The Synthetic Utility of Heteroaromatic Azido Compounds. Part VI. Preparation of some 1*H*-1,2,3-Triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidines

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Some 1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidines have been prepared by the reaction of active methylene nitriles with 3-azido-2-substituted thiophenes. Thus, for example the 3-carboxy derivative **5** was prepared by condensation of 3-azido-2-formylthiophene dimethyl acetal (**1**) with ethyl cyanoacetate, followed by intramolecular cyclization. Decarboxylation of **5** led to the unsubstituted parent compound **6**. The structure of the triazole-fused compounds is discussed.

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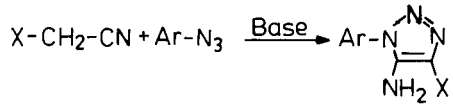
Introduction.

The base-catalyzed condensation of organic azido compounds with activated methylene compounds is a well-established route to 1,2,3-triazoles (1). In particular, it is a most convenient method for the preparation of 1-aryl-1,2,3-triazoles carrying an amino group in the 5-position and an aryl, cyano or carbonyl-containing group in the 4-position (see Scheme 1). The mechanism of this reaction can be



Scheme 1

envisaged as a nucleophilic attack by the initially generated carbanion on the terminal nitrogen of the azide, followed by cyclization to a triazoline, and subsequent aromatization (1,2). In accordance with this mechanism, electron-withdrawing groups in the azide enhance reaction, while electron-releasing groups render it more difficult.

If the aromatic azido compound contains a suitable *ortho* substituent, the amino group of the initially generated triazole can react with it in an intramolecular condensation, resulting in the formation of a fused, tricyclic triazole. This type of reaction has previously been exploited in the benzene series, starting from 2-azidonitrobenzene (2,3), 2-azidobenzoic acid (4) and 2-azidobenzonitrile (5). This paper delineates an extension of this synthetic approach by describing the synthesis of some 1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidines starting from 3-azido-2-substituted thiophenes.

Synthesis.

The key starting material was 3-azido-2-formylthiophene (6), a compound which previously has been shown to be of great synthetic value for the preparation of a number of fused thiophenes (7-10). In order to avoid any undesired byproducts resulting from a Knoevenagel condensation, the azido aldehyde was first converted to the corresponding dimethyl acetal (**1**). This was accomplished rapidly, mildly and in high yield (99%) by the method of Luche, *et al.* (11), using methanol, trimethyl *ortho*-formate and, as catalyst, praseodymium chloride. Although praseodymium chloride was not among the rare earth chlorides originally used by Luche, *et al.* it was nevertheless found to function quite satisfactorily.

Treatment of **1** in boiling methanol with phenyl acetonitrile in the presence of sodium methoxide gave the expected triazole **2** in 61% yield. Acidic regeneration of the formyl group using 50% acetic acid at room temperature led to a spontaneous, intramolecular ring closure, affording 3-phenyl-1,2,3-triazolo[1,5-*a*]-thieno[3,2-*d*]pyrimidine (**3**) in good yield (84%).

The ethoxide-promoted condensation of ethyl cyanoacetate with **1** gave a sodium salt, **4**, tentatively assigned as depicted in Scheme 2. Excess of sodium ethoxide was here found necessary in order to effect complete hydrolysis of the ester function. It should be mentioned that **4** of course also could be obtained starting directly from cyanoacetic acid. When the crude sodium salt was treated with 50% acetic acid, 3-carboxy-1,2,3-triazolo-[1,5-*a*]thieno[3,2-*d*]pyrimidine (**5**) was obtained. Efforts to purify this compound by recrystallization from toluene caused a rapid decarboxylation, thus opening a route to the unsubstituted parent compound **6**. The overall yield of **6** starting from **1** was 48%.

If only one equivalent of base was used in the reaction between **1** and ethyl cyanoacetate, a mixture of **4** and **7** resulted. Separation and treatment of the latter with acid gave 3-carbethoxy-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**8**). The overall yield of **8** starting from **1** was 15%.

