Notes

A New Synthetic Route to 3-(Acylamino)-1-aryl-2-pyrazolin-5-ones

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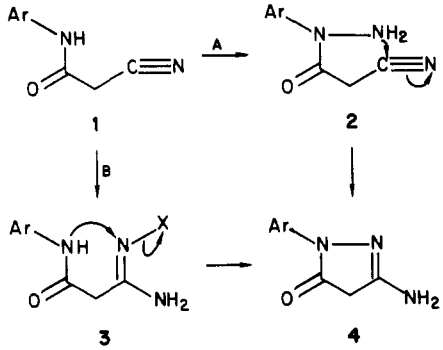
2-Pyrazolin-5-ones having 1-aryl and 3-acylamino substituents are well-known as photographically useful magenta couplers.[1] All the known methods for the synthesis of these pyrazolinones require arylhydrazines as a source of two adjacent nitrogens in the heterocyclic ring.[2] We have been interested in exploring a new synthetic route to the pyrazolinones without using the arylhydrazine precursors. We report herewith the first synthesis of pyrazolinones which does not require arylhydrazine intermediates.

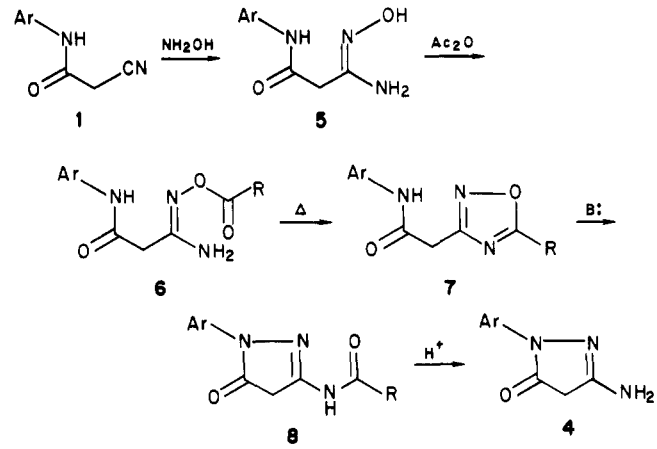
Our approach has been focused on how to add one more nitrogen function to a 2-cyanoacetanilide (1) and build the desired heterocyclic ring, 3-amino-1-aryl-2-pyrazolin-5-one (4). We considered the following two possibilities: (A) formation of N–N bond first, e.g., amination, to give *N*-amino-2-cyanoacetanilide (2) which would cyclize to afford the desired 3-aminopyrazolinone (4); (B) addition of an appropriate nitrogen function, e.g. hydroxylamine, to nitrile first to give intermediate 3 (X = OH) and effecting



N–N bond formation to afford the desired heterocycle 4. After a quick unsuccessful attempt to aminate 1 to 2 using hydroxylamine-*O*-sulfonic acid as an aminating agent according to the route A, we decided to concentrate on preparing the amidoxime 3 and effecting the N–N bond formation according to the route B.

Amidoximes **5a,b** were readily available from 2-cyanoacetanilides **1a,b** (Scheme I) by the addition of hydroxylamine.[3] Attempts to cyclize the amidoxime **5a** by simple dehydration have met with failure. It is interesting to note that *O*-tosylamidoxime prepared from the amidoxime **5a** gave, upon treatment with a base, a 2-amino-1-azirine derivative with no trace of pyrazolinone **4a**.[4] When the

Scheme I



1,4,5: a, Ar = 2,4,6-$Cl_3C_6H_2$
b, Ar = C_6H_5

6,7,8: a, Ar = 2,4,6-$Cl_3C_6H_2$; R = CH_3
b, Ar = C_6H_5, R = CH_3
c, Ar = 2,4,6 $Cl_3C_6H_2$; R = CH(O-C_6H_4-C_4H_9)
d, Ar = 2,4,6-$Cl_3C_6H_2$; R = CH(Et)-O-C_6H_4-$C_{15}C_{31}$-*n*
e, Ar = 2,4,6-$Cl_3C_6H_2$; R = CH_2-O-C_6H_4-NO_2

