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Studies of Enamines. III.[1] The Reaction of 4-(1-Piperidyl)- and 4-(1-Pyrrolidinyl)-3-penten-2-ones with Aryl Isothiocyanates

Otohiko Tsuge[2] and Akitaka Inaba

Research Institute of Industrial Science, Kyushu University, Hakozaki, Higashi-ku, Fukuoka 812

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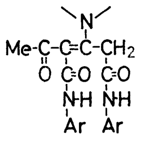
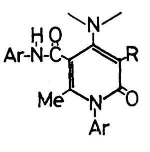
The reaction of enamino ketones, derived from acetylacetone and piperidine or pyrrolidine, with aryl isothiocyanates has been investigated. In contrast with phenyl isocyanates, phenyl isothiocyanates react with the enamino ketones to yield the corresponding 3-phenylthiocarbamoyl derivatives (1: 1 adducts). The reaction with 1-naphthyl isothiocyanate forms 3-naphthylthiocarbamoyl and/or 2-thiopyridone derivatives, depending on the reaction conditions.

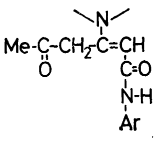
We have reported that 4-(1-piperidyl)- (Ia) and 4-(1-pyrrolidinyl)-3-penten-2-one (Ib) react with phenyl isocyanates to give 3,5-diphenylcarbamoyl (**A**), 2-pyridone (**B**) and/or its 3-phenylcarbamoyl derivatives (**C**), depending on the reaction conditions.[1] The reaction with 1-naphthyl isocyanate afforded the 1: 1 adduct (**D**).



A



B (R=H)
C (R=CONHAr)



D

The only example involving the reaction of enamino ketones with isothiocyanates was reported by Goerdeler and Keuser;[3] cyclic enamino ketones derived from cyclohexane-1,3-dione and its 5,5-dimethyl derivative reacted with aryl isothiocyanates to yield the corresponding 2-thiocarbamoyl compounds.

For comparison with the reactions of enamino ketones I with isocyanates, and those of cyclic enamino ketones with isothiocyanates, it seemed to be of interest to investigate the reaction of I with isothiocyanates.

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[1] Part II of this series: O. Tsuge and A. Inaba, This Bulletin, **46**, 286 (1973).

[2] To whom inquiries should be directed.

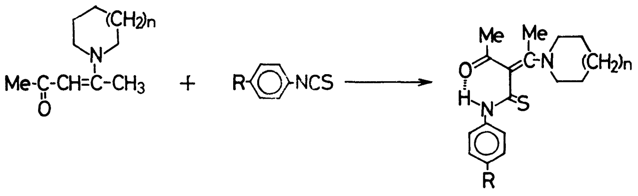
[3] J. Goerdeler and U. Keuser, *Chem. Ber.*, **97**, 2209 (1964).

Results and Discussion

When a solution of equimolar amounts of enamino ketone Ia and phenyl isothiocyanate (IIa) in benzene was refluxed for 5 hr, a 1: 1 adduct IIIa was obtained in a good yield. Enamino ketone Ia reacted with phenyl isocyanate to give 1: 2 adduct **A** and its derivatives **B** and **C**.[1] However, the 1: 1 adduct IIIa was also formed even when excess IIa was employed.

Similarly, the reaction of Ia with *p*-chlorophenyl isothiocyanate (IIb), and that of enamino ketone Ib with IIa afforded the corresponding 1: 1 adducts IIIb and IIIc, respectively.

The IR spectra of all III exhibited no well-defined bands ascribable to ν_{NH} absorptions, but their structures were assigned to those of the corresponding 3-arylthiocarbamoyl-4-amino-3-penten-2-ones on the basis of their NMR spectral data and chemical conversion. The NMR spectra in deuteriochloroform ($CDCl_3$) displayed signals at δ about 14 (1H, broad, **NH**), and 2.8, 1.8 ppm (each 3H, s, $\mathbf{CH_3}$), besides methylene and aromatic protons. These observations indicate that III exists as the chelating form[4] as shown in Scheme 1.

