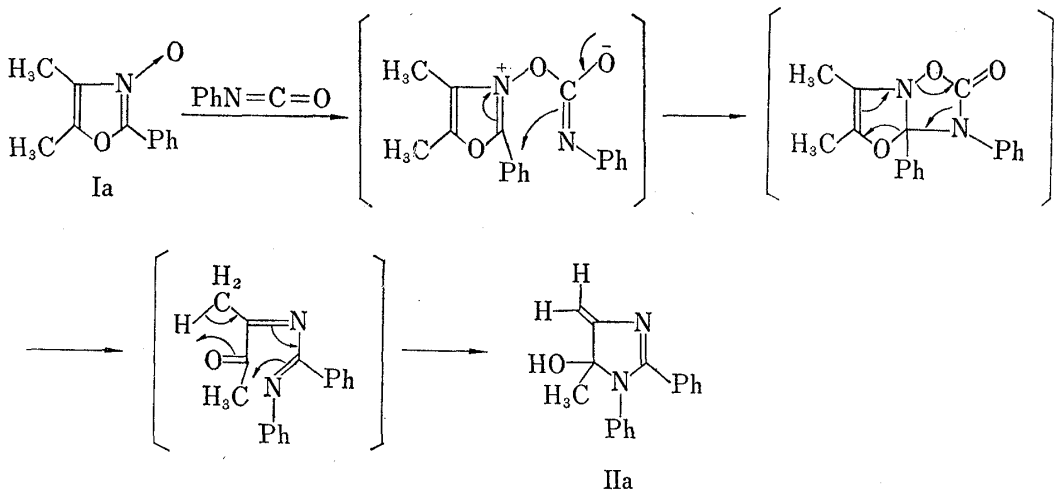

Chart 4

On the other hand, the allylic rearrangement of IIa to IVa is assumed to be catalyzed with acid shown in Chart 5.

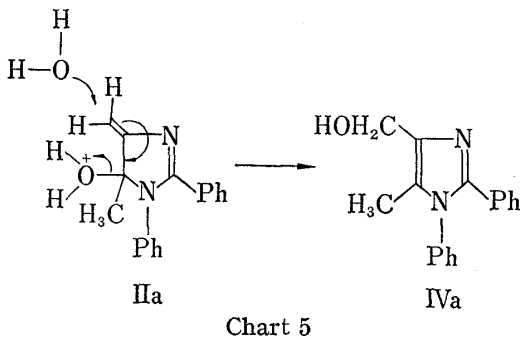

Chart 5

The reactions of 4,5-dimethyl-2-anisyl- (Ib), 4-methyl-2,5-diphenyl-(Ic) and 5-ethyl-4-methyl-2-phenyl-oxazole N-oxide (Id) with phenylisocyanate gave also similar compounds IIb, IIc and IId to IIa. Their chemical behavior and spectral data shown in Table I—V and experimental part are quite similar to those of IIa.

On the basis of these above results, it can be concluded definitely that in general the 2-position of oxazole N-oxides is extraordinarily sensitive to anionoid agents.

In the preliminary experiment, the reactions of 4-phenyloxazole N-oxide derivatives with phenylisocyanate gave the different results from those of 4-methyloxazole N-oxides, that is, imidazolino-oxazolidone derivatives were obtained. Details on these results will be reported in the near future.

Table I. UV Spectra of IIa—d, IIIa—d, IVa—d and Va—d

Compound No.	λ_{max}^{EtOH} mμ (log ε)			
	a	b	c	d
II	242 (4.02) 315 (4.02)	277 (4.13) 315 (3.97)	243 (4.27) 316 (4.05)	243 (4.18) 315 (4.01)
III	228[a] (4.02) 265[a] (3.74)	256 (4.29)	228[a] (4.19) 270[a] (3.77)	230[a] (4.01) 270[a] (3.77)
IV	279 (4.00)	286 (4.21)	281 (4.54)	276 (4.12)
V	286 (4.02)	288 (4.23)	290 (4.28)	285 (4.02)

a) inflexion

Table II. Mass Spectra of IIa—d

Compound No.	M	M-R^1	M-R^1CO	$C_6H_5\overset{+}{N}\equiv CR^2$	M-C_6H_5NH	$R^2C\equiv\overset{+}{N}H$	C_6H_5	R^1CO
IIa *m/e*	264	249	221	180	172	104	77	43
Rel. Ab.[a]	24	10	8	58	12	19	100	19
IIb *m/e*	294	279	251	210	202	134	77	43
Rel. Ab.[a]	54	21	10	96	30	27	100	30
IIc *m/e*	326	—	221	180	—	104	77	105
Rel. Ab.[a]	13		67	83		25	100	17
IId *m/e*	278	249	221	180	186	104	77	—
Rel. Ab.[a]	26	49	10	57	6	22	100	