amidoxime **5a** was acetylated with acetic anhydride, only *O*-acetylamidoxime **6a** was obtained. The *O*-acetylamidoxime **6a** was then cyclized by heating in a high boiling solvent to afford 1,2,4-oxadiazole **7a**. The *O*-acetylation and cyclization can be done in one step. Thus, the 1,2,4-oxadiazole **7a** was obtained in a quantitative yield by stirring the amidoxime **5a** with acetic anhydride in acetic acid at room temperature for awhile and heating under reflux for a few hours. Upon heating with a base, the oxadiazole **7a** was converted to 3-(acetylamino)-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8a**). Hydrolysis of the 3-(acetylamino)pyrazolinone **8a** afforded 3-amino-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**4a**). In a similar sequence, 3-amino-1-phenyl-2-pyrazolin-5-one (**4b**) was obtained from the amidoxime **5b**. The reaction of the 3-amino-1-aryl-2-pyrazolin-5-ones **4a,b** with appropriate ballasting acid chlorides gave the desired couplers, 3-(acylamino)-1-aryl-2-pyrazolin-5-ones.[5]

Several examples of the rearrangement of 1,2,4-oxadiazoles, whose general feature is shown in **9**, to other five-membered ring heterocycles **10** are known.[6] Among the

(1) Fleckenstein, L. J. "The Theory of the Photographic Process" 4th ed.; James, T. H., Ed.; Macmillan: New York, 1977; p 356.
(2) Wiley, R. H.; Wiley, P. "Pyrazolones, Pyrazolidones, and Derivatives", Weissberger, A., Ed.; Interscience: New York, 1964; Chapter VIII, Vol. 20 of the series "The Chemistry of Heterocyclic Compounds."
(3) Eloy, F.; Lenaers, R. *Chem. Rev.* **1962**, *62*, 155.
(4) Hyatt, J. A. *J. Org. Chem.* **1981**, *46*, 3953.
(5) Loria, A.; Weissberger, A.; Vittum, P. W. U.S. Pat. 2600788, 1952, to Eastman Kodak Co.
(6) See: Clapp, L. B. "Advances in Heterocyclic Chemistry"; Katritzky, A. R., Boulton, A. J., Ed.; Academic Press: New York, 1976; p 104, Vol. 20.

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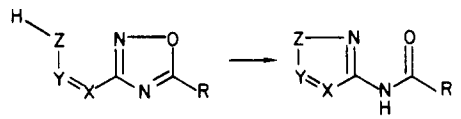


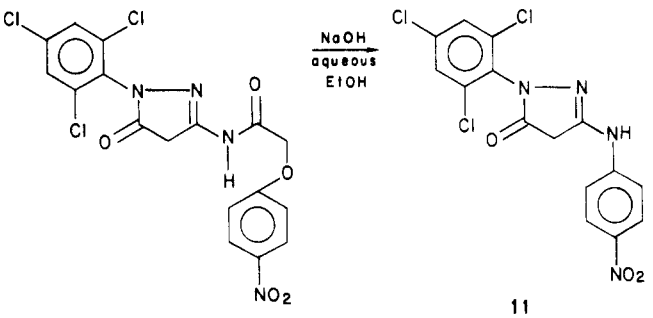
9 10

heterocycles formed by this rearrangement are 1,2,3-triazole (where —X=Y—Z— is CNN), 1,2,5-oxadiazole (CNO), imidazole (NCC), 1,2,4-triazole (NCN), isoxazole (CCO), and 1,2,4-thiadiazole (NCS). A new system pyrazole, where —X=Y—Z— is CCN,[7,8] is now added to this list.

The rearrangement of oxadiazoles **7a,b** to pyrazolinones **8a,b** proceeded smoothly in a protic solvent with a strong inorganic base. Without base, no reaction took place. With organic bases such as triethylamine and 1,4-diazabicyclo[2.2.2]octane, no evidence of reaction was observed. Potassium hydroxide in alcoholic solvents gave the best yields, although the yields were lowered by solvolysis of the amide group to give aniline as a byproduct in **7a** and **7b**.