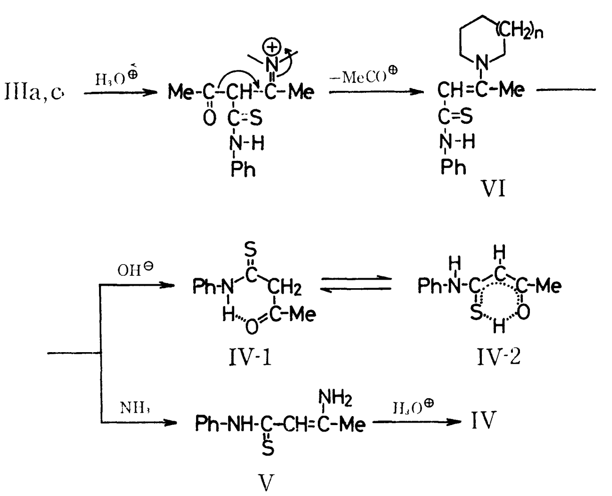


I	II	III
a: *n*=1	a: R=H	a: *n*=1, R=H
b: *n*=0	b: R=Cl	b: *n*=1, R=Cl
		c: *n*=0, R=H

Scheme 1

Hydrolysis of both IIIa and IIIc with 18% hydrochloric acid at room temperature for 6 hr, followed by neutralization with aqueous sodium hydroxide, afforded the same product, phenylthiocarbamoylacetone (IV).[5] When the hydrolyzed product of IIIa under same conditions was treated with ammonium hydroxide, 1-phenylthiocarbamoyl-2-aminopropene (V) was obtained; V was transformed into IV on further acidic hydrolysis.

Hydrolysis of III is assumed to proceed *via* the initial formation of 1-phenylthiocarbamoyl-2-(1-piperidyl or 1-pyrrolidinyl)propene (VI) as shown in Scheme 2. 1-Phenylthiocarbamoyl-2-(1-pyrrolidinyl)propene (VIa) was isolated by the hydrolysis of IIIc under mild conditions.



Scheme 2.

The structures of IV, V, and VIa were confirmed on the basis of their spectral data and microanalyses. The NMR spectrum of IV indicates that IV exists as a 5: 3 mixture of hydrogen-bonded froms IV-1 and IV-2 in $CDCl_3$; signals appear at δ 1.98 (9/8H, s, $\mathbf{CH_3}$ in IV-2), 2.34 (15/8H, s, $\mathbf{CH_3}$ in IV-1), 4.13 (5/4H, s, $\mathbf{CH_2}$), 5.56 (3/4H, s, =**CH**), 7.20—7.9 (5H, m, aromatic protons), 10.6—10.9 (3/8H, broad, **NH** and **OH** in IV-2), and 14.45 ppm (5/8H, broad singlet, **NH** in IV-1) in the spectrum.

Treatment of IIIc with hydrazine hydrate afforded 3(5)-methyl-4-acetyl-5(3)-anilinopyrazole (VII), 3,5-dimethyl-4-phenylthiocarbamoylpyrazole (VIII), and hydrazone (IX) of VII. Similarly, IIIa reacted with hydrazine hydrate to give VII, VIII, and IX. The structures of VII and IX were confirmed by their spectral data and microanalyses. The reaction of VII with hydrazine hydrate gave hydrazone IX, which was easily hydrolyzed to VII. Purification of VIII was difficult owing to contamination with sulfur, the NMR spectrum of crude VIII exhibited a signal ascribable to two methyls at δ 2.38 ppm. Acetylation of VIII with acetic anhydride afforded 1-acetyl-3,5-dimethyl-4-phenylthiocarbamoylpyrazole (X) in a good yield. On the other hand, IIIc reacted with phenylhydrazine to form 1-phenyl-3-methyl-5-anilinopyrazole (XI), whose structure was deduced from its spectral data and the mode of its formation (Scheme 3).

The reaction of IIIc with *p*-chlorophenyl isocyanate afforded bis(*p*-chlorophenylcarbamoyl) derivative XIII, instead of the expected product XII.

3-(1-Naphthylthiocarbamoyl) compound XVa, a product of the same type as III, was obtained, when enamino ketone Ia was treated with 1-naphthyl isothiocyanate (XIV) in refluxing benzene. The structure of XVa was confirmed by its spectral data as well as by its microanalysis. In the same reaction under reflux in xylene two products XVa and XVIa were formed in low yields. Under reflux in both benzene and xylene, however, enamino ketone Ib gave XVIb but not 1: 1 adduct XVb corresponding to XVa.

