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TETRAHEDRON

Preparation of 7-Arylmethyl -1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-diones and α-Aryl-3-hydroxy-5-pyridylacetonitriles Using Arynic Methodology

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Abstract: 7-Arylmethyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-diones and α-aryl-3-hydroxy-5-pyridylacetonitriles can be prepared in modest yields from the respective reactions of 5-bromonicotinamide and 5-chloro-3-pyridinol with arylacetonitriles and LDA.

Intramolecular ring closure reactions of arynes possessing substituents adjacent to the "triple bond" and containing a negatively charged hetero atom (usually positioned γ or δ to the ring) have found considerable use in the construction of 5- or 6-membered heterocyclic rings onto arene rings.[1] The chemistry of arynes possessing substituents that contain a negatively charged heteratom α or β to the ring has been much less studied. In a brief report, we showed several years ago[2] that benzyne-3-carboxylate, generated by the reaction of sodium amide with 2-halobenzoic acid in liquid ammonia, underwent addition by preformed alkanenitrile anions exclusively at its 1-position to give α–(3-carboxyphenyl)alkanenitriles, after proton quench. Recently, we discovered[3] that benzyne-3-carboxylate, which was generated from the reaction of 2-bromobenzoic acid and LDA, preformed α–lithiated 4-methoxyphenylacetonitrile in THF at -40 °C gave mainly 3-diisopropylaminobenzoic acid. However, when α-lithiated-4-methoxyphenyl-acetonitrile was added to lithium bromobenzoate, and the reaction was carried out at -70 °C, benzyne 3-carboxylate were readily formed and reacted with the nitrile anion to give d 2-cyano-3-(4-methoxypheny)lmethylbenzoic acid. The base-initiated generation of an aryne intermediate from an haloarene at such a low temperature is unprecedented. Using similar reverse addition methodology, 3,4-dehydropyridine-5-carboxylate could also be generated from the reaction of 5-bromonicotinic acid and LDA at -70 °C; however, it reacted with α- lithioarylacetonitrile anions to give simple addition nitrile products,

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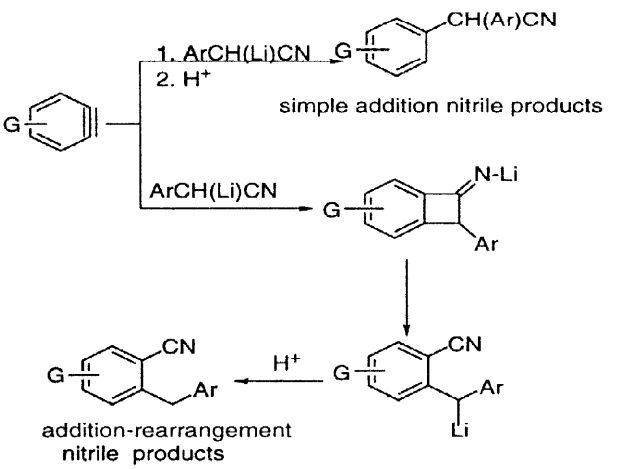
i.e., 5-(α–aryl-α–cyano)methylnicotinic acids.[4] In all reactions studied, the addition of nitrile anion to benzyne-3-carboxylates occurred at the position away from the carboxylate group, where unfavorable electronic interactions between the two charged species are absent. The mixed results obtained from the LDA-mediated reactions are consistent with past studies.[5] For example, we have shown that the reaction of arylacetonitriles with haloarenes proceed by two competing pathways. One way involves the usual arynic mechanism,[6] which gives simple addition products, and the other proceeds *via* a tandem addition-rearrangement mechanism,[7] which yields rearranged nitrile products (see Scheme 1). Typically, arynes having

Scheme 1



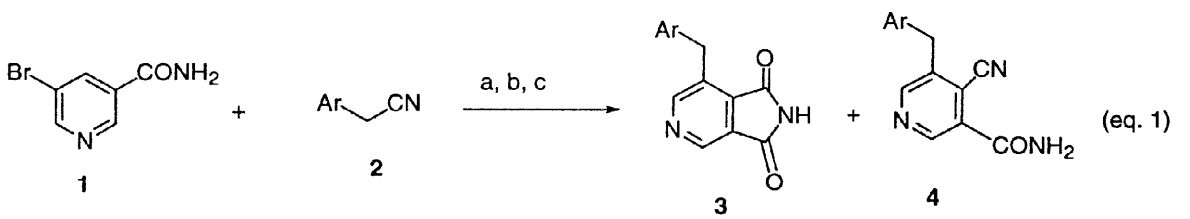
electron-releasing groups (including carboxylate)[8] react with α-lithiated arylacetonitriles to give addition-rearrangement products, whereas similarily treated arynes lacking such groups or heteroarynes possessing electron deficient rings usually give simple addition nitrile products.