The synthesis of a pyrazolinone by rearrangement of an oxadiazole is of unique value in the preparation of the magenta coupler, a pyrazolinone with a ballasting acylamino group,[5] since the coupler can be obtained directly from the oxadiazole with the ballasting group attached. For example, 3-oxo-3-(2,4,6-trichloroanilino)propionamidoxime (**5a**) was reacted with 2-(2,4-di-*tert*-pentylphenoxy)hexanoyl chloride to give *O*-acylamidoxime **6c**, which was cyclized to the corresponding oxadiazole **7c**. When heated with potassium hydroxide in ethanol, the oxadiazole **7c** was converted to the coupler 3-[[2-(2,4-di-*tert*-pentylphenoxy)hexanoyl]amido]-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8c**). Similarly, the coupler 3-[2-(3-pentadecylphenoxy)butyramido]-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8d**) was prepared from the amidoxime (**5a**) and 2-(3-pentadecylphenoxy)butyryl chloride. Interestingly, the rearrangement of the oxadiazole **7c** or **7d** proceeded much faster than that of the oxadiazole **7a** or **7b**, and the product **8c** or **8d** was obtained in much higher yield and higher purity.

Certain 3-anilino-1-aryl-2-pyrazolin-5-ones were available from 3-(acylamino)-1-aryl-2-pyrazolin-5-ones. For example, 3-(4-nitroanilino)-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**11**) was prepared by the Smiles rearrangement of 3-[2-(4-nitrophenoxy)acetamido]-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8e**).[9]



8e 11

Thus, our new synthesis was extended to the preparation of an 1-aryl-3-(arylamino)-2-pyrazolin-5-one (**11**). Oxadiazole **7e** was prepared from the amidoxime **5a** and (4-nitrophenoxy)acetyl chloride via *O*-acylamidoxime **6e**. Treatment of **7e** with a base afforded **11** in good yield by the rearrangement of **7e** to **8e** and subsequent Smiles rearrangement of **8e**.

Experimental Section

All melting points were determined on a Thomas-Hoover capillary melting point apparatus and are uncorrected. Infrared spectra were recorded on a Beckman 4220 spectrophotometer. A Varian T-60 nuclear magnetic resonance spectrometer was used for ^1H NMR spectra with tetramethylsilane as an internal standard, and an AEI MS-9 mass spectrometer was used for mass spectra. Precoated silica gel 60F-254 plates made by EM Reagents were used for thin layer chromatography (TLC). Elemental analyses were performed by Industrial Laboratory, Kodak Park, Eastman Kodak Co.

3-Oxo-3-(2,4,6-trichloroanilino)propionamidoxime (5a). This compound was prepared from 2-cyano-2′,4′,6′-trichloroacetanilide (**1a**)[10] in 93% yield by a procedure similar to that described for **5a** by Hyatt:[4] mp 198–199.5 °C dec (lit.[4] mp 200 °C).

3-Oxo-3-anilinopropionamidoxime (5b). This was also prepared from 2-cyanoacetanilide (**1b**) in 67% yield by a procedure similar to that described for **5a** by Hyatt:[4] mp 166–168 °C dec; IR (KBr) 3450, 3350, 3000, 1670, 1640, 1610, 1550 cm^{-1}; ^1H NMR (Me_2SO-d_6) δ 2.10 (s, 3 H, $COCH_3$), 3.25 (s, 2 H, —$COCH_2$—), 6.60 (br s, 2 H, NH_2), 7.00–7.76 (m, 5 H, C_6H_5), 10.27 (s, 1 H, —N*H*CO—). Anal. Calcd for $C_{11}H_{13}N_3O_3$: C, 56.2; H, 5.6; N, 17.9. Found: C, 56.0; H, 5.6; N, 18.0.

5-Methyl-3-[2-oxo-2-(2,4,6-trichloroanilino)ethyl]-1,2,4-oxadiazole (7a). A mixture of 74.2 g (0.25 mol) of **5a** and 29.6 g (0.29 mol) of acetic anhydride in 500 mL of glacial acetic acid was stirred at room temperature for 2 h. TLC of an aliquot of the reaction mixture showed only one new spot at this time. The mixture was then heated under reflux for 1 $^1/_2$ h. The reaction mixture was concentrated to one-thrid of the original volume under a reduced pressure, and 500 mL of water was added with vigorous stirring. After stirring for awhile, the precipitated product was collected, washed with water, and dried in air. The crude product obtained in quantitative yield was recrystallized from ethanol to give 76.0 g (95%) of **7a** as colorless crystals: mp 185–186 °C; IR (KBr) 3220, 3190, 1675, 1585, 1570, 1530 cm^{-1}; ^1H NMR (Me_2SO-d_6) δ 2.61 (s, 3 H, CH_3), 3.98 (s, 2 H, —$COCH_2$—), 7.80 (s, 2 H, $C_6H_2Cl_3$), 10.35 (br s, 1 H, —NHCO—); mass spectrum, *m/e* (relative intensity) 321 (M^+, 5), 284 (40), 195 (100), 98 (31), 97 (31), 43 (35), 41 (10). Anal. Calcd for $C_{11}H_8Cl_3N_3O_2$: C, 41.2, H, 2.5; N, 13.1. Found: C, 41.0; H, 2.5; N, 13.4.

