phase for the investigated halogenoamines (based on AM1 calculation data): $NH_3 > NH_2I > NH_2Br \sim NHI_2 > NH_2Cl > NI_3 \sim NH_2F > NHBr_2 > NBr_3 > NHCl_2 > NHF_2 \sim NCl_3 > NF_3$.

It is known that the PA energy of a base correlates with Taft's σ-contants,[17] the electronegativity of the substituents at nitrogen,[18] the ionization potential of molecules,[19] or on the charge on the acidic proton after protonation of the base.[20] A linear dependence was observed of the calculated PA's on the sum of the Pauling electronegativities of the substituents at nitrogen (coefficient of correlation $r = 0.98$) [eqn. (2)] or on the charge on the proton after protonation ($r = 0.97$, see Table 1) [eqn. (3)].

$$PA = -55.78EN + 1199.18 \quad (2)$$

(EN = sum of electronegativity of substituents at nitrogen.)

$$PA = -2344.75Q + 1460.43 \quad (3)$$

(Q = charge on proton after protonation of nitrogen.)

The dependence of the PA values on the electronegativities of the substituents may be used for the estimation of the PA values of nitrogen in the mixed halogenoamines.

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A Novel Microbial Transformation of γ-Carboline Derivative 3,6-Dimethyl-9-[2-(2-methylpyrid-5-yl)ethyl]-1,2,3,4-tetrahydro-γ-carboline

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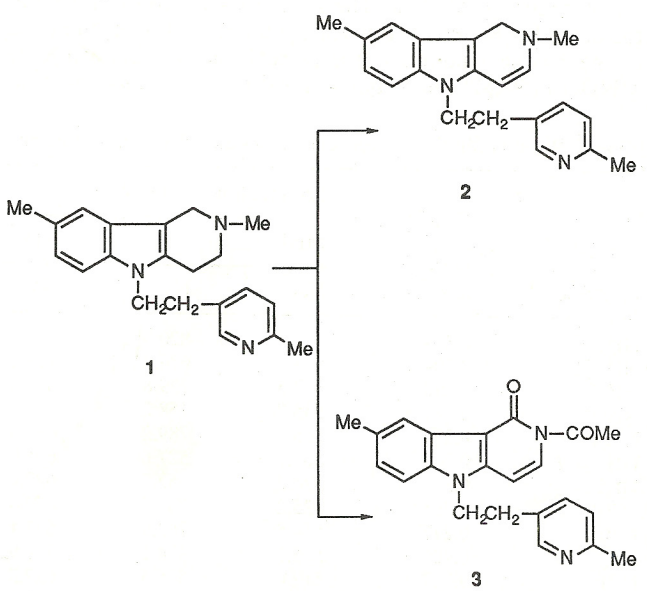
The transformation of 'Dimebon', a γ-carboline derivative, has been accomplished by *Penicillium simplicissimum* and involves dehydrogenation of the γ-carboline ring, followed by *N*-demethylation, formation of a carbonyl group at C-4 and *N*-acetylation.

Microbial transformation is known to provide both a model process for drug metabolism in animals and in humans, and also a method for the synthesis of potentially physiologically active metabolites.[1]

Thus, the biotransformation of the carcinostatic drug acronicine by *Cunninghamella bainieri* ATCC 9244 and *C. echinulata* NRRL-3655,[1,2] along with the transformation of nalidixic acid by *Penicillium adametzi* 737,[3] completely mimics the metabolism of these compounds in humans and animals. In all cases the hydroxy derivatives were obtained in 30–60% yields.

To our knowledge, the microbial transformation of γ-carboline derivatives has never been described previously. We have investigated the transformation of 3,6-dimethyl-9-[2-(2-methylpyrid-5-yl)ethyl]-1,2,3,4-tetrahydro-γ-carboline **1**, which possesses strong antihystaminic activity (USSR trade mark 'Dimebon').[4]

In order to achieve the transformation, we chose the following fungal cultures: *Beauveria bassiana* ATCC 7159 which is able to transform β-carboline derivatives,[5] along with *Aspergillus niger* VKMF-1119, *A. awamori* VKMF-758, *B. bassiana* VKMF-3111D, *C. verticillata* VKPMF-430 and *P. simplicissimum*, which perform stereoselective hydroxylation of ethylpyridines[6] and of 1-benzoylpiperidine.[7] Biotransformations were carried out following the known methods for culture growth and with previously grown cells.[6] *P. simplicissimum* proved to be the only species among those listed capable of transforming **1**. From a



Scheme 1

chloroform extract of the fermentation medium two products **2** and **3** were isolated in 10% yields by column chromatography. Both differ distinctly from **1** in their chromatographic properties [**2**: R_f 0.25, **3**: R_f 0.17; solvent system ethanol–aqueous ammonia (5:4)] (Scheme 1).

