Adventures with S,N-Heterocycles

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4,5-Dichloro-1,2,3-dithiazolium chloride (Appel salt) 1, which is readily prepared from chloroacetonitrile and disulfur dichloride, is a useful reagent for the preparation of various 4-chloro-5H-1,2,3-dithiazoles 2. Appropriately substituted 5H-dithiazoles 2 are useful precursors to an increasing variety of cyano-substituted heteroarenes. During our investigations on the chemistry of 1,2,3-dithiazoles, we investigated the reaction of Appel salt 1 with 5-aminopyrazoles. 1,3-Dimethyl-5-aminopyrazole gives as main products 6H-pyrazolo[3,4-c]isothiazole-3-carbonitrile 3 and 4-chloro-N-(pyrazol-5-yl)-5H-1,2,3-dithiazol-5-imine 4 the ratio of which can be modified by adjusting the pH of the reaction medium. Single crystal X-ray crystallography supports the structure of 4,6-dimethyl-6H-pyrazolo[3,4-c]isothiazole-3-carbonitrile 3 which was previously misassigned, in the literature, as the 4,6-dimethyl-1H-pyrazolo[3,4-d]thiazole-5-carbonitrile 5. Furthermore, thermolysis of 4-chloro-N-(pyrazol-5-yl)-5H-1,2,3-dithiazol-5-imine 4 gives the correct 1H-pyrazolo[3,4-d]thiazole-5-carbonitrile 5. During our investigation on the thermolysis of pyrazolimine 4 we also observed the formation of 1,2,4-dithiazine 6. The rarity of this ring system prompted us to investigate its formation further and we developed a two-step one-pot procedure for accessing these systems in good yield. The 1,2,4-dithiazine 6 thermolyzed to give the pyrazolo[3,4-d]thiazole 5 in quantitative yield. During our investigations for the formation of the 1,2,4-dithiazine 5 we encounter another interesting ring transformation on reaction of dithiazolimine 4 with 1,4-diazabicyclo[2.2.2]octane (DABCO). The reaction gives 4-[N-(2-chloroethyl)piperazin-1-yl]-5H-1,2,3-dithiazole 7. Optimized reaction conditions are developed and applied to a variety of 4-chloro-5H-1,2,3-dithiazoles 2. The products are obtained in very good yields and can be further manipulated on the 2-chloroethyl moiety by reaction with various nucleophiles leaving intact the dithiazole ring.