The molecular formulas of XVIa and XVIb corresponded to those of the compounds derived from 1: 1 adducts with loss of water. The IR spectra of both XVI exhibited bands assignable to $\nu_{C=C}$, but no absorption bands of ν_{NH}. Both NMR spectra displayed two olefinic protons besides methyl, methylene and aromatic protons. Thus, XVI were concluded to be the corresponding 1-(1-naphthyl)-4-amino-6-methylpyrid-2-thiones, whose structures correspond to those derived

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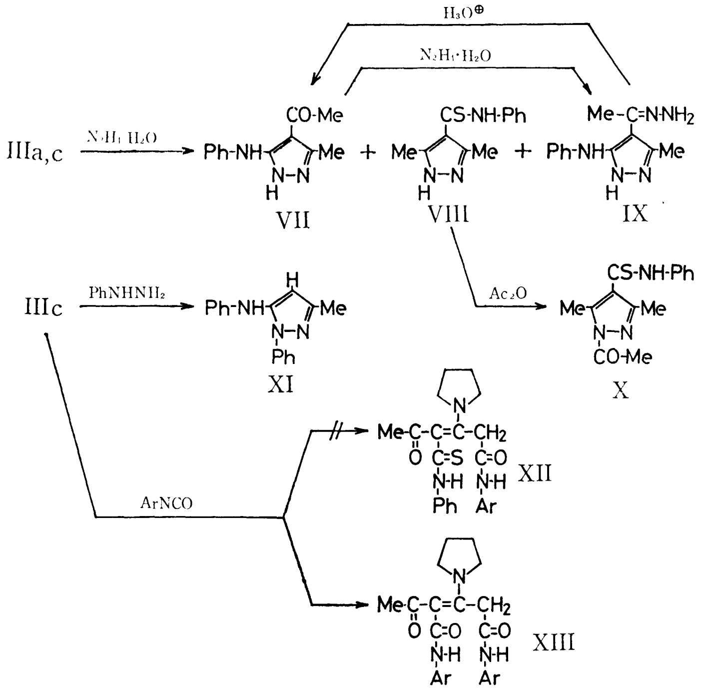
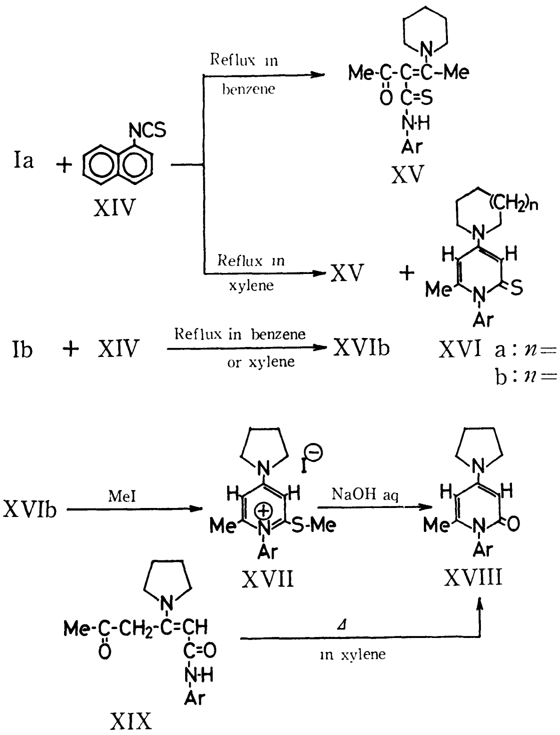
[4] Goerdeler and Keuser[3] reported that 1-amino-2-arylthiocarbamoylcyclohexen-3-ones exist as double chelating forms.

[5] Similarly, hydrolysis of bis(phenylcarbamoyl) derivative **A** afforded 1,3-bis(phenylcarbamoyl)acetone with loss of acetyl group.[1]



Ar=p-ClC$_6$H$_4$

Scheme 3.



Ar=1-naphthyl

Scheme 4.

from isomers of XV, 4-amino-5-(1-naphthylthiocarbamoyl)-4-penten-2-ones, with dehydration.

Compounds XVIa and XVIb remained unchanged on both acidic and alkaline hydrolysis under various conditions. The reaction of XVIb with methyl iodide afforded S-methyl pyridinium iodide XVII, which was treated with ethanolic sodium hydroxide to give 1-(1-naphthyl)-4-(1-pyrrolidinyl)-6-methylpyrid-2-one (XVIII). The structure of XVIII was confirmed by its spectral data as well as by identification with an authentic sample prepared from 4-(1-pyrrolidinyl)-5-(1-naphthylcarbamoyl)-4-penten-2-one (XIX).[1] This supports the proposed structure for XVI.