a) Rel. Ab.=relative abundance

Table III. Mass Spectra of IIIa—d

Compound No.	M	M-H_2O (A)	(A)-CH_3	M-R^1CO	(A)-CH_3CN	$C_6H_5\overset{+}{N}\equiv CR^2$	M-C_6H_5NH	C_6H_5
IIIa *m/e*	266	248	233	223	207	180	174	77
Rel. Ab.[a]	6	58	2	3	9	73	21	100
IIIb *m/e*	296	278	263	253	237	210	204	77
Rel. Ab.[a]	23	65	11	6	6	100	37	75
IIIc *m/e*	328	310	—	223	269	180	236	77
Rel. Ab.[a]	15	38		6	1	100	24	64
IIId *m/e*	280	262	247	223	221	180	188	77
Rel. Ab.[a]	15	23	34	7	<1	100	24	48

a) Rel. Ab.=relative abundance

Table IV. Mass Spectra of IVa—d

Compound No.	M	M-OH (A)	(A)-H_2	M-CHO	$C_6H_5\overset{+}{N}\equiv CR^2$
IVa *m/e*	264	247	245	235	180
Rel. Ab.[a]	100	25	13	12	21
IVb *m/e*	294	277	275	265	210
Rel. Ab.[a]	100	16	11	6	9
IVc *m/e*	326	309	307	297	180
Rel. Ab.[a]	100	9	8	14	29
IVd *m/e*	278	261	259	249	180
Rel. Ab.[a]	100	12	7	8	7

a) Rel.Ab.=relative abundance

Table V. Mass Spectra of Va—d

Compound No.	M	M-CH_3	M-CH_3CN	$C_6H_5\overset{+}{N}\equiv CR^2$
Va *m/e*	248	233	207	180
Rel. Ab.[a]	100	1	4	8
Vb *m/e*	278	263	237	210
Rel. Ab.[a]	100	19	3	3
Vc *m/e*	310	—	269	180
Rel. Ab.[a]	100		3	4
Vd *m/e*	262	247	—	180
Rel. Ab.[a]	100	70		3

a) Rel.Ab.=relative abundance

Experimental[14]

Reaction of Oxazole N-Oxide with Phenylisocyanate——General Procedure: Into a solution of oxazole N-oxide (Ia—d) (0.01 mole) in $CHCl_3$ (10 ml), phenylisocyanate (0.01 mole) in $CHCl_3$ (10 ml) was added dropwise with stirring under cooling with water. After the reaction mixture was further allowed to stand for 15 min at room temperature, the solvent was removed *in vacuo*. Ether was added to the residue and the oily residue was solidified gradually in a crystallized condition, filtered, washed with ether, and recrystallized from acetone to give 4-methylene-4,5-dihydroimidazole derivatives (IIa—d).

5-Hydroxy-5-methyl-4-methylene-1,2-diphenyl-4,5-dihydroimidazole (IIa)——White needles (from acetone), mp 150—151°, 46% yield. *Anal.* Calcd. for $C_{17}H_{16}ON_2$: C, 77.25; H, 6.10; N, 10.60. Found: C, 77.73; H, 6.04; N, 10.58. NMR (in $CDCl_3$) τ: 2.25—3.05 (10H, multiplet, phenyl-H), 3.41 (1H, broad singlet, -OH), 4.67 (1H, singlet, terminal methylene), 5.24 (1H, singlet, terminal methylene), 8.75 (3H, singlet, CH_3).

2-Anisyl-5-hydroxy-5-methyl-4-methylene-1-phenyl-4,5-dihydroimidazole (IIb)——Colorless prisms (from acetone), mp 153°, 46% yield. *Anal.* Calcd. for $C_{18}H_{18}O_2N_2$: C, 73.45; H, 6.16; N, 9.52. Found: C, 73.38; H, 5.92; N, 9.25. NMR (in $CDCl_3$) τ: 2.58 (2H, doublet, $J=9$ cps, anisyl-H), 3.22 (2H, doublet, $J=9$ cps, anisyl-H), 2.6—3.2 (5H, multiplet, phenyl-H), 4.37 (1H, broad singlet, -OH), 4.91 (1H, singlet, terminal methylene), 5.43 (1H, singlet, terminal methylene), 6.20 (3H, singlet, $-OCH_3$), 8.81 (3H, singlet, $-CH_3$).