Information about orientation of nucleophilic addition to aryne intermediates possessing a hetero-atom with a negative charge localized on an atom attached directly to the aromatic ring is also sparse. A few studies were carried out during the early days of aryne chemistry to evaluate the role of these substituents on directing the addition of amines or amide ions to the "triple bond" of benzyne.[9] For example, benzynes possessing an *O*-Li or *N*-Li substituent could be generated from 2-bromophenol or 2-bromoaniline. However, even using an eight fold excess of potassium amide in liquid ammonia (15 min at -33 °C)[10] or refluxing a suspension of lithium diethylamide in diethylamine for 98 h,[11] the desired aminated products were obtained in poor yields (15-20%). In each case, a large quantity of starting haloarene was recovered. The reluctance of these haloarenes to form benzyne intermediates under the aforementioned conditions is most likely the result of the decreased acidity of the benzenoid hydrogen atoms engendered by the negatively charged groups. Although the product yields were low, the *o:m* ratios of aminated products were interesting. For example, the *o:m* ratios were heavily in favor of the *ortho* isomer (90:10, *o:m*, respectively) for the potassium amide mediated reactions, whereas the lithium diethylamide promoted reactions gave

exclusively *meta* substitution products. These mixed results suggest other factors (possibly chelation) in addition to inductive effects and electrostatic interactions are important in orientation of nucelophilic addition to arynes possessing negatively charged substituents.

To obtain more information on the role of arynes possessing charged heteroatoms β- and α- to the ring, the reactions of 5-bromonicotinamide and 5-chloro-3-pyridinol with various arylacetonitriles and LDA in THF were carried out, and the results reported herein. 5-Bromonicotinamide (**1**) was prepared by successive treatment of commercially available 5-bromonicotinic acid with thionyl chloride and ammonia; 5-chloro-3-pyridinol was obtained commercially.

As shown in Eq. 1 and Table 1, **1** reacted with arylacetonitriles (**2a-f**) and LDA in THF using the reverse addition procedure at -70 °C to give 7-arylmethyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-diones (**3a-f**) in modest yields (43-54%); a small amount (~7-8%) of rearranged 5-arylmethyl-4-cyanonicotinamide (**4a** and **4d**) could be isolated from some reactions. The structures of **3a-f** were ascertained by ^{1}H NMR, ^{13}C NMR, and elemental analyses, and, in the case of **3b**, by single crystal X-ray diffractometry. The ORTEP[12] drawing of **3b** is shown in Figure 1.



a. LDA / -70 °C. b. -70 °C to room temperature c. H^+

Table 1. Yields (%) of Compounds **3** and **4**

entry	**3**	Ar	yield, %	**4**	yield, %
1	**a**	C_6H_5	54	**a**	7
2	**b**	2-MeO-C_6H_4	52	**b**	a
3	**c**	4-MeO-C_6H_4	48	**c**	a
4	**d**	1-naphthyl	43	**d**	8
5	**e**	2,4-diMeO-C_6H_3	36	**e**	a
6	**f**	2-F-C_6H_4	54	**f**	a

a. The yield of rearranged nicotinamide (**4**) was less than 2% as determined by presence of ArCN absorption peak (~ 2125 cm^{-1}) in the FTIR spectrum of the appropriate chromatographic fraction.