Experimental

All melting points are uncorrected. The IR spectra were measured as KBr pellets by a Nippon Bunko IR-S spectrophotometer, and the NMR spectra were determined at 60 MHz on a Hitachi R-20 NMR spectrometer with TMS as an internal reference. The mass spectra were obtained on a Hitachi RMS-4 mass spectrometer with a direct inlet and an ionization energy of 70 eV. Microanalyses were carried out by Miss M. Akita with a Yanagimoto C.H.N. Corder MT-1.

Materials. 4-(1-Piperidyl)- (Ia) and 4-(1-pyrrolidinyl)-3-penten-2-one (Ib) were prepared from acetylacetone and the corresponding amines.[1] Commercial phenyl (IIa), *p*-chlorophenyl (IIb), and 1-naphthyl isothiocyanate (XIV) were used.

Reaction of 4-(1-Piperidyl)-3-penten-2-one (Ia) with Phenyl Isothiocyanate (IIa). 1.67 g (0.01 mol) of Ia and 1.35 g (0.01 mol) of IIa were dissolved in 50 ml of benzene and the solution was refluxed for 5 hr, and concentrated *in vacuo* to give crystals which, on recrystallization from ethanol, afforded 2.53 g (84%) of 3-phenylthiocarbamoyl-4-(1-piperidyl)-3-penten-2-one (IIIa), mp 135—136 °C (decomp.), as yellow prisms.

Found: C, 67.30; H, 7.60; N, 9.33%. Calcd for $C_{17}H_{22}N_2OS$: C, 67.52; H, 7.33; N, 9.27%.

NMR (in $CDCl_3$) δ ppm: 1.78 (3H, s, CH_3), 1.85 (6H, m, CH_2), 2.80 (3H, s, CH_3), 3.93 (4H, m, CH_2), 7.0—7.95 (5H, m, aromatic protons), 13.98 (1H, broad, NH).

Similarly, the reaction of 4-(1-pyrrolidinyl)-3-penten-2-one (Ib) with IIa gave 3-phenylthiocarbamoyl-4-(1-pyrrolidinyl)-3-penten-2-one (IIIc), mp 131—132 °C (decomp.), as yellow prisms (from ethanol). Yield, 83%.

Found: C, 66.65; H, 7.03; N, 9.71%. Calcd for $C_{16}H_{20}N_2OS$: C, 66.64; H, 6.99; N, 9.72%.

NMR (in $CDCl_3$) δ ppm: 1.80 (3H, s, $\mathbf{CH_3}$), 2.11 (4H, m, $\mathbf{CH_2}$), 2.73 (3H, s, $\mathbf{CH_3}$), 3.88 (4H, m, $\mathbf{CH_2}$), 7.0—8.0 (5H, m, aromatic protons), 13.89 (1H, broad, **NH**).

A similar reaction of Ia with *p*-chlorophenyl isothiocyanate (IIb) at room temperature for 10 hr afforded 3-*p*-chlorophenylthiocarbamoyl-4-(1-piperidyl)-3-penten-2-one (IIIb), mp 141—142 °C (decomp.), as yellow prisms (from ethanol). Yield, 44%.

Found: C, 60.85; H, 6.32; N, 8.27%. Calcd for $C_{17}H_{21}N_2OSCl$: C, 60.62; H, 6.24; N, 8.59%.

NMR (in $CDCl_3$) δ ppm: 1.80 (3H, s, $\mathbf{CH_3}$), 1.88 (6H, m, $\mathbf{CH_2}$), 2.81 (3H, s, $\mathbf{CH_3}$), 3.96 (4H, m, $\mathbf{CH_2}$), 7.1—7.9 (4H, m, aromatic protons), 14.04 (1H, broad, **NH**). Mass spectrum *m/e*: 336, 338 (M^+, rel. intensity 3: 1).

Hydrolysis of 1: 1 Adduct III. *i)* A solution of 1.0 g of IIIa in 10 ml of 18% hydrochloric acid was stirred at room temperature for 6 hr, and neutralized (*a*) with aqueous sodium hydroxide or (*b*) with ammonium hydroxide as follows. (a) The solution was neutralized with aqueous sodium hydroxide and then extracted with diethyl ether. The ether extract was concentrated to give crystals which on recrystallization from ethanol–petroleum ether mixture afforded 0.38 g (60%) of phenylthiocarbamoylacetone (IV), mp 61—62.5 °C (decomp.), as yellow prisms.