5-Hydroxy-4-methylene-1,2,5-triphenyl-4,5-dihydroimidazole (IIc)——Colorless prisms (from acetone), mp 141—142°, 52% yield. *Anal.* Calcd. for $C_{22}H_{18}ON_2$: C, 80.95; H, 5.56; N, 8.58. Found: C, 80.84; H, 5.46; N, 8.47. NMR (in $CDCl_3$) τ: 2.3—3.3 (15H, multiplet, phenyl-H), 3.50 (1H, broad singlet,-OH), 4.63 (1H, singlet, terminal methylene), 5.52 (1H, singlet, terminal methylene).

5-Ethyl-5-hydroxy-4-methylene-1,2-diphenyl-4,5-dihydroimidazole (IId)——Colorless prisms (from acetone), mp 143°, 45% yield. *Anal.* Calcd. for $C_{18}H_{18}ON_2$: C, 77.67; H, 6.52; N, 10.07. Found: C, 77.55;

14) All melting points are uncorrected. UV spectra were measured on a Shimadzu SV-50A Spectrophotometer, IR spectra on a Nihon-Bunko DS-301 Spectrophotometer, NMR spectra on a Japan Electron Optics JNM C-60-H Spectrometer at 60 Mc with tetramethylsilane as an internal standard, Mass spectra on a Japan Electron Optics Model JMS-OlSG Mass spectrometer.

H, 6.18; N, 9.84. NMR (in $CDCl_3$) τ: 2.52—3.13 (10H, multiplet, phenyl-H), 4.52 (1H, broad singlet,-OH), 4.79 (1H, singlet, terminal methylene), 5.44 (1H, singlet, terminal methylene), 8.33 (2H, quartet, $J=7.5$ cps, $-CH_2-$), 9.4 (3H, triplet, $J=7.5$ cps, $-CH_3$).

Reduction of IIa—d with Pd-C——General Procedure: A solution of IIa—d (0.01 mole) in MeOH (200 ml) was shaken with Pd-C (from 1% $PdCl_2$ soln. (15 ml) and active charcoal (1.5 g)) in H_2 stream at atmospheric pressure. Reduction stopped when 0.01 mole of H_2 had been absorbed. The catalyst was removed by filtration. The solvent was evaporated to dryness *in vacuo* and the residue was recrystallized from acetone or acetone–petr. benzine to give dihydroderivatives (IIIa—d).

5-Hydroxy-4,5-dimethyl-1,2-diphenyl-4,5-dihydroimidazole (IIIa)——Colorless prisms (from acetone–petr. benzine), mp 110°, 81% yield. *Anal.* Calcd. for $C_{17}H_{18}ON_2 \cdot H_2O$: C, 71.80; H, 7.09; N, 9.85. Found: C, 71.93; H, 6.76; N, 10.21. NMR (in $CDCl_3$) τ: 2.58—3.30 (10H, multiplet, phenyl-H), 5.86 (1H, quartet, $J=6$ cps, >CH–), 7.04 (1H, singlet, –OH), 8.58 (3H, singlet, 5-CH_3), 8.76 (3H, doublet, $J=6$ cps, 4-CH_3).

2-Anisyl-5-hydroxy-4,5-dimethyl-1-phenyl-4,5-dihydroimidazole (IIIb)——Colorless prisms (from acetone), mp 125°, 46% yield. *Anal.* Calcd. for $C_{18}H_{20}O_2N_2$: C, 72.95; H, 6.80; N, 9.45. Found: C, 72.98; H, 6.56; N, 9.10. NMR (in $CDCl_3$) τ: 2.80 (2H, doublet, $J=9$ cps, anisyl-H), 3.37 (2H, doublet, $J=9$ cps, anisyl-H), 2.75—3.35 (5H, multiplet, phenyl-H), 4.71 (1H, broad singlet, –OH), 5.93 (1H, quartet, $J=7.0$ cps, >CH–), 6.25 (3H, singlet, $-OCH_3$), 8.65 (3H, singlet, 5-CH_3), 8.71 (3H, doublet, $J=7.0$ cps, 4-CH_3).