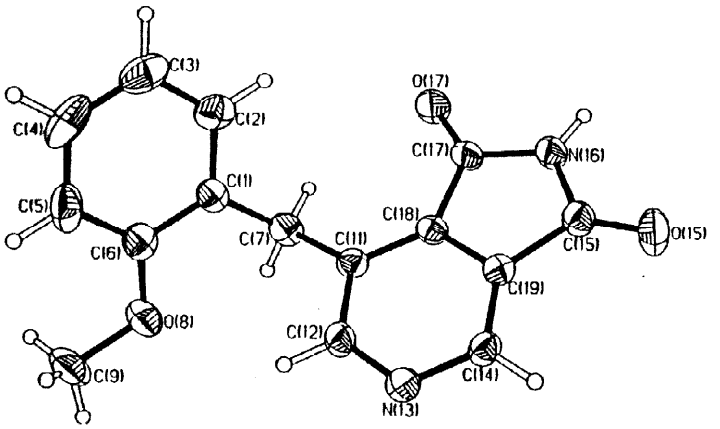
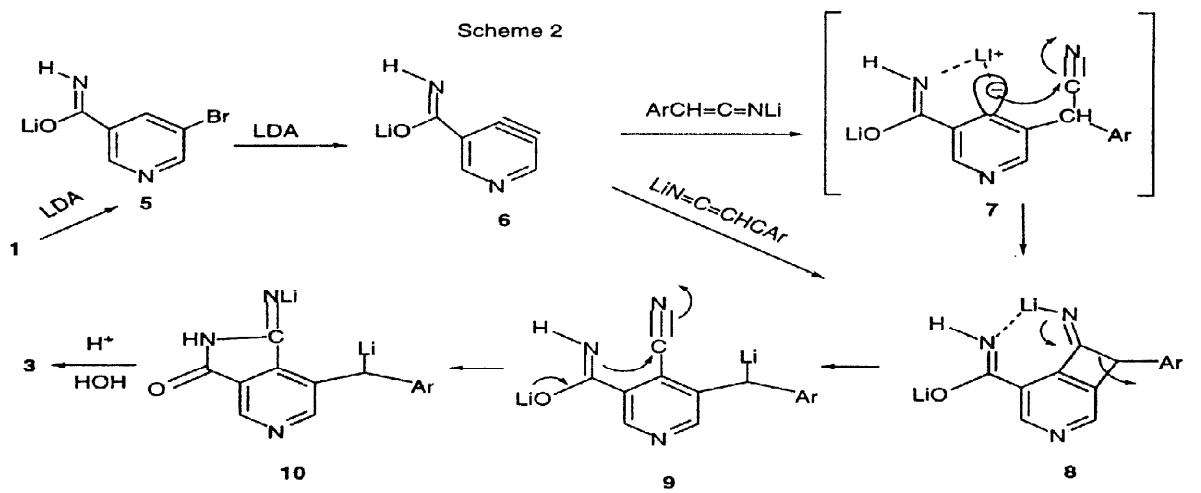


Figure 1 ORTEP Drawing of Compound **3b**

A possible mechanism for this reaction is shown in Scheme 2. Thus, amide (**1**) reacts with two equivalents of LDA to produce a *N*-lithiated-3,4-dehydropyridinecarboxamide heteroaryne intermediate (**6**) *via* amidate (**5**). This intermediate can then undergo nucleophilic attack by the α-lithio arylacetonitrile anion to give either an aryne/nitrile anion adduct (**7**), which undergoes ring closure to the cyclobutaniminium (**8**) and/ or produce **8** directly by a 2+2 cycloaddition process. In the former, che-

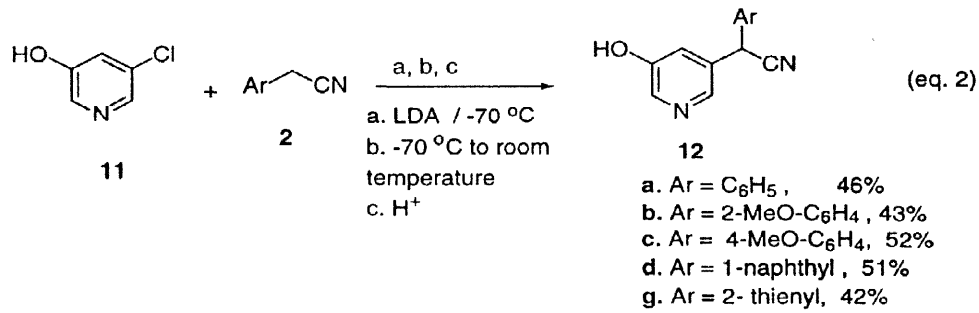
Scheme 2



lation of the 4-lithio atom by the adjacent amide nitrogen lone-pair electrons should increase the nucleophilicity of the 4-position which would facilitate the ring closure of **7** to **8** to such an extent that the overall process of **6** to **8** occurs in a concerted manner. Subsequent ring opening of **8** gives the 4-cyano derivative (**9**), which is converted to **3** by successive intramolecular cyclization to **10** and aqueous proton quench.