Found: C, 62.09; H, 5.75; N, 7.30%. Calcd for $C_{10}H_{11}NOS$: C, 62.16; H, 5.74; N, 7.25%.

IR cm^{-1}: 3290, 3220 (NH or OH), 1630 (C=O or C=C). Mass spectrum *m/e*: 193 (M^+).

(b) The solution was treated with 20% ammonium hydroxide and the resulting precipitate was filtered. Recrystallization from ethanol–petroleum ether mixture afforded 0.25 g (40%) of 1-phenylthiocarbamoyl-2-aminopropene (V), mp 155—157 °C (decomp.), as pale yellow needles.

Found: C, 62.28; H, 6.35; N, 14.50%. Calcd for $C_{10}H_{12}N_2S$: C, 62.48; H, 6.29; N, 14.58%.

IR cm^{-1}: 3300 (NH), 1672 (C=C). NMR (in $CDCl_3$) δ ppm: 1.93 (3H, s, $\mathbf{CH_3}$), 5.32 (1H, s, =**CH**), 7.0—7.5 (7H, m, aromatic protons (5H) and **NH** (2H)), 8.0 (1H, broad, **NH**). Mass spectrum *m/e*: 192 (M^+).

The hydrolysis of V with 18% hydrochloric acid gave IV quantitatively.

ii) A solution of 1.0 g of IIIc in 10 ml of 18% hydrochloric acid was stirred at room temperature for 2 hr, and neutralized with aqueous sodium hydroxide. The resulting precipitate was filtered. Recrystallization from ethanol afforded 0.37 g (43%) of 1-phenylthiocarbamoyl-2-(1-pyrrolidinyl)propene (VIa), mp 156—157 °C, as yellow plates.

Found: C, 68.08; H, 7.42; N, 11.34%. Calcd for $C_{14}H_{18}N_2S$: C, 68.27; H, 7.37; N, 11.37%.

IR cm^{-1}: 3290 (NH), 1580 (C=C).

A trace of IV was obtained from the filtrate by a treatment similar to i)-(a).

Reaction of 1: 1 Adduct IIIc with Hydrazine Hydrate. A solution of 2.35 g of IIIc and 1 ml of hydrazine hydrate in 10 ml of ethanol was stirred at room temperature for 2 hr and then poured into 30 ml of water. The resulting precipitate was collected by filtration. Recrystallization from ethanol–petroleum ether mixture afforded 0.5 g (28.5%) of 3(5)-methyl-4-acetyl-5(3)-anilinopyrazole (VII), mp 236—237 °C (decomp.), as colorless prisms.

Found: C, 66.90; H, 6.14; N, 19.29%. Calcd for $C_{12}H_{13}N_3O$: C, 66.95; H, 6.09; N, 19.52%.

IR cm^{-1}: 3320, 3220 (NH), 1600 (C=O). NMR (in $CDCl_3$) δ ppm: 2.42, 2.53 (each 3H, s, $\mathbf{CH_3}$), 6.85—7.8 (6H, m, aromatic protons (5H) and **NH**), 9.36 (1H, broad, **NH**). Mass spectrum *m/e*: 215 (M^+), 200 (M^+-Me), 172 (M^+-COMe), 124 (M^+-PhNH), 104, 77.

The filtrate was concentrated *in vacuo* to leave a residue which was triturated with benzene to give 50 mg of 3,5-dimethyl-4-phenylthiocarbamoylpyrazole (VIII) contaminated with sulfur. Its purification was very difficult.

Crude VIII; mp 148—149 °C (decomp.), yellow prisms. IR cm^{-1}: 3220, 3120—2800 (NH). NMR (in $CDCl_3$) δ ppm: 2.38 (6H, broad singlet, $\mathbf{CH_3}$), 7.0—8.0 (6H, m, aromatic protons (5H) and **NH**), 9.1 (1H, broad, **NH**). Mass spectrum *m/e*: 231 (M^+), 198 (M^+-SH), 139 (M^+-PhNH, base peak), 122 (139^+-NH_3), 93, 77.