The results described above are summarized in Scheme 2.

3-Azido-2-cyanothiophene (**9**) can be prepared in high yield (93%) from the corresponding azido aldehyde by the method of Streith, *et al.* (12), using hydroxylamine-*O*-sulfonic acid (HOS) in water. Another, although not as efficient and rapid, method of synthesizing this compound

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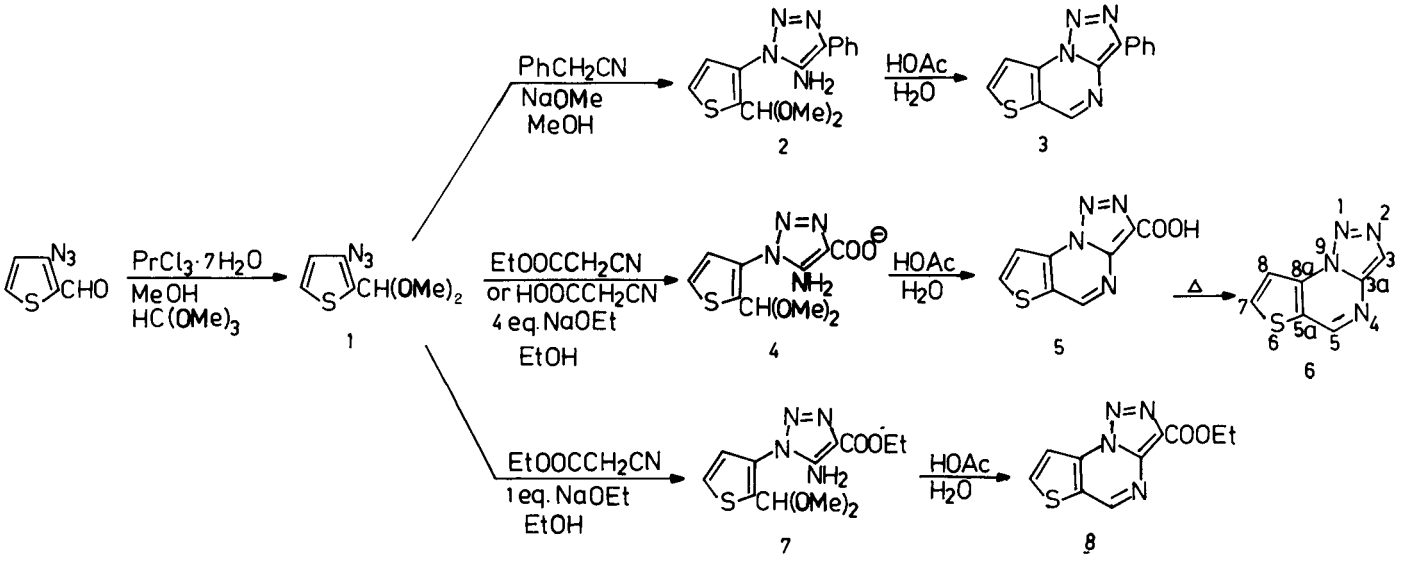
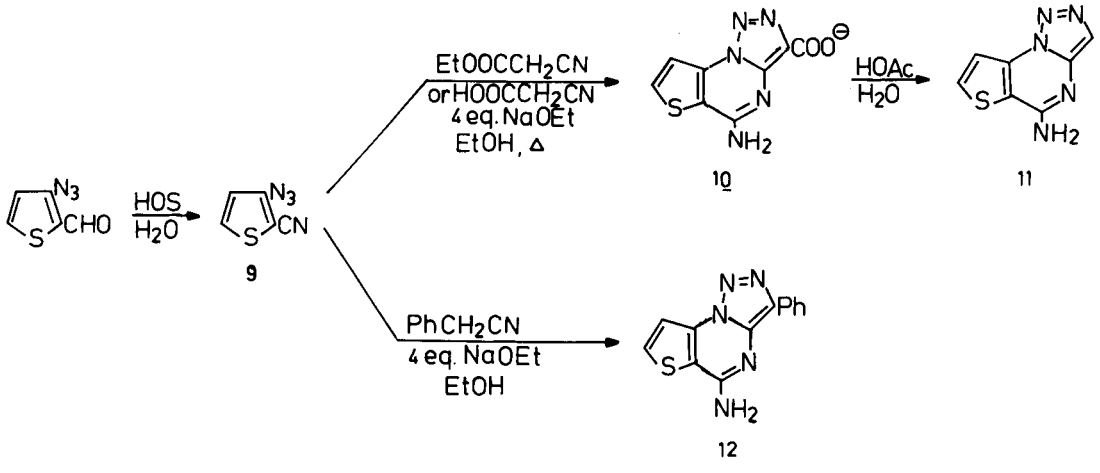