5-Methyl-3-(2-oxo-2-anilinoethyl)-1,2,4-oxadiazole (7b). This compound was prepared from **5b** in 72% yield by a procedure similar to that described for **7a**: mp 99–101 °C; IR (KBr) 3240, 3180, 3120, 3075, 1650, 1610 (sh), 1585, 1545 cm^{-1}; ^1H NMR (Me_2SO-d_6) δ 2.55 (s, 3 H, CH_3), 3.87 (s, 2 H, —$COCH_2$—), 7.03–7.75 (m, 5 H, C_6H_5), 10.50 (s, 1 H, —NHCO—). Anal. Calcd for $C_{11}H_{11}N_3O_2$: C, 60.8; H, 5.1; N, 19.3. Found: C, 60.8, H, 5.2; N, 19.3.

3-(Acetylamino)-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (8a). A solution of 20 g (62.4 m mol) of **7a** and 10 g of potassium hydroxide in 200 mL of ethanol was heated under reflux for 10 h. After being cooled to room temperature, the mixture was neutralized with acetic acid and concentrated under a reduced pressure to a thick orange oil. This was stirred with 200 mL of water with cooling in an ice bath. The resulting solid was collected, washed, and dried in air to give 17.6 g of tan solid. This solid was triturated with 50 mL of hot hexane and filtered. The hexane solution was concentrated and cooled to give 1.5 g (12%) of 2,4,6-trichloroaniline, mp 76.5–78 °C (lit.[11] mp 78.5 °C). The solid remained after the hexane treatment was recrystallized twice from ethanol to give 11.6 g (58%) of **8a** as colorless crystals: mp 234–235.5 °C; its mp, mmp, and IR and ^1H NMR spectra were

(7) Another CCN system where —C=C— is the part of benzene and thus the heterocycle formed is indazole was reported while our investigation was under way. See: Vivona, N.; Cusmano, G.; Macaluso, G.; Frenna, V.; Ruccia, M. *J. Heterocycl. Chem.* **1979**, *16*, 783.

(8) It is interesting to note that even the oxadiazole with a saturated CH_2CH_2NHR side chain instead of —C=C—N— undergoes the rearrangement reaction to give a nonaromatic heterocycle pyrazoline. See: Korbonits, D.; Bakó, E. M.; Korváth, K. *J. Chem. Res.* **1979**, 810.

(9) Beavers, L. E. U.S. Pat. 2983608, 1961, to Eastman Kodak Co.

(10) Seidel, M.; Viste, K.; Yih, R. Ger. Offen. 1900947, 1969, to Rohm and Haas Co.; *Chem. Abstr.* **1970**, *72*, 21616g.

(11) Grammaticakis, P. *Bull Soc. Chim. Fr.* **1949**, 767.

identical with those of an authentic sample of **8a** prepared from **4a** by the known procedure.[12,13]

3-(Acetylamino)-1-phenyl-2-pyrazolin-5-one (8b). This compound was prepared from **7b** in 42% yield by following a procedure similar to that described for **8a**: mp 207–213 °C dec (lit.[13] mp 218–220 °C).

3-Amino-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (4a). (a) From 3-(acetylamino)-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8a**): A solution of 16 g (50 m mol) of **8a** and 6 g of anhydrous hydrogen chloride in 150 mL of absolute ethanol was heated under reflux for $1^1/_2$ h. The mixture was concentrted under a reduced pressure, and the residue was stirred with 100 mL of water and neutralized with ammonium hydroxide. The mixture was allowed to stand at room temperature for several hours and cooled to 10 °C. The product was collected, washed, and dried in air. The crude material was slurried in hexane, collected, and recrystallized from aqueous ethanol to give 11 g (79%) of **4a** as light tan crystals: mp 220–223 °C (lit.[9] mp 222–224 °C). IR and ^{1}H NMR spectra were identical with those of an authentic sample of **4a** prepared by the known procedure.[9]

