## HETEROCONDENSED URACIL BETAINES BY THREE COMPONENT REACTION: IMINOPHOSPHORANE, HETEROARENE, ISOCYANATE<sup>1</sup>

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Summary: 1,3-Dimethyl-6(triphenylphosphoranylideneamino)uracil 1 affords with pyridines and the isocyanates 2a-f in a novel type of a three component reaction pyrido[1,2-f]pyrimido-[4,5-d]pyrimidines 5a-h (X-ray analysis of 5a).

Recently, we have reported on a simple procedure for annulating a pyrimidine ring to an existing heterocyclic molecy, via iminophosphoranes.<sup>2</sup> By this means, uracils give pyrimido-[4,5-d]pyrimidines;<sup>3</sup> these versatile reactions supplement our synthetic strategy of tailor made heterocycles starting from heterocyclic ß-enamino esters and their iminophosphoranes.<sup>5</sup>

In the course of heterocyclic syntheses with dihalogentriphenylphosphoranes<sup>1</sup> combined with studies on 6-aminouracil,<sup>6</sup> upon treatment of 1,3-dimethyl-5(triphenylphosphoranylidene-amino)uracil **1** with isocyanates 2a-f in pyridine (as solvent), we have found a surprising-ly simple and versatile three component reaction leading to novel types of heterocondensed uracils 5a-h (*cf.* Scheme 1).

In an one-pot procedure, carbodiimides  $\exists$  are generated in situ by Aza-Wittig reaction from the highly polarized uracil 1, 6, 7 followed by a spontaneous addition to pyridine, present originally as solvent. The reaction proceeds presumably via an 1,6-dipolar pyridinium ylide 4B to form the tricycle 4A which in turn is dehydrogenated to afford the yellow to orange colored, novel pyrido[1,2-f]pyrimido[4,5-d]pyrimidines 5a-f; from these, 5e exhibits a remarkably strong fluorescence. This reaction course represents a fundamentally new type of heteroannulation. The structure of 5a was established by an X-ray<sup>8</sup> diffraction analysis of crystals obtained from ethanol (cf. Figure 1).

Following from this analysis, 5a exists as a totally planar molecule ( e.g. torsion angle at N(14) (plot): 0.0°). Similar to several studies of Potts et al.<sup>9</sup> on cross and pseudocross con-





11

-R

11a 115

4N 40

ıзĊH<sub>3</sub>

<sup>12</sup>CH



3







Figure 1. X-ray crystal structure of  $5a^8$ 

jugated mesoionic betaines, it can be assumed that 5a-h can be described also in zwitterionic canonical formulae. This is *i.a.* supported by some bond lengths:<sup>9</sup> thus, the bond C(5)-C(9) shows  $\sigma$ -character with  $\pi$ -contributions (142.2(4) pm) and the bond C(14)-N(14) is extremely long (147.5(4) pm) signifying no  $\pi$ -overlap between pyridine ring and C(14). With increasing polarity of the solvent, the UV-absorption maxima shift to shorter wavelengths indicating a charge separation in the ground state of the molecule  $^{10}$  ln 5a-h, the low field shift of 8-H (9.31-10.29 ppm) 9-H (7.93-8.12 ppm), and 11-H (9.31-9.85 ppm) in the  $^{1}$  H NMR spectra may be explained by anisotropic effects caused by C=O and C=N groups, respectively, but as well as by a positive polarization of the pyridine moiety.

This three component reaction can also be transferred to substituted pyridines, as e.g. ethyl nicotinate and 4-picoline, and the tricycles **5g**, **5h** are smoothly formed:



At present, pyridine alkaloids, such as nicotine and anabasine, are studied as heteroarene components in this synthesis of uracil betaines; additionally, we have found that this novel heteroannulation can be easily transferred also to other  $6 \pi$ -heteroarenes and their benzo derivatives. Further investigations and additional aspects of this generally applicable reaction will be the subject of a forthcoming publication.

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- All new compounds were characterized unambiguously by IR, <sup>1</sup>H NMR, <sup>13</sup>C NMR, MS and 8. elemental analyses. Representative spectral properties of 5a follow: Yield: 41%; m.p. 211°C; <sup>1</sup>H NMR(90 MHz, CDCl<sub>3</sub>):  $\delta$  = 3.38(s, 3H, 12-H), 3.45(s, 3H, 13-H), 7.00-7.43 (m, 6H, 10-H, H<sub>ar</sub>), 7.93 (ddd,  ${}^{3}J$  = 7.9, 7.0;  ${}^{4}J$  = 2.0 Hz; 1H, 9-H), 9.66 (dd,  ${}^{3}J$  = 8.4;  ${}^{4}J$  = 2.0 Hz; 1H, 11-H), 9.80(dd;  ${}^{3}J$  = 7.9;  ${}^{4}J$  = 2.0 Hz; 1H, 8-H);  ${}^{13}C$  NMR(90 MHz, CDCl<sub>3</sub>): 6 = 28.06 (C-12), 29.48 (C-13), 85.41 (C-11b), 118.01 (C-16), 122.64 (C-18), 123.61 (C-11), 128.53 (C-17), 132.61 (C-10), 140.47 (C-8), 144.13 (C-15), 147.24 (C-6), 151.51 (C-3), 153.26 (C-4a), 156.01 (C-11a), 160.31 (C-1); IR (KBr):  $\bar{\nu}$  [cm<sup>-1</sup>] = 1700 (m, CO), 2945 (w), 3100 (w), 1618, 1575 (s); UV (CH<sub>2</sub>Cl<sub>2</sub>):  $\lambda_{max}$  [nm](log  $\varepsilon$ ) = 420, 342, 250, 233, 225, 218 (3.77, 4.18, 4.29, 4.32, 4.54, 4.32); MS (70 eV): m/z 333 (M<sup>+</sup>, 100%); HR-MS: 333.1227 (Diff. 0.0000). - Crystallographic data have been deposited at the Fach= informationszentrum Karlsruhe, Gesellschaft für wissenschaftlich-technische Information mbH D-7514 Eggenstein-Leopoldshafen 2, and can be obtained referring to the code No. CSD 320 265 , the author's names, and the citation of this work. Some crystal data for  $\mathbf{5a}$  :  $C_{18}H_{15}N_5O_2$ ; M = 333.4; P2<sub>1</sub>/a; Z = 4; a = 9.168(1), b = 17.786(3), c = 9.447(2) Å; ß = 92.40(1)°; V = 1539.1(4) Å<sup>3</sup> ;  $\mu$  (Mo<sub>Ka</sub>) = 0.09 mm<sup>-1</sup>,  $\lambda$  = 0.71073 Å ; T = 298 K. Siemens R3m/V diffractometer. 2  $\Theta_{max}$  = 50°, 2717 symmetry independent reflexes, 1716 with F > 4.0  $\sigma$  (F). The structure was solved (direct methods) and refined (226 parameters) with SHELXTL PLUS (VMS). Refinement with full-matrix least-squares, H-atoms refined by "riding" model; R = 0.051, R<sub>w</sub> = 0.053 (  $\omega^{-1} = \sigma^2(F) + 0.0006 F^2$ ).
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- 10. For **5a**:  $\lambda_{max}$  [nm] 420 (CH<sub>2</sub>Cl<sub>2</sub>)  $\rightarrow$  408 (CH<sub>3</sub>OH).

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