The exclusive formation of simple aryne addition products from the reaction of 3,4-dehydropyridine-5-carboxylate acids with arylnitrile anions[3] is probably a reflection of the decreased basicity of carboxylate oxygen atoms as compared to that of the amidate nitrogen atom of **6**. This lower basicity retards the cyclization of the initially formed 3,4-dehydropyridine-5-carboxylate/arylacetonitrile anion adduct to the 4-membered ring. This cyclization is a crucial step in the tandem addition-rearrangement pathway, so that its absence results in the usual arynic mechanism.

We next turned our attention to the reaction of 5-chloro-3-pyridinol (**11**) with arylacetonitriles (**2a-d**) and thienylacetonitrile (**2g**) and LDA in THF and (eq. 2) found that using the reverse addition process these reactions proceeded readily to give modest yields (42-51%) of simple addition products, namely, α-aryl-3-hydroxy-5-pyridylacetonitriles (**12**). The structures of **12a-d, g** were proven by ^{1}H NMR and elemental analysis, and in the case of **12c**, single-crystal X-ray diffractometry, of which the ORTEP is shown in Figure 2. The ability of these pyridinols to undergo the arynic reaction smoothly could be due



(eq. 2)

to the electron-deficient nature of the pyridine ring which would be expected to increase the acidity of the hydrogens adjacent to the 3-chloro group,[13] and which subsequently overcomes the electron-releasing, acid weakening effect of the OLi group.

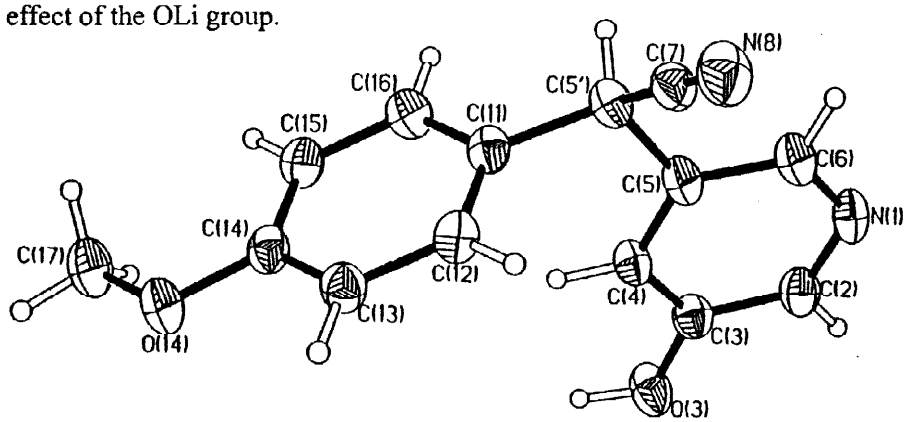


Figure 2 ORTEP Drawing of Compound **12c**

We have demonstrated that the use of a reverse addition arynic procedure provides a convenient, one-step, low temperature route to 7-arylmethyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-diones and α-aryl-3-hydroxy-5-pyridylacetonitriles from inexpensive, commercially available starting materials. While the parent compound, 1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-dione and its synthetic precursor pyridine-3,4-dicarboxylic anhydride[14] are commercially available, they are quite expensive, thereby limiting their desirability as starting materials. These compounds synthesized by our method should serve as valuable intermediates in the directed synthesis of biologically active heterocycles. For example, derivatives of 1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-diones have found use as inhibitors against tissue degradation,[15] tumor necrosis factor alpha,[16] and useful agents against cataracts.[17]