(b) From 5-methyl-3-[2-oxo-2-(2,4,6-trichloroanilino)ethyl]-1,2,4-oxadiazole (**7a**): A solution of 20 g (62.4 m mol) of **7a** and 9.9 g of potassium hydroxide in 200 mL of absolute ethanol was heated under reflux for 10 h. The reaction mixture was concentrated by distilling the solvent until about 90 mL of distillate was collected. To the remaining mixture was added slowly a solution of 13.3 g of anhydrous hydrogen chloride in 90 mL of absolute ethanol, and the mixture was heated under reflux for $1^1/_2$ h. Same workup as described in a above gave 13.2 g (76%) of **4a** as light tan crystals, whose mp, IR, and ^{1}H NMR were identical with those of **4a** obtained in a above.

3-Amino-1-phenyl-2-pyrazolin-5-one (4b). This compound was obtained in 71% yield from **8b** by following the same procedure as described for **4a** from **8a**: mp 207–213 °C (lit.[13] mp 218–220 °C).

***O*-[2-(2,4-Di-*tert*-pentylphenoxy)hexanoyl]-3-oxo-3-(2,4,6-trichloroanilino)propionamidoxime (6c).** To a stirred mixture of 11.9 g (40 m mol) of **5a** and 5.1 g of triethylamine in 100 mL of tetrahydrofuran (THF) was added slowly a solution of 15.4 g (42 m mol) of 2-(2,4-di-*tert*-pentylphenoxy)hexanoyl chloride[14] in 50 mL of THF. The initial reaction was exothermic and the temperature rose to 40 °C. The mixture was stirred at room temperature for 5 h and then heated under reflux for 30 min. The mixture was cooled to room temperature and filtered to remove triethylamine hydrochloride and some undissolved material. The filtrate was evaported to dryness under a reduced pressure. The residual oil was dissolved in 250 mL of toluene, washed with 2 N hydrochloric acid and water, dried over anhydrous magnesium sulfate, and evaporated to dryness under a reduced pressure. The resulting brown oil was crystallized from hexane to give 21.1 g (84%) of **6c** as slightly tan solids: mp 156–157 °C; IR (KBr) 3420, 3330, 3220, 2940, 2880, 1740, 1660, 1640, 1575, 1550, 1500 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 0.60–2.05 (m, 31 H, C_4H_9 and $-OC_6H_3C_{10}H_{22}$), 3.27 (s, 2 H, $-COCH_2-$), 5.03 (t, 1 H, —(CO)CHO—), 6.49 (br s, 2 H, NH_2), 6.80–7.18 (m, 3 H, $-OC_6H_3-$), 7.72 (s, 2 H, $C_6H_2Cl_3$), 10.10 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{31}H_{42}Cl_3N_3O_4$: C, 59.4; H, 6.8; N, 6.7. Found C, 59.8; H, 6.7; N, 6.7.

3-Oxo-*O*-[2-(3-pentadecylphenoxy)butyryl]-3-(2,4,6-trichloroanilino)propionamidoxime (6d). This was prepared from **5a** and 2-(3-pentadecylphenoxy)butyryl chloride[15] in 77% yield by following a procedure similar to that described for **6c**: mp 105–108 °C; IR (KBr) 3420, 3280, 2900, 2840, 1740, 1660, 1630, 1605 (sh), 1575, 1550, 1500 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 0.80–1.75 (m, 34 H, $C_{14}H_{29}$ and C_2H_5), 1.98 (t, 2 H, $-OC_6H_4CH_2-$), 3.33 (s, 2 H, $-COCH_2-$), 4.96 (t, 1 H, —(CO)CHO—), 6.62 (br s, 2 H, NH_2), 6.76–7.35 (m, 4 H, $-OC_6H_4-$), 7.76 (s, 2 H, $C_6H_2Cl_3$), 10.27 (s, 1 H, —NHCO—). Anal. Calcd for $C_{34}H_{48}Cl_3N_3O_4$: C, 61.0; H, 7.2; N, 6.3. Found: C, 61.4; H, 7.3; N, 6.2.