The benzene solution which was removed VIII was concentrated *in vacuo* to give crystals, which on recrystallization from ethanol–petroleum ether afforded 0.32 g (17%) of hydrazone IX, mp 175—177 °C (decomp.), as colorless prisms.

Found: C, 63.20; H, 6.85; N, 30.36%. Calcd for $C_{12}H_{15}N_5$: C, 62.86; H, 6.60; N, 30.55%.

IR cm^{-1}: 3280, 3150, 3040—2800 (NH), 1640 (C=N). NMR (in $CDCl_3$) δ ppm: 2.1 (6H, broad singlet, $\mathbf{CH_3}$), 4.8—6.0 (3H, broad, **NH**), 6.5—7.5 (6H, m, aromatic protons (5H) and **NH**). Mass spectrum *m/e*: 229 (M^+), 198 ($M^+-N_2H_3$), 137 (M^+-PhNH), 120 (137^+-NH_3), 93, 77.

Similarly, the reaction of IIIa with hydrazine hydrate afforded three pyrazoles VII, VIII, and IX in similar yields to those in the case of IIIc.

1-Acetyl-3,5-dimethyl-4-phenylthiocarbamoylpyrazole (X). A solution of crude VIII (20 mg) in 10 ml of acetic anhydride was stirred at room temperature for 5 hr and then poured into water. The resulting precipitate was filtered. Recrystallization from ethanol–petroleum ether mixture afforded 20 mg of X, mp 163—164 °C (decomp.), as yellow needles.

Found: C, 61.48; H, 5.65; N, 15.17%. Calcd for $C_{14}H_{15}N_3OS$: C, 61.53; H, 5.53; N, 15.38%.

IR cm^{-1}: 3310 (NH), 1730 (C=O). Mass spectrum *m/e*: 273 (M^+), 240 (M^+-SH), 230 (M^+-COMe), 198 (230^+-S), 181 (M^+-PhNH), 139 (181^+-CH_2CO, base peak).

Reaction of 1: 1 Adduct IIIc with Phenylhydrazine. A solution of 1.15 g of IIIc and 0.5 g of phenylhydrazine in 30 ml of ethanol was stirred at room temperature for 7 hr and then concentrated *in vacuo* to leave a solid, which was chromatographed on alumina using benzene as an eluent to give 1-phenyl-3-methyl-5-anilinopyrazole (XI), mp 119—120 °C (decomp.) (lit,[6] mp 120 °C), as red prisms. Yield, 0.3 g (34.7%).

Found: 77.32; H, 6.12; N, 16.70%. Calcd for $C_{16}H_{15}N_3$: C, 77.08; H, 6.06; N, 16.86%.

IR cm^{-1}: 3200 (NH). NMR (in $CDCl_3$) δ ppm: 2.28 (3H, s, $\mathbf{CH_3}$), 5.67 (1H, broad, **NH**), 5.98 (1H, s, =**CH**), 6.7—7.6 (10H, m, aromatic protons).

Reaction of 1: 1 Adduct IIIc with p-*Chlorophenyl Isocyanate.* A solution of 1.5 g of IIIc and 1.53 g of *p*-chlorophenyl isocyanate in 30 ml of benzene was refluxed for 5 hr. After cooling, filtration gave crystals, which on recrystallization from benzene afforded 2.0 g (85%) of bis(*p*-chlorophenylcarbamoyl)-4-(1-pyrrolidinyl)-3-penten-2-one (XIII), mp 162—163 °C (lit,[1] mp 162—163 °C), as colorless needles.

Reaction of Enamino Ketone I with 1-Naphthyl Isothiocyanate (XIV). *i)* A solution of 1.67 g (0.01 mol) of Ia and 1.85 g (0.01 mol) of XIV in 30 ml of benzene was refluxed for 5 hr. It was concentrated *in vacuo* to give crystals, which on recrystallization from ethanol afforded 1.58 g (45%) of 3-(1-naphthylthiocarbamoyl)-4-(1-piperidyl)-3-penten-2-one

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6) A. Michaelis and E. Grunkel, *Ber.*, **34**, 723 (1901).

(XVa), mp 123—124 °C (decomp.), as yellow needles.

Found: C, 71.73; H, 6.96; N, 7.66%. Calcd for $C_{21}H_{24}N_2OS$: C, 71.57; H, 6.86; N, 7.95%.