Scheme 2



Scheme 3

has previously been published (6).

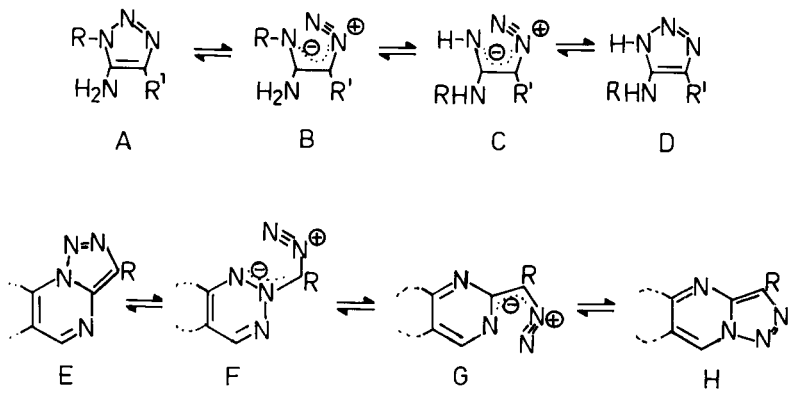
Heating of **9** with ethyl cyanoacetate or cyanoacetic acid in the presence of excess of sodium ethoxide gave a sodium salt, **10**, as the primary product. The identity of this salt is somewhat uncertain. However, the absence of C≡N absorption in its ir spectrum indicates the structure to be that depicted in Scheme 3 and not the alternative one, analogous to **4**, with a non-fused triazole unit. Thus, in this case, the intramolecular cyclization occurred prior to the acidification. Treatment of **10** with 50% acetic acid at room temperature led to a spontaneous decarboxylation, giving 5-amino-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]-pyrimidine (**11**). The ease of decarboxylation in this case is analogous to that reported by Tennant, *et al.* (5) for 5-amino-3-carboxy-1,2,3-triazolo[1,5-*a*]quinazoline. The overall yield of **11** starting from **9** was 96%. Unfortunately, mainly due to its low solubility, it was found impossible to obtain **11** in a completely pure state.

Treatment of **9** with phenyl acetonitrile at room temperature in the presence of excess of sodium ethoxide resulted in the direct formation of 5-amino-3-phenyl-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**12**) in 80% yield. Thus, also in this case the intramolecular cyclization occurred spontaneously under the conditions used, a result which is completely in agreement with the observations of Tennant, *et al.* (5) in the benzene series.

The results described above are summarized in Scheme 3.

Structural considerations.

Both fused and non-fused triazoles are known to be subject to interconversions by the Dimroth rearrangement under a variety of conditions (13-15). The equilibrium is generally established thermally, but its position may be influenced by the basicity of the solvent. The rearrange-



Scheme 4

ments relevant in this case can be depicted in generalized form as in Scheme 4.