***O*-(4-Nitrophenoxyacetyl)-3-oxo-3-(2,4,6-trichloroanilino)propionamidoxime (6e).** This was prepared from **5a** and 4-nitropenoxyacetyl chloride[16] in 74% yield by following a procedure similar to that described for **6c**: mp 152–154 °C dec; IR (KBr) 3460, 3310, 3260, 1750, 1670, 1640, 1625 (sh), 1610, 1595, 1560, 1510 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 3.37 (s, 2 H, $-COCH_2-$), 5.16 (s, 2 H, $-COCH_2O-$), 6.72 (br s, 2 H, NH_2), 7.21 and 8.22 (AB q, 4 H, $OC_6H_4NO_2$), 7.72 (s, 2 H, $C_6H_2Cl_3$), 10.10 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{17}H_{13}Cl_3N_4O_6$: C, 42.9; H, 2.8; N, 11.8. Found: C, 42.8; H, 2.7; N, 11.4.

5-[1-(2,4-Di-*tert*-pentylphenoxy)pentyl]-3-[2-oxo-2-(2,4,6-trichloroanilino)ethyl]-1,2,4-oxadiazole (7c). A solution of 18 g (28.7 m mol) of **6c** in 210 mL of xylene was heated under reflux by using Dean–Stark water separator for 2 h. The solvent was evaporated under a reduced pressure, and the residual light brown oil was crystallized from hexane to give 14.4 g (82%) of **7c** as slightly tan solids: mp 128–130 °C; IR (KBr) 3250, 2950, 2880, 1680, 1600, 1580, 1560, 1520 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 0.53–2.10 (m, 31 H, C_4H_9 and $OC_6H_3C_{10}H_{22}$), 3.92 (s, 2 H, $-COCH_2-$), 5.83 (t, 1 H, >CHO—), 6.85–7.20 (m, 3 H, $-OC_6H_3-$), 7.72 (s 2 H, $C_6H_2Cl_3$), 10.27 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{31}H_{40}Cl_3N_3O_3$: C, 61.1; H, 6.6; N, 6.9. Found: C, 61.3; H, 6.7; N, 6.8.

3-[2-Oxo-2-(2,4,6-trichloroanilino)ethyl]-5-[1-(3-pentadecylphenoxy)propyl]-1,2,4-oxadiazole (7d). This compound was prepared from **6d** in 62% yield by following a procedure similar to that described for **7c**: mp 83–85 °C; IR (KBr) 3210, 2910, 2840, 1660, 1600, 1570, 1550, 1520 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 0.72–1.80 (m, 34 H, C_2H_5 and $C_{14}H_{29}$), 2.08 (t, 2 H, $-OC_6H_4CH_2-$), 3.94 (s, 2 H, $-COCH_2-$), 5.70 (t, 1 H, >CHO—), 6.77–7.35 (m, 4 H, $-C_6H_4-$), 7.72 (s, 2 H, $C_6H_2Cl_3$), 10.30 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{34}H_{46}Cl_3N_3O_3$: C, 62.7; H, 7.1; N, 6.5. Found: C, 62.7; H, 7.2; N, 6.7.

5-(4-Nitrophenoxymethyl)-3-[2-oxo-2-(2,4,6-trichloroanilino)ethyl]-1,2,4-oxadiazole (7e). This compound was prepared from **6e** in 65% yield by following a procedure similar to that described for **7c**: mp 180–181 °C; IR (KBr) 3420, 3210, 3190, 1675, 1615, 1600, 1570, 1510 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 4.02 (s, 2 H, $-COCH_2-$), 5.76 (s, 2 H, $-CH_2O-$), 7.32 and 8.27 (AB q, 4 H, $-OC_6H_4NO$), 7.71 (s, 2 H, $C_6H_2Cl_3$), 10.30 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{17}H_{11}Cl_3N_4O_5$: C, 44.6; H, 2.4; N, 12.2. Found: C, 44.8; H, 2.4; N, 12.2.