Experimental Section

General Data: Melting points were taken on a Mel-Temp capillary apparatus and are uncorrected with respect to stem correction. IR spectra were recorded on a Nicolet Magna-IR™ 550 FTIR spectrometer and the ^1H and ^{13}C NMR spectra were recorded on a 400 MHz Bruker AVANCE DRX-400 Multi-nuclear NMR spectrometer; chemical shifts were referenced to TMS as internal standard. Elemental analyses were obtained from E + R Microanalytical Laboratories, Inc., Corona, NY. High resolution mass spectra were performed by the Washington University Mass Spectrometry Resource, an NIH Research Resource (Grant Np. P41RR0954). 5-Bromonicotinic acid (**1**), 5-chloro-3-pyridinol (**11**) and aryl-acetonitriles (**2**) were purchased from Aldrich Chemical Company. Diisopropylamine was refluxed over and distilled from calcium hydride. Tetrahydrofuran (THF) was distilled from Na/benzophenone immediately prior to use. *n*-Butyllithium (*n*-BuLi) was purchased from Aldrich Chemical Company as a solution in hexane. The glassware was heated at 125 °C in an oven overnight prior to use. All reactions were done under an atmosphere of dry O_2-free N_2 *via* balloon.

General Procedure for Arynic Reactions. In a flame-dried flask flushed with nitrogen, fresh LDA (15 mmol) was prepared by adding *n*-BuLi (15 mmol, 2.5 M in hexane) to a solution of diisopropylamine (15 mmol) in THF (30 mL) at -70 °C. After stirring for 10 min, the appropriate aryne precursor (**1** or **11**) (5 mmol) in THF (30 mL) was added dropwise over 20 min, and the stirring was continued for 10 min at -70 °C. The appropriate arylacetonitrile (**2**) was then added during which the solution developed a deep red color. The resulting solution was stirred for an additional 30 min, allowed to warm to room temperature, stirred overnight, and quenched with sat. aq. NH_4Cl (30 mL). The THF was evaporated under reduced pressure, and the remaining residue was extracted with methylene chloride (3 X 20 mL). The combined extracts were washed with dilute HCl (1 X 20 mL), brine (2 X 20 mL), dried (Na_2SO_4), and concentrated (rotary evaporator) to provide crude solid material. The mixture was subjected to flash column chromatography (silica gel) using a mixture of hexane/acetone (6:4) as eluent to give product, which was recrystallized from EtOAc. Pertinent data of isolated compounds (**3** and **12**) follow.

7-Benzyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-dione (3a): mp 225-226 °C; IR (Nujol) 1772, 1747 cm^{-1} (cyclic imide). ^1H NMR (DMSO-d_6) δ 4.43 (s, 2 H), 7.21-7.35 (m, 5 H), 8.92 (s, 1 H), 8.96 (s, 1 H), 11.70 (s, 1 H); ^{13}C NMR (DMSO-d_6) δ 33.5, 127.0, 129.1, 129.3, 134.0, 136.7, 139.7, 142.5, 145.8, 157.6, 168.8, 169.5. Anal. Calcd for $C_{14}H_{10}N_2O_2$; 70.58; H, 4.23; N, 11.76. Found; C, 70.52; H 4.25; N. 11.97.

7-(2-Methoxyphenyl)methyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-dione (3b): mp 232-233 °C; IR (Nujol) 1770 and 1745 cm^{-1} (cyclic imide). ^1H NMR (DMSO-d_6) δ 3.79 (s, 3 H), 4.35 (s, 2 H), 6.87 (t, J = 7.4 Hz, 1 H), 7.01 (d, J = 8.0 Hz, 1 H), 7.16 (d, J = 7.4 Hz, 1 H), 7.24 (t, J = 8.0 Hz, 1 H), 8.74 (s, 1 H),

8.88 (s, 1 H), 11.70 (s, 1 H); ^{13}C NMR (DMSO-d_6) δ 29.3, 56.7, 112.2, 121.8, 127.9, 128.0, 129.6, 131.5, 134.5, 137.8, 143.1, 158.1, 158.3, 169.7, 170.2. Anal. Calcd for $C_{15}H_{12}N_2O_3$; C, 73.16; H, 4.51; N, 10.44. Found; C, 73.19; H, 4.57; N, 10.49.