In the case of two of the three non-fused triazoles described in the previous section, namely **2** and **7**, ^{1}H nmr and ir showed the presence of a primary amino group, thus excluding structures corresponding to D. The absence of diazo-absorption at *ca.* 2200 cm^{-1} also excluded the ring-opened structures B and C, at least at room temperature in the solid state. In the case of **4**, its high affinity to ethanol made similar spectral considerations impossible. Despite this, it seems reasonable to assume that structure A is the predominant one in all three compounds.

In the case of the fused triazoles, that is compounds **3,5,6,8,11** and **12**, the situation is not so straightforward. Although the three non-fused precursors exist in the form of A, a Dimroth rearrangement prior to or subsequent to cyclization could not *a priori* be excluded. However, the ring-opened structures, *i.e.* F and G, could also in this case be excluded, at least at room temperature in the solid state, due to the absence of diazo-absorption in ir. To differentiate between E and H proved more difficult. Neither nmr, ir or ms was able to pinpoint one of the structures in the absence of spectral data on the other one. Tennant, *et al.* (3-5) have determined the structures of a number of 5-substituted triazolo[1,5-*a*]quinazolines by degradation to known quinazolines. This procedure was not adopted in this case, partly due to the inaccessibility of suitable thienopyrimidines, partly to the fact that it is difficult to completely exclude the possibility of structural ambiguity caused by the possible operation of the Dimroth rearrangement concurrent with degradation. However, since all 1,2,3-triazolo[1,5-*a*]quinazolines studied by Tennant, *et al,* were found exclusively to have the angular structure, *i.e.* E, it seems reasonable that this also pertains to the compounds described in this paper. The preference for the angular structure (E) shown by Tennant, *et al.* could perhaps be rationalized by invoking a thermodynamically controlled reluctance to form the *ortho*-quinoid arrangement inherent in the linear structure (H).

Assuming that the structural assignment described above is correct, the ^{1}H nmr spectra of **6** and **8** were studied in order to ascertain the influence of temperature on the potential equilibrium E ⇌ H. Variable temperture ^{1}H nmr studies have previously demonstrated the occurrence of a reversible ring chain tautomerism of this type in a series of 1,2,3-triazolo[1,5-*a*]pyrimidines at elevated temperatures (14). At room temperature, the ^{1}H nmr spectrum of **6** in dimethyl sulfoxide-d_6/deuteriochloroform consisted of one doublet centered at δ 9.33 (H-5), one doublet centered at δ 8.61 (H-7), one singlet at δ 8.44 (H-3) and two doublets centered at δ 8.15 (H-8). Increasing the temperature to +95° did not appreciably change this spectrum. Between +95° and +180°, however, the signal attributed to H-3 was gradually broadened and shifted upfield (~0.5 ppm). A lesser broadening of the signal attributed to H-8 was also evident. The changes described above, which were completely reversed on cooling, may possibly be attributed to a rapid interconversion E ⇌ F ⇌ G ⇌ H at these temperatures. In the case of **8** no appreciable change occurred in its spectrum after heating at +160°. This result is somewhat unexpected, since one would assume the temperature necessary for interconversion to be lower in this case, due to enhanced stabilization of the diazo-tautomers (F and G) by the electron-withdrawing carbethoxy group.

Properties.

1,2,3-Triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**6**) is a stable crystalline solid which melts with decomposition at 205-210°. In solution, as stated in the previous section, it seems quite stable up to ~95°, and can be recovered from solutions heated for a short time at 180°. It was also found to be stable to sodium ethoxide in boiling ethanol and to prolonged heating with methyl iodide in methylene chloride. Furthermore, provided the absence of anions of high or medium nucleophilicity, **6** was also stable in acidic

media. Thus, it was found stable in concentrated sulfuric acid at room temperature (16). In the presence of nucleophiles, however, a rapid scission of the triazole ring occurred in acidic media. The exploitation of this synthetically useful scission reaction for the preparation of substituted thieno[3,2-*d*]pyrimidines is the subject of the accompanying paper (17).