NMR (in $CDCl_3$) δ ppm: 1.77 (6H, m, CH_2), 1.82, 2.77 (each 3H, s, CH_3), 3.83 (4H, m, CH_2), 7.2—8.6 (7H, m, aromatic protons), 14.40 (1H, broad, **NH**).

ii) After a solution of 1.67 g of Ia and 1.85 g of XIV in 20 ml of xylene had been refluxed for 1 hr, it was concentrated *in vacuo* to leave a residue. The residue was chromatographed on alumina using chloroform as an eluent to give 0.26 g (7.8%) of 1-(1-naphthyl)-4-(1-piperidyl)-6-methylpyrid-2-thione (XVIa) and 0.46 g (13%) of XVa.

Compound XVIa; mp 215—217 °C (decomp.), pale orange prisms.

Found: C, 75.62; H, 6.68; N, 8.62%. Calcd for $C_{21}H_{22}N_2S$: C, 75.42; H, 6.63; N, 8.38%.

IR cm^{-1}: 1622 (C=C). NMR (in $CDCl_3$) δ ppm: 1.70 (6H, m, CH_2), 1.87 (3H, s, CH_3), 3.47 (4H, m, CH_2), 6.31, 7.21 (each 1H, d, =**CH**, J=3 Hz), 7.3—8.1 (7H, m, aromatic protons). Mass spectrum *m/e*: 334 (M^+), 302 ($M^+ - S$).

Similarly, Ib reacted with XIV in refluxing benzene to afford a 17.2% yield of 1-(1-naphthyl)-4-(1-pyrrolidinyl)-6-methylpyrid-2-thione (XVIb), mp 298—300 °C (decomp.), as pale orange prisms.

Found: C, 75.18; H, 6.33; N, 8.55%. Calcd for $C_{20}H_{20}N_2S$: C, 74.99; H, 6.29; N, 8.74%.

IR cm^{-1}: 1620 (C=C). NMR (in $CDCl_3$) δ ppm: 1.88 (3H, s, CH_3), 2.05, 3.45 (each 4H, m, CH_2), 6.14, 7.00 (each 1H, d, =**CH**, J=3 Hz), 7.4—8.1 (7H, m, aromatic protons). Mass spectrum *m/e*: 320 (M^+), 288 ($M^+ - S$).

1-(1-Naphthyl)-4-(1-pyrrolidinyl)-6-methylpyrid-2-one (XVIII). *i)* A solution of 1.0 g of pyrid-2-thione XVIb in 10 ml of methyl iodide was stirred at room temperature for 2 hr, during which time crystals were precipitated. The crystals were collected by filtration and washed with petroleum ether to give 1.4 g (97%) of *S*-methyl pyridinium iodide XVII, mp 200—202 °C (decomp.), as colorless crystals.

NMR (in $CDCl_3$) δ ppm: 2.12, 2.56 (each 3H, s, CH_3), 2.18, 3.82 (each 4H, m, CH_2), 6.48, 6.99 (each 1H, d, =**CH**, J=3 Hz), 7.2—8.2 (7H, m, aromatic protons).

XVII was hydrolyzed without further purification. A solution of 1.0 g of XVII in 10 ml of ethanol was stirred with 10 ml of 5 M aqueous sodium hydroxide at room temperature for 5 hr, and then was poured into water to precipitate crystals, which on recrystallization from ethanol afforded 0.48 g (73%) of XVIII, mp 233—234 °C, as colorless prisms.

Found: C, 79.25; H, 6.65; N, 9.22%. Calcd for $C_{20}H_{20}N_2O$: C, 78.92; H, 6.62; N, 9.20%.

IR cm^{-1}: 1655 (C=O). NMR (in $CDCl_3$) δ ppm: 1.78 (3H, s, CH_3), 2.01, 3.37 (each 4H, m, CH_2), 5.53, 5.81 (each 1H, d, =**CH**, J=3 Hz), 7.3—8.1 (7H, m, aromatic protons). Mass spectrum *m/e*: 304 (M^+).

ii) A solution of 100 mg of 4-(1-pyrrolidinyl)-5-(1-naphthylcarbamoyl)-4-penten-2-one (XIX)[1] in 10 ml of xylene was refluxed for 5 hr, and then concentrated *in vacuo*. The residue was then extracted with petroleum ether. The solvent was removed from the extract to leave crystals. Recrystallization from ethanol gave 25 mg (26%) of colorless prisms, which were identical with XVIII.