5-Hydroxy-4-methyl-1,2,5-triphenyl-4,5-dihydroimidazole (IIIc)——Colorless prisms (from acetone–petr. benzine), mp 104—105°, 37% yield. *Anal.* Calcd. for $C_{22}H_{20}ON_2 \cdot H_2O$: C, 76.27; H, 6.40; N, 8.09. Found: C, 75.98; H, 6.21; N, 8.28. NMR (in $CDCl_3$) τ: 2.12—3.61 (15H, multiplet, phenyl-H), 4.63 (1H, broad singlet, –OH), 7.52 (1H, quartet, $J=7.0$ cps, >CH–), 8.51 (3H, doublet, $J=7.0$ cps, 4–CH_3).

5-Ethyl-5-hydroxy-4-methyl-1,2-diphenyl-4,5-dihydroimidazole (IIId)——Colorless prisms (from acetone–petr. benzine), mp 108—110°, 88% yield. *Anal.* Calcd. for $C_{18}H_{20}ON_2 \cdot H_2O$: C, 72.45; H, 7.43; N, 9.39. Found: C, 72.76; H, 7.32; N, 9.51. NMR (in $CDCl_3$) τ: 2.68—3.44 (10H, multiplet, phenyl-H), 5.58 (1H, quartet, $J=7.0$ cps, >CH–), 7.08 (1H, broad singlet, –OH), 7.83 (2H, quartet, $J=7.5$ cps, $-CH_2-$), 8.59 (3H, doublet, $J=7.0$ cps, 4-CH_3), 8.99 (3H, triplet, $J=7.5$ cps, $-CH_3$).

Isomerization of IIa—d into IVa—d with HCl——General Procedure: A solution of IIa—d (1.0 g) in 10% HCl (20 ml) was heated on a water-bath (90°) for 5 hr. The resulting mixture was neutralized with K_2CO_3, extracted with $CHCl_3$, the $CHCl_3$ extract was dried over anhyd. Na_2SO_4, $CHCl_3$ was removed and the residue was recrystallized from acetone or MeOH to give 4-hydroxymethylimidazole derivatives (IVa—d).

4-Hydroxymethyl-5-methyl-1,2-diphenylimidazole (IVa)——Colorless prisms (from acetone), mp 203—204°, 91% yield. *Anal.* Calcd. for $C_{17}H_{16}ON_2$: C, 77.25; H, 6.10; N, 10.60. Found: C, 77.04; H, 6.15; N, 11.12. NMR (in $CDCl_3$) τ: 2.51—2.97 (10H, multiplet, phenyl-H), 5.29 (2H, singlet, $-CH_2-$), 6.27 (1H, singlet, –OH), 7.92 (3H, singlet, 5-CH_3).

2-Anisyl-4-hydroxymethyl-5-methyl-1-phenylimidazole (IVb)——Colorless prisms (from acetone), mp 205—206°, 84% yield. *Anal.* Calcd. for $C_{18}H_{18}O_2N_2$: C, 73.45; H, 6.16; N, 9.52. Found: C, 73.84; H, 6.11; N, 9.42. NMR (in $CDCl_3$) τ: 2.56 (2H, doublet, $J=9.0$ cps, anisyl-H), 3.27 (2H, doublet, $J=9.0$ cps, anisyl-H), 2.55—2.93 (5H, multiplet, phenyl-H), 5.28 (2H, singlet, $-CH_2-$), 5.66 (1H, broad singlet, –OH), 6.25 (3H, singlet, $-OCH_3$), 7.90 (3H, singlet, 5-CH_3).

4-Hydroxymethyl-1,2,5-triphenylimidazole (IVc)——White prisms (from MeOH), mp 234—235°, 16% yield. *Anal.* Calcd. for $C_{22}H_{18}ON_2$: C, 80.95; H, 5.56; N, 8.58. Found: C, 80.91; H, 5.20; N, 8.72. NMR (in d^5-pyridine) τ: 1.35 (1H, singlet, –OH), 2.27—2.95 (15H, multiplet, phenyl-H), 4.82 (2H, singlet, $-CH_2-$).

5-Ethyl-4-hydroxymethyl-1,2-diphenylimidazole (IVd)——Colorless prisms (from acetone), mp 192—193°, 80% yield. *Anal.* Calcd. for $C_{18}H_{18}ON_2$: C, 77.67; H, 6.52; N, 10.07. Found: C, 77.77; H, 6.66; N, 10.19. NMR (in $CDCl_3$) τ: 2.37—2.90 (10H, multiplet, phenyl-H), 5.24 (2H, singlet, $-CH_2-$), 6.86 (1H, broad singlet, –OH), 7.40 (2H, quartet, $J=7.5$ cps, $-CH_2-$), 9.02 (3H, triplet, $J=7.5$ cps, $-CH_3$).