Compound **6** was also found to be quite resistant to electrophilic aromatic substitution, at least under strongly acidic conditions. Thus, no proton-deuterium exchange was observed even after standing for several weeks at room temperature in concentrated deuteriated sulfuric acid. Efforts to nitrate **6** using a mixture of hot concentrated sulfuric acid and fuming nitric acid were unsuccessful. Instead scission of the triazole ring occurred upon dilution with water. Treatment with bromine in a nonpolar solvent also resulted in ring scission (17).

The reluctance of **6** to undergo electrophilic substitution in acidic media is similar, although even more pronounced, that that of simple thienopyrimidines (18).

^{13}C Nmr Data.

^{13}C Nmr data for **6** are given in the experimental part. The shifts were obtained from the proton-decoupled spectrum using tetramethylsilane as internal standard. The assignments of shifts and couplings were made as described below.

The proton-decoupled spectrum showed 7 distinct signals. The peripheral carbon atoms were assigned by comparison of the observed direct and long-range coupling constants with literature values for thiophenes (19), pyrimidines (20) and 1,2,3-triazole (21). In the proton-decoupled spectrum, three of the signals were of lower intensity, which identifies them as derived from the quaternary, bridging carbon atoms C-3a, C-5a and C-8a. It was evident from the coupled spectrum that these carbon atoms exhibited long-range couplings to the peripheral protons. A tentative assignment of C-3a was based on the known value for the long-range coupling in 1,2,3-triazole. No exact assignment of C-5a or C-8a could be made, since it is difficult to estimate the size of the mesomeric and inductive effects of the heteroatoms on these positions.

EXPERIMENTAL

The ^{1}H nmr spectra were obtained with a JEOL MH 100 high resolution spectrometer. The ^{13}C nmr spectrum was obtained at 15.04 MHz on a JEOL JNM-FX 60 spectrometer with a built-in JEOL IEC 980 A computer with 12 K memory. The ir spectra were recorded on a Perkin-Elmer model 257 instrument. Mass spectra were obtained with an LKB 9000 mass spectrometer. Elemental analyses were carried out at the Analytical Department of the Chemical Center, Lund, and by Ilse Beetz, Microanalytisches Laboratorium, Kronach, Germany.

3-Azido-2-formylthiophene dimethyl acetal (**1**).

To a stirred solution of 5.00 g. (0.0326 mole) of 3-azido-2-formylthiophene (**6**) in 75 ml. of methanol, 12.3 g. (0.0329 mole) of praseodymium chloride heptahydrate and 28.0 g. (0.264 mole) of trimethyl *ortho*formate were added. The resulting greenish mixture was stirred at room temperature for 0.5 hour and then poured into 600 ml. of saturated sodium hydrogen carbonate solution. The resulting milky suspension was extracted 4 times with 150 ml. of ether. After washing twice with 100 ml. of saturated sodium chloride solution, the combined organic phase was dried over magnesium sulfate. Removal of the solvent gave 6.41 g. (99%) of a colorless oil, which crystallized when placed in a refrigerator. An analytical sample was obtained by recrystallization from light petroleum (40-60°), m.p. ~25°; ir (potassium bromide): 2110 cm^{-1} (N_3); ^{1}H nmr (deuteriochloroform): δ 6.88 (d, 1H, H-4), 7.29 (d, 1H, H-5), 5.56 (s, 1H, CH), 3.35 (s, 3H, CH_3), $J_{4,5}$ = 5.5 Hz, ms: 199 m/e (M^+).

Anal. Calcd. for $C_7H_9N_3O_2S$: C, 42.2; H, 4.55; N, 21.1; S, 16.1. Found: C, 42.0; H, 4.42; N, 21.3; S, 16.2.

5-Amino-4-phenyl-1-(2'-dimethoxymethyl-3'-thienyl)-1*H*-1,2,3-triazole (**2**).