3-[[2-(2,4-Di-*tert*-pentylphenoxy)hexanoyl]amino]-1-(2,4,6-trichloropenyl)-2-pyrazolin-5-one (8c). To a stirred solution of 10 g (16.4 mmol) of **7c** in 85 mL of ethanol was added a solution of 2.2 g of potassium hydroxide in 15 mL of water. The mixture was heated under reflux for $2^1/_2$ h. The mixture was acidified with 3 mL of acetic acid, and the solvent was evaporated under a reduced pressure. The residual oil was taken up into 100 mL of toluene, washed with water and brine, dried over anhydrous magnesium sulfate, and evaporated to dryness under a reduced pressure. The residual yellow oil was crystallized from hexane to give 8.9 g (89%) of **8c** as colorless crystals: mp 98–100 °C; IR (KBr) 3390, 3230, 3170, 3070, 2950, 2870, 1725 (sh), 1690, 1615, 1570, 1550 cm^{-1}; ^{1}H NMR (Me_2SO-d_6) δ 0.52–2.10 (m, 31 H, C_4H_9 and $OC_6H_3C_{10}H_{22}$), 4.95 (t, 1 H, —(CO)CHO—), 5.98 (s, ~1 H, >C=CH—), 6.70–7.25 (m, 3 H, $-OC_6H_3-$), 7.90 (s, 2 H, $C_6H_2Cl_3$), 10.70 (br s, 1 H, —NHCO—). Anal. Calcd for $C_{31}H_{40}Cl_3N_3O_3$: C, 61.1; H, 6.6; N, 6.9. Found: C, 61.1; H, 6.6; N, 6.6.

3-[2-(3-Pentadecylphenoxy)butyramido]-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (8d). This was prepared from **7d** in 85% yield by following a procedure similar to that described for **8c**: mp 131–132 °C (lit.[15] mp 133–134 °C).

3-(4-Nitroanilino)-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (11). To a stirred mixture of 10 g (21.9 m mol) of **7e** in 100 mL of ethanol was added a solution of 12 g of potassium carbonate in 25 mL of water. The mixture was heated under reflux and the progress of reaction was monitored by TLC. After 1 h, 3-[(4-nitrophenoxyacetyl)amino]-1-(2,4,6-trichlorophenyl)-2-pyrazolin-5-one (**8e**)[9] was detected along with **7e** and **11**. After 5 h, **7e** and **8e** were not seen. The mixture was cooled to room temperature, acidified with acetic acid to pH 5.5, stirred for 1 h, and poured into 140 mL of water. The product was collected,

(12) Bouchet, P.; Elguero, J.; Jacquier, R.; Pereillo, J. M. *Bull Soc. Chim. Fr.* **1974**, 291.
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(15) Coles, R. F. U.S. Pat. 3285747, 1966, to General Aniline and Film Corp.
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washed with water and ethanol, and dried. There was obtained 6.6 g (75%) of **11** as a brown solid: mp 297–300 °C; its mp, mmp, and IR and ^{1}H NMR spectra were identical with those of an authentic sample of **11** prepared by the known method.[9]

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Registry No. **1a**, 24522-44-9; **1b**, 621-03-4; **4a**, 27241-31-2; **4b**, 4149-06-8; **5a**, 78515-46-5; **5b**, 61239-31-4; **6c**, 92694-92-3; **6d**, 92694-93-4; **6e**, 92694-94-5; **7a**, 84104-39-2; **7b**, 84104-44-9; **7c**, 84104-40-5; **7d**, 84104-41-6; **7e**, 84104-53-0; **8a**, 52472-98-7; **8b**, 2311-90-2; **8c**, 84104-31-4; **8d**, 14230-56-9; **8e**, 92694-95-6; **11**, 34320-82-6; acetic anhydride, 108-24-7; 2-(2,4-di-*tert*-pentylphenoxy)hexanoyl chloride, 63059-55-2; 2-(3-pentadecylphenoxy)butyl chloride, 62609-88-5; (4-nitrophenoxy)acetyl chloride, 20142-88-5.

Lithiation Reaction of 2,5-Dibromothiophene. ^{13}C NMR Spectra of 3-Substituted Derivatives

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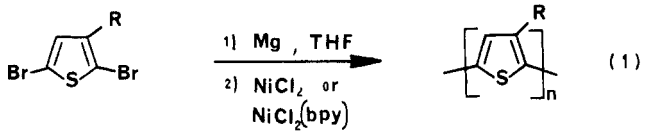
Poly(2,5-thienylenes), after doping with iodine, have been shown to exhibit significant conductivity. The polymeric materials were obtained by transition-metal-induced polymerization of the bis Grignard compounds derived from 2,5-dibromothiophene, **1**, and 2,5-dibromo-3-methylthiophene, **2**.[1] The polymeric material derived from **2** exhibited improved conductivity in comparison with that of **1** (eq 1).