Dehydration of IIIa—d with H_2SO_4——General Procedure: A solution of IIIa—d (0.5 g) in 50% H_2SO_4 (10 ml) was heated on a water-bath (90°) for 90 min. The reaction mixture was neutralized with K_2CO_3, extracted with $CHCl_3$, the $CHCl_3$ extract was dried over anhyd. Na_2SO_4, $CHCl_3$ was removed and the residue was recrystallized from petr. benzine or acetone to give imidazole derivatives (Va—d).

4,5-Dimethyl-1,2-diphenylimidazole (Va)——Colorless prisms (from petr. benzine), mp 89—90°, 73% yield. *Anal.* Calcd. for $C_{17}H_{16}N_2$: C, 82.22; H, 6.50; N, 11.28. Found: C, 82.45; H, 6.40; N, 11.26. NMR (in $CDCl_3$) τ: 2.51—3.01 (10H, multiplet, phenyl-H), 7.73 (3H, singlet, $-CH_3$), 8.02 (3H, singlet, $-CH_3$).

2-Anisyl-4,5-dimethyl-1-phenylimidazole (Vb)——Colorless plates (from petr. benzine), mp 83—84°, 60% yield. *Anal.* Calcd. for $C_{18}H_{18}ON_2 \cdot 1/2\ H_2O$: C, 75.23; H, 6.67; N, 9.75. Found: C, 75.27; H, 6.52; N, 10.22. NMR (in $CDCl_3$) τ: 2.70 (2H, doublet, $J=9.0$ cps, anisyl-H), 3.33 (2H, doublet, $J=9.0$ cps, anisyl-H), 2.55—2.98 (5H, multiplet, phenyl-H), 6.30 (3H, singlet, $-OCH_3$), 7.73 (3H, singlet, $-CH_3$), 8.30 (3H, singlet, $-CH_3$).

4-Methyl-1,2,5-triphenylimidazole (Vc)——Colorless prisms (from acetone), mp 204—205°, 71% yield. *Anal.* Calcd. for $C_{22}H_{18}N_2$: C, 85.13; H, 5.85; N, 9.03. Found: C, 85.06; H, 6.03; N, 8.91. NMR (in $CDCl_3$) τ: 2.81—3.31 (15H, multiplet, phenyl-H), 7.68 (3H, singlet, $-CH_3$).

5-Ethyl-4-methyl-1,2-diphenylimidazole (Vd)——Colorless needles (from petr. benzine), mp 89—90°, 94% yield. *Anal.* Calcd. for $C_{18}H_{18}N_2$: C, 82.40; H, 6.92; N, 10.68. Found: C, 82.24; H, 7.04; N, 10.32.

NMR (in $CDCl_3$) τ: 2.6—3.6 (10H, multiplet, phenyl-H), 7.58 (2H, quartet, $J=7.5$ cps, $-CH_2-$), 7.72 (3H, singlet, 4-CH_3), 9.10 (3H, triplet, $J=7.5$ cps, $-CH_3$).

Reduction of IVa with P and HI——A mixture of IVa (424 mg), red phosphorus (60 mg) and 57% hydriodic acid (2 ml) was refluxed for 5 hr. The precipitate was removed by filtration and the filtrate was neutralized with 10% NaOH, extracted with $CHCl_3$, the $CHCl_3$ layer was dried over anhyd. Na_2SO_4, and the solvent was removed. The residue was recrystallized from petr. benzine to give 360 mg of Va (90% yield), mp 89—90°, undepressed on admixture with a sample, prepared by using the technique of Lions and Ritchie.[8]

Preparation of 4,5-Dimethyl-1,2-diphenylimidazole (Va)——To a solution of diacetyl (4.3 g) in abs. EtOH (10 ml), aniline (5.2 g) in abs. EtOH (10 ml) was added dropwise with stirring at room temperature. After the resulting solution was further stirred for 3 hr, benzaldehyde (5.3 g) in abs. EtOH (20 ml), saturated with ammonia gas, was added dropwise during 20 min. The reaction mixture was further stirred overnight at room temperature, made alkaline by adding excess conc. NaOH, and the unreacted starting materials were removed by steam distillation. The residue on steam distillation was extracted with $CHCl_3$, the $CHCl_3$ extract was dried over anhyd. Na_2SO_4, the solvent was removed, and the residue was chromatographed over alumina with petr. benzine to give 3.92 g of Va (recrystallized from petr. benzine).

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