To a stirred solution of 6.40 g. (0.0321 mole) of 3-azido-2-formylthiophene dimethyl acetal (**1**) and 3.80 g. (0.0324 mole) of phenyl acetonitrile in 50 ml. of methanol, a solution of 2.94 g. (0.128 mole) of sodium in 50 ml. of methanol was added in one portion. The resulting mixture was refluxed for two days and then poured into 500 ml. of water. The resulting suspension was then extracted 5 times with 75 ml. of ether. The combined organic phase was washed twice with 50 ml. of water and dried over magnesium sulfate. Removal of the solvent by evaporation gave 8.2 g. of crude, red-brown product. Repeated rinsing with hot ligroin gave 6.20 g. (61%) of **2**. An analytical sample was obtained by recrystallization from toluene, m.p. 122.5-124.0°; ir: (potassium bromide): 3450, 3410, 3340 cm^{-1} (NH_2); ^{1}H nmr (DMSO-d_6): δ 7.21 (d, 1H, H-4), 7.77 (d, 1H, H-5), 7.21-7.92 (m, 5H, Ph), 5.65 (s, 1H, CH), 3.22 (s, 6H, CH_3), 5.71 (s, 2H, NH_2), $J_{4,5}$ = 5.4 Hz; ms 316 m/e (M^+).

Anal. Calcd. for $C_{15}H_{16}N_4O_2S$: C, 57.0; H, 5.10; N, 17.7; S, 10.1. Found: C, 57.3; H, 5.20; N, 17.4; S, 10.1.

3-Phenyl-1*H*-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**3**).

A solution of 7.71 g. (0.0244 mole) of **2** in 200 ml. of 50% acetic acid was stirred for 15 hours at room temperature. The precipitated solid was filtered and recrystallized from methanol, giving 5.19 g. (84%) of **3** in the form of yellow, lustrous crystals, m.p. 223-227° dec.; ^{1}H nmr (DMSO-d_6): δ 9.40 (d, 1H, H-5), 8.61 (d, 1H, H-7), 8.17 (2d, 1H, H-8), 7.34-8.51 (m, 5H, Ph), $J_{7,8}$ = 5.4 Hz, $J_{5,8}$ = 0.7 Hz, ms 252 m/e (M^+).

Anal. Calcd. for $C_{13}H_8N_4S$: C, 61.9; H, 3.20; N, 22.2; S, 12.7. Found: C, 61.8; H, 3.45; N, 22.2; S, 12.6.

1*H*-1,2,3-Triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**6**).

To a solution of 13.4 g. (0.0673 mole) of 3-azido-2-formylthiophene dimethyl acetal (**1**) and 7.64 g. (0.0675 mole) of ethyl cyanoacetate in 150 ml. of ethanol, a solution of 6.19 g. (0.269 mole) of sodium in 150 ml. of ethanol was added in one portion. The resulting mixture was stirred at room temperature for three days. The precipitated sodium salt (**4**) was removed by filtration and then stirred for 15 hours at room temperature with 500 ml. of 50% acetic acid. The yellow solid material was then collected by filtration and washed repeatedly with water, giving 8.24 g. (56%) of **5**. 3-Carboxy-1*H*-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**5**) decomposed ~120°; ir (potassium bromide): ~1700 cm^{-1} (C=O); ^{1}H nmr (DMSO-d_6): δ 9.60 (d, 1H, H-5), 8.72 (d, 1H, H-7), 8.24 (2d, 1H, H-8), $J_{7,8}$ = 5.8 Hz, $J_{5,8}$ = 0.7 Hz. Efforts to recrystallize **5** from toluene resulted in rapid decarboxylation. Thus, 8.24 g. (0.0375 mole) of **5** was refluxed for 0.5 hour in *ca.* 1 l. of toluene. The resulting solution was filtered while hot and then placed in a refrigerator. The precipitated straw-colored crystals were then collected by filtration, giving 5.68 g. (86%) of **6**, m.p. 205-210° dec.; ^{1}H nmr (DMSO-d_6/deuteriochloroform 10/1): δ 8.44 (s, 1H, H-3), 9.33 (d, 1H, H-5), 8.61 (d, 1H, H-7), 8.15 (2d, 1H, H-8), $J_{7,8}$ = 5.4 Hz, $J_{5,8}$ = 0.7 Hz; (deuteriosulfuric acid): δ 9.82 (s, 1H, H-3), 10.51 (d, 1H, H-5), 10.04 (d, 1H, H-7), 9.12 (2d, 1H, H-8), $J_{7,8}$ = 5.5 Hz, $J_{5,8}$ = 0.7 Hz; ^{13}C nmr (DMSO-d_6): δ 125.7 (d, C-3, $J_{C_3H_3}$ = 200 Hz), 147.6 (2d, C-5, $J_{C_5H_5}$ = 193 Hz, J_{C_5H} = 3.1 Hz), 139.0 (2d, C-7, $J_{C_7H_7}$ = 192 Hz, $J_{C_7H_8}$ = 6.1 Hz), 115.5 (2d, C-8, $J_{C_8H_8}$ = 180 Hz, $J_{C_8H_7}$ =