7-(4-Methoxyphenyl)methyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-dione (3c): mp 233-234 °C; IR (Nujol) 1773 and 1744 cm^{-1} (cyclic imide). ^{1}H NMR (DMSO-d_6) δ 3.71 (s, 3 H), 4.35 (s, 2 H), 6.87 (d, J = 7.6 Hz, 2 H), 7.27 (d, J = 7.6 Hz, 2 H), 8.90 (s, 1 H), 8.92 (s, 1 H), 11.67 (s, 1 H); ^{13}C NMR (DMSO-d_6) δ 33.5, 56.4, 115.4, 128.1, 131.2, 132.5, 135.4, 137.4 , 143.1, 158.3, 159.3, 169.7, 170.4. Anal. Calcd for $C_{15}H_{12}N_2O_3$; C, 73.16; H, 4.51; N, 10.44. Found; C, 73.12; H, 4.52; N, 10.39.

7-(1-Naphthyl)methyl-1*H*-pyrrolo[3,4-*c*]pyridine-(2*H*)-dione (3d): mp 254-255 °C; IR (Nujol) 1775 and 1742 cm^{-1} (cyclic imide). ^{1}H NMR (DMSO-d_6) δ 4.88 (s, 2 H), 7.28 (d, J = 6.0 Hz, 1 H), 7.43 (t, J = 8.0 Hz, 1 H), 7.53 (m, 2 H), 7.85 (d, J = 8.0 Hz, 1 H), 7.95 (t, J = 6.0 Hz, 1 H), 8.10 (m, 1 H), 8.60 (s, 1 H), 8.89 (s, 1 H), 11.78 (s, 1 H). ^{13}C NMR (DMSO-d_6) δ 30.7, 124.2, 126.2, 126.5, 127.0, 127.3, 127.6, 127.9, 129.2, 131.8, 133.4, 134.0, 135.1, 137.2, 142.5, 157.0, 168.9, 169.6. Anal. Calcd for $C_{18}H_{12}N_2O_2$; C, 74.99; H, 4.20; N, 9.72. Found; C, 74.92; H, 4.43; N, 9.82.

7-(3,4-Dimethoxyphenyl)methyl-1*H*-pyrrolo[3,4-*c*]pyridine-(2*H*)-dione (3e): mp 211-212 °C; IR (Nujol) 1772 and 1745 cm^{-1} (cyclic imide). ^{1}H NMR (DMSO-d_6) δ 3.71 (s, 3 H), 3.73 (s, 3 H), 4.35 (s, 2 H), 6.86 (m, 2 H), 7.00 (s, 1 H), 8.89 (s, 1 H), 8.94 (s, 1 H), 11.72 (s, 1 H). ^{13}C NMR (DMSO-d_6) δ 33.1, 55.9, 56.0, 112.6, 113.3, 121.2, 127.2, 132.1, 134.5, 136.5, 142.4, 148.0, 149.3, 157.5, 168.9, 169.6. Anal. Calcd for $C_{16}H_{14}N_2O_4$; C, 64.42; H, 4.73; N, 9.39. Found; C, 64.37; H, 4.78; N, 9.30.

7-(2-Fluorophenyl)methyl-1*H*-pyrrolo[3,4-*c*]pyridine-1,3-(2*H*)-dione (3f): mp 221-223 °C; IR (Nujol) 1769 and 1745 cm^{-1} (cyclic imide). ^{1}H NMR (DMSO-d_6) δ 4.45 (s, 2 H), 7.13-7.29 (m, 4 H), 8.83 (s, 1 H), 8.95 (s, 1 H), 11.70 (s, 1 H). ^{13}C NMR (DMSO-d_6) δ 27.1, 115.7, 115.9, 125.1, 127.3, 129.3, 129.4, 131.6, 132.3, 137.2, 142.7, 157.2, 168.8, 169.2. Calcd for $C_{14}H_9FNO_2$; C, 65.62; H, 3.54; 7.41. Found; C, 65.59; H,3.55; N, 7.53.

4-Cyano-5-benzylnicotinamide (4a): mp 229-230 °C, IR (Nujol) 3454, 3304 cm^{-1} (CONH$_2$), 2220 cm^{-1} (ArCN), 1733, and 1669 cm^{-1} (*ortho* CN, CONH$_2$).[18] ^{1}H NMR (DMSO- d_6) δ 4.59 (s, 2 H), 7.20-7.35 (m, 5 H), 8.84 (s, 1 H), 8.88 (s, 1 H), 9.25 (br s, 2 H). ^{13}C NMR (DMSO-d_6) δ 33.7, 126.8, 127.5, 129.0, 129.3, 133.8, 142.4, 142.7, 156.2, 156.9, 157.5, 169.5. Anal. Calcd for $C_{14}11N_3O$; C, 70.87; H, 4.67, N, 17.71. Found; C, 70.83; H, 4.65, N, 17.91.