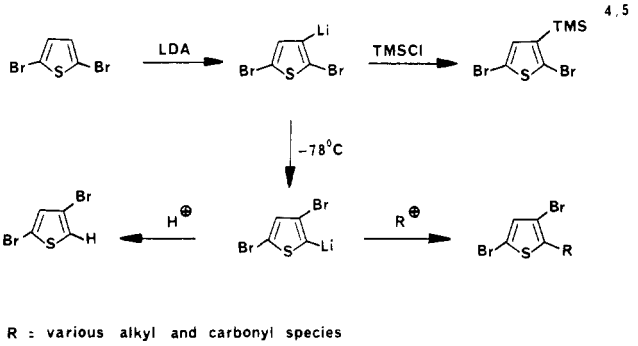
(1)

R = H (**1**), CH_3 (**2**)

Very recently we showed that conducting polymeric materials could be synthesized in a homogeneous reaction via the corresponding organolithium compounds that were obtained from either **1** or **2**.[2a,b] We also became interested in synthesizing 3-organometal-substituted poly(2,5-thienylenes) and to investigate their ability to conduct an electric current. In light of the well-documented "halogen dance" exhibited by halogenated thiophenes[3-5a] when they are treated with lithium organics, it was essential we demonstrate that **1** reacts with 2 equiv of *n*-butyllithium (the lithiation reagent used by us) to give the expected 2,5-dilithiothiophene rather than other positional isomers. We also had to show that treatment of **1** with various organometal electrophiles after lithiation with lithium diisopropylamide (LDA) gives the desired 3-substituted 2,5-dibromothiophenes. Proof of position of lithiation has now been accomplished either by transformation of the lithiated products to known compounds or by ^{1}H and ^{13}C NMR spectroscopic analysis of the 3-substituted derivatives.

The reaction of 2,5-dibromothiophene (**1**) with LDA has been studied previously.[4,5a] Thus, Davies et al.[4] found that **1** reacted with LDA, and subsequent quenching of the lithiated product with trimethylsilyl chloride gave 2,5-dibromo-3-(trimethylsilyl)thiophene, **4**. Kano et al.[5a] confirmed this result; however, they also observed formation of 2,4-dibromothiophene or 2-substituted 3,5-dibromothiophenes, respectively, when quenching the in-

Scheme I



R = various alkyl and carbonyl species

Scheme II

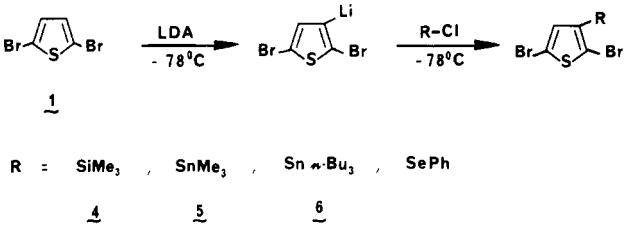


Table I. ^{13}C NMR Spectral Data for 2,5-Dibromothiophene Derivatives

compd	carbon	δ^a (ppm)	CH coupling const.,[b] Hz
1	C_2 (C_5)	111.5[c] (114.3)	$^2J = {}^3J = 7.8$
	C_3 (C_4)	130.2[c] (131.3)	$^1J = 173.5$; $^2J = 4.5$
4	C_2	116.5 (118.7)	
	C_3	137.4 (143.7)	
	C_4	134.4 (135.7)	$^1J = 178.1$
	C_5	116.5 (113.2)	
	C_6	−0.8	
5	C_2	117.9[d]	
	C_3	137.1	
	C_4	133.1	$^1J = 177.0$
	C_5	116.7[d]	
	C_6	−7.7	$^1J = 129.5$
6	C_2	117.9[d]	
	C_3	137.7	
	C_4	133.2	
	C_5	116.6[d]	
	C_6	11.4	
	C_7	28.9	
	C_8	27.2	
	C_9	13.6	

[a] $CDCl_3$ solution with δ referred to the 77.0 ppm line; precision 0.1 ppm. Values in parentheses are predicted (see text). [b] Absolute values; precision 0.5 Hz. [c] Reference 6 lists 111.4 and 130.1 ppm. [d] Assignments for C_2 and C_3 are tentative and may be reversed.[9]

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(5) (a) Kano, S.; Yuasa, Y.; Yokomatsu, T.; Shibuya, S. *Heterocycles* **1983**, *20*, 2035. (b) To check whether reacting **1** with an excess of LDA would lead to an Li–Br exchange in addition to the observed H–Li exchange, **1** in THF was treated with 2 equiv of LDA at −78 °. After hydrolysis **1** was recovered quantitatively.

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