4.9 Hz), 141.1 (2d, C-3a, $J_{C_{3a}H} \approx 14$ Hz), 137.7 (m, C-5a or C-8a), 123.0 (m, C-8a or C-5a); ms: 176 m/e (M^+).

Anal. Calcd. for $C_7H_4N_4S$: C, 47.7; H, 2.29; N, 31.8; S, 18.2. Found: C, 47.9; H, 2.48; N, 31.8; S, 18.1.

5-Amino-4-carbethoxy-1-(2'-dimethoxymethyl-3'-thienyl)-1*H*-1,2,3-triazole (**7**).

To a stirred solution of 4.90 g. (0.0246 mole) of 3-azido-2-formylthiophene dimethyl acetal (**1**) and 2.94 g. (0.0260 mole) of ethyl cyanoacetate in 50 ml. of dry ethanol, a solution of 0.60 g. (0.026 mole) of sodium in 75 ml. of dry ethanol was added in one portion. The resulting mixture was stirred at room temperature for two days. The precipitated sodium salt **4** was removed by filtration and the filtrate poured into 400 ml. of ice-water. The resulting yellow precipitate was collected by filtration, giving 1.74 g. (23%) of **7**. An analytical sample was obtained by recrystallization from a small amount of toluene, m.p. 125.0-128.0° (solidifies and melts again at 205.0-208.0°): ir (potassium bromide): 3430, ~3200 cm^{-1} (NH_2), 1670 cm^{-1} (C=O); ^1H nmr (DMSO-d_6): δ 7.78 (d, 1H, H-5), 7.20 (d, 1H, H-4), 5.30 (s, 1H, CH), 3.20 (s, 6H, CH_3), 4.15 (q, 2H, CH_2CH_3), 1.30 (t, 3H, CH_2CH_3), 6.50 (s, 2H, NH_2), $J_{4,5} = 5.3$ Hz, $J_{CH_2CH_3} = 7.0$ Hz.

Anal. Calcd. for $C_{12}H_{16}N_4O_4S$: C, 46.2; H, 5.16; S, 10.3; N, 17.9. Found: C, 46.0; H, 5.30; S, 10.1; N, 18.1.

3-Carbethoxy-1*H*-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**8**).

A solution of 1.81 g. (0.00579 mole) of **7** in 150 ml. of 50% acetic acid was stirred at room temperature for 4 hours. The precipitated solid was collected by filtration and recrystallized from ethanol giving 0.95 g. (66%) of **8**, m.p. 205-210° dec.; ir (potassium bromide): 1700 cm^{-1} (C=O); ^1H nmr (DMSO-d_6): δ 9.61 (s, 1H, H-5), 8.73 (d, 1H, H-7), 8.24 (d, 1H, H-8), 4.46 (q, 2H, CH_2CH_3), 1.39 (t, 3H, CH_2CH_3), $J_{7,8} = 5.4$ Hz, $J_{CH_2CH_3} = 7.0$ Hz; ms: 248 m/e (M^+).