4-Cyano-5-(1-naphthyl)methylnicotinamide (4d): mp 245-246 °C, IR (Nujol) 3454, 3304 cm^{-1} (CONH$_2$), 2220 cm^{-1} (ArCN), 1733, and 1669 cm^{-1} (*ortho* CN, CONH$_2$).[19] ^{1}H NMR (DMSO- d_6) δ 5.06 (s,

2 H), 7.32 (d, J = 6.0 Hz, 1 H), 7.43 (t, J = 8.0 Hz, 1 H), 7.53 (m, 2 H), 7.85 (d, J = 8.0 Hz, 1 H), 7.95 (t, J = 6.0 Hz, 1 H), 8.10 (m, 1 H), 8.53 (s, 1 H), 8.88 (s, 1 H), 9.30 (br s, 2 H). ^{13}C NMR (DMSO-d_6) δ 31.2, 124.4, 126.2, 126.4, 126.9, 127.4, 127.7, 129.2, 131.9, 133.2, 134.0, 135.8, 140.0, 142.7, 145.8, 155.5, 157.0, 167.1. Anal. Calcd for $C_{18}H_{13}N_3O$; C, 75.25; H, 4.56, N, 14.62. Found; C, 75.17; H, 4.15, N, 14.52.

3-Hydroxy-α-phenyl-5-pyridylacetonitrile (12a): mp 194-195 °C; IR (Nujol) 3411cm^{-1} (OH), 2244 cm^{-1} (aliphatic CN). ^{1}H NMR (acetone-d_6) δ 5.83 (m, 1 H), 7.12 (bt, J~ 2.1 Hz, 1 H), 7.32-7.41 (m, 5 H), 8.07 (bd, J ~ 1.9 Hz, 1 H), 8.08 (bd, J ~ 2.2 Hz, 1 H), 9.06 (bs, 1H). ^{13}C NMR (DMSO-d_6) δ 38.8, 120.3, 121.3, 128.0, 128.8, 129.9, 133.7, 136.4, 138.5, 139.4, 154.4. Anal. Calcd for $C_{13}H_{10}N_2O$; C, 74.27; H, 4.70, N, 13.32. Found; C, 74.17; H, 4.75, N, 13.38.

3-Hydroxy-α-(2-methoxyphenyl)-5-pyridylacetonitrile (12b): mp 160 °C; IR (Nujol) 3408 cm^{-1} (OH), 2248 cm^{-1} (aliphatic CN). ^{1}H NMR (acetone-d_6) δ 3.81 (s, 3 H), 5.71 (s, 1 H), 7.09 (dd , J = 1.7, 2.3 Hz, 1 H), 7.21 (m, 1 H), 7.45 (m, 2 H), 8.14 (d, J = 2.3 Hz, 1 H), 8.16 (d, J = 1.7 Hz, 1 H), 9.04 (br s, 1 H). ^{13}C NMR (DMSO-d_6) δ 34.0, 55.3, 11.7, 119.1, 121.1, 121.2, 123.9, 128.6, 130.2, 133.1, 137.6, 139.9, 153.8, 156.4. Anal. Calcd for $C_{14}H_{12}N_2O_2$; C, 69.99; H, 5.03; N, 11.66. Found; C, 69.91; H, 5.13; N, 11.78.

3-Hydroxy-α-(4-methoxyphenyl)-5-pyridylacetonitrile (12c): mp 179-180 °C; IR (Nujol) 3411cm^{-1} (OH), 2244 cm^{-1} (aliphatic CN). ^{1}H NMR (DMSO-d_6) δ 2.37 (s, 3 H), 4.43 (s, 2 H), 6.89 (d, J = 8.4 Hz, 2 H), 7.12 (dd, J = 1.8, 2.4 Hz, 1 H), 7.40 (d, J = 8.4 Hz, 2 H), 8.18 (d, J = 1.6 Hz, 1 H), 8.20 (d, J = 2.4 Hz, 1 H), 9.04 (br s, 1 H); ^{13}C NMR (acetone-d_6) 38.0, 55.7, 115.2, 130.5, 121.2, 128.2, 129.3, 134.0, 138.3, 139.3, 154.3, 159.6. Anal. Calcd for $C_{14}H_{12}N_2O_2$; C, 69.99; H, 5.03; N, 11.66. Found; C, 69.89; H, 5.08; N, 11.68.