Anal. Calcd. for $C_{10}H_8N_4O_2S$: C, 48.4; H, 3.25; S, 12.9; N, 22.6. Found: C, 48.5; H, 3.27; S, 13.2; N, 22.7.

3-Azido-2-cyanothiophene (**9**).

To a stirred suspension of 8.00 g. (0.0522 mole) of 3-azido-2-formylthiophene (**6**) in 50 ml. of water, a solution of 7.07 g. (0.0625 mole) of hydroxylamine-*O*-sulfonic acid in 25 ml. of water was added in one portion. The resulting mixture was stirred at ~30° until all solid material had dissolved, and was then heated for 0.5 hour at 40-50°. After cooling in a refrigerator, the precipitated crystals were collected by filtration and rinsed with water. This gave 7.32 g. (93%) of **9** with m.p. 77.0-78.5° (lit. value (6) 77.5-79.0°). The spectral data were identical with those previously reported (6).

5-Amino-1*H*-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**11**).

To a solution of 5.50 g. (0.0366 mole) of 3-azido-2-cyanothiophene (**9**) and 3.11 g. (0.0366 mole) of cyanoacetic acid in 75 ml. of ethanol, a solution of 3.37 g. (0.146 mole) of sodium in 75 ml. of ethanol was added in one portion. Almost immediately, a gelatinous solid separated and the mixture was then refluxed for 2.5 hours. After cooling in a refrigerator, the precipitated sodium salt **10** was collected by filtration and dried. No CN-absorption was evident in the ir spectrum (potassium bromide) of this compound. The sodium salt was then stirred at room temperature overnight in 250 ml. of 50% acetic acid. The greyish solid material was filtered off and washed repeatedly with water. This gave 6.73 g. (96%) of **11** in form of a grey, hard and brittle cake. Due to its low solubility in most organic solvents, it was found impossible to obtain **11** in analytical purity, dec. ~250°; ir (potassium bromide): 3410, 3320, 3200 cm^{-1} (NH_2); ^1H nmr (DMSO-d_6): δ 7.64 (s, 1H, H-3), 8.34 (d, 1H, H-7), 7.96 (d, 1H, H-8), 7.60 (s, 2H, NH_2), $J_{7,8} = 5.4$ Hz; ms: 191 m/e (M^+).

3-Phenyl-5-amino-1*H*-1,2,3-triazolo[1,5-*a*]thieno[3,2-*d*]pyrimidine (**12**).

To a solution of 2.00 g. (0.0133 mole) of 3-azido-2-cyanothiophene (**9**) and 1.60 g. (0.0137 mole) of phenylacetonitrile in 25 ml. of methanol, a solution of 1.23 g. (0.0535 mole) of sodium in 25 ml. of methanol was added in one portion. The resulting mixture was stirred at room temperature over night, and then cooled in a refrigerator. The precipitated crystals were collected by filtration, giving 2.90 g. (82%) of **12**. An analytical sample was obtained by recrystallization from methanol, m.p. 225-235° dec.; ir (potassium bromide): 3390, 3330, 3200 cm^{-1} (NH_2); ^1H nmr (DMSO-d_6): δ 8.26 (d, 1H, H-7), 7.96 (d, 1H, H-8), 7.12-8.47 (m, 5H, Ph), 7.70 (s, 2H, NH_2), $J_{7,8} = 5.6$ Hz; ms 267 m/e (M^+).

Anal. Calcd. for $C_{13}H_9N_5S$: C, 58.4; H, 3.39; N, 26.2; S, 12.0. Found: C, 58.2; H, 3.45; N, 26.0; S, 11.9.

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