3-Hydroxy-α-(1-naphthyl)-5-pyridylacetonitrile (12d): mp 217-218 °C; IR (Nujol) 3424 cm^{-1} (OH), 2247 cm^{-1} (aliphatic CN). ^{1}H NMR (acetone-d_6) δ 6.37 (s, 1 H), 7.18 (bt, J~ 2.1 Hz, 1 H), 7.56-7.64 (m, 3 H), 7.78 (d, J =7.2 Hz, 1 H), 8.00 (m, 3 H), 8.17 (d, J = 1.9 Hz, 1 H), 8.27 (d, J = 2.3 Hz, 1 H), 9.06 (br s, 1 H). ^{13}C NMR (DMSO-d_6) δ 36.6, 119.0, 121.2, 123.3, 125.6, 126.5, 126.9, 127.1, 129.2, 129.7, 130.2, 131.5, 133.0, 134.5, 138.1, 140.0, 147.5, 154.2. Anal. Calcd for $C_{17}H_{12}N_2O$; C, 78.44; H, 4.65; N, 10.76. Found; C, 78.49; H, 4.62; N, 10.86.

3-Hydroxy-α-(2-thienyl)-5-pyridylacetonitrile (12 g): mp 186-188 °C; IR (Nujol) 3424 cm^{-1} (OH), 2247 cm^{-1} (aliphatic CN). ^{1}H NMR (acetone-d_6) δ 5.70 (t, J = 2.0 Hz, 1 H), 7.12 (m, 1 H), 7.24 (s, 1 H), 7.87 (m, 2 H), 8.18 (d, J = 1.9 Hz, 1 H), 8.20 (d, J = 2.1 Hz, 1 H), 9.06 (br s, 1 H). ^{13}C NMR (DMSO-

d_6) δ 34.7, 119.5, 121.0, 123.5, 126.7, 127.9, 132.5, 136.5, 138.1, 139.7, 159.5. Anal. Calcd for $C_{11}H_8N_2OS$; C, 61.09; H, 3.73; 12.95. Found; C, 61.14; H, 3.73; 12.89.

X-ray Single Crystal Analyses. All data were collected on a Nicolet R3m/V diffractometer using the θ –2θ scan technique, Mo-Kα radiation (λ = 0.71073), scan speed 3.0-15 deg min^{-1}, scan range 3.5-50.0^0 and a graphite monochromator. Data were corrected for Lorentz, absorption, and polarization effects. The structures were solved by direct methods using SHELXS-86,[20] and the model was refined by using full-matrix least-squares techniques. Pertinent data are given in the Table 2.

Table 2 X-ray data collection and processing parameters for **3b** and **12c**

	3b	**12c**
formula	$C_{15}H_{12}N_2O_3$	$C_{14}H_{12}N_2O_2$
crystal dmns, cm^{-3}	0.35 X 0.30 X 0.10	0.25 X 0.20 X 0.10
Space Group	$P2_1$	C_c
a (Å)	7.597(1)	9.701(1)
b (Å)	6.718(1)	12.838(1)
c (Å)	12.15(2)	10.35(1)
β (°)	97.94(1)	111.36(1)
V (Å^3)	614.3(2)	1200.4(2)
Z-value	2	4
D calc (g-cm^3)	1.45	1.33
abs coeff, mm^{-1}	0.103	0.091
T (K)	228	228
decay, %	3.94	3.55
Data collected	1261	1132
Unique reflections	1006	1017
R_{int}	0.051	0.036
Parameters	180	161
R, R_W	0.051, 0.063	0.036, 0.051
$(\Delta/\sigma)_{max}$	<0,01	<0.01
$\rho_{max};\rho_{min}$ (eÅ^{-3})	0.28; -.0.25	0.14; -0.16
GOF	1.48	1.22

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