The IR spectrum of **2** showed a weak band at 1600 cm^{-1} ($\nu_{C=C}$) and no absorption in the 3200–3600 cm^{-1} region, ruling out the possibility of the involvement of the hydroxylation process. The mass spectrum of **2**† showed that the β-pyridylethyl moiety was left unchanged, but the mass of the molecular ion was 2 amu less than that of **1**. The latter fact made us think that **2** is the dehydrogenation product of **1**. This hypothesis also explains the high intensity of the (M − H)† peak in the mass spectrum of **2** due to hydrogen loss from the dihydropyridine ring. A similar enzymatic dehydrogenation was noted in the biotransformation of the alkaloid glaucine by *Fusarium solani* ATCC 12823.[8] Analogous processes are known to take place in humans.[9]

The IR spectrum of **3** showed no absorption in the 3200–3600 cm^{-1} region, but there were two carbonyl bands at 1650 and 1715 cm^{-1}. The mass of the molecular ion of **3**† and the fragmentation pattern showed that the β-pyridylethyl moiety was still intact and that a carbonyl and an acetyl group had been introduced into the γ-carboline ring. All the conclusions drawn from the IR and MS data are in agreement with the structure proposed for **3**. Compound **3** may have been produced by demethylation of **2** followed by oxidation of C-4 of the carboline ring and acetylation of the nitrogen atom. Such processes also take place during the biotransformation of the alkaloid vindoline by *Streptomyces albogriseus* NRRL 5748 and of α-tetrandine by *C. blakesleeana* 8688a.[8] Demethylation of nicotine and of doxylamine has been observed previously in humans,[9] and microbial *N*-acetylation is described, for example, by Kieslich.[10]

In conclusion, the microbial transformation of the γ-carboline antihystaminic drug 'Dimebon' by *P. simplicissimum* involves the dehydrogenation of its saturated ring followed by demethylation, *C*-oxidation and *N*-acetylation, unlike the known biotransformation of similar heterocycles such as β-carboline.

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† *Mass spectrum* of compound **2**: *m/z* (rel. intensity, %) 317(34) (M), 316(100) (M − H), 315(12) (M − 2H), 210(9) (M − H − C_7H_8N), 209(14) (M − 2H − C_7H_8N), 195(22) (M − 2H − $C_8H_{10}N$), 120(9) ($C_8H_{10}N$), 119(8) (C_8H_9N).

For **3**: *m/z* (rel. intensity, %) 359(19) (M), 317(22) (M − C_2H_2O), 316(36) (M − C_2H_3O), 289(100) (M − C_2H_2O − CO), 183(22) (M − C_2H_2O − CO − C_7H_8N), 170(18) (M − C_2H_2O − CO − C_8H_9N), 120(32) ($C_8H_{10}N$).

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Saturated Vapour Pressure and Enthalpy of Sublimation of Germanium

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The vapour pressure of germanium has been determined over the temperature interval 1134–1647 K.

The literature data[1–5] on the sublimation enthalpy of germanium (Table 1) are in sharp contradiction with the values that have been calculated from the dissociation energy of GeS(g) and the enthalpies of formation and sublimation of GeS(cr) (see ref. 7, pp. 307 and 342).

We measured the vapour pressure of crystalline and liquid germanium over a wide temperature interval because the enthalpy of sublimation of germanium is the key value in the thermochemistry of the gaseous compounds of germanium. The vapour pressure over solid germanium has been measured for the first time.

The vapour pressure of germanium was determined by means of an integral variant of the Knudsen method in a hydrocarbon-free vacuum 10^{-6}–10^{-7} Pa. The operating principle and design of the device have been described previously.[8] The effusion cell and the diaphragm were of graphite MPG-6

Table 1 Enthalpy of sublimation of germanium according to data obtained by various authors

Author, ref.	Method	No. of measurements	Temp. range T/K	Enthalpy of sublimation at 298.15 K/kJ mol^{-1}	
				2nd Law	3rd Law
Searcy, 1	Knudsen	13	1510–1882	389 ± 25	371.7 ± 1.2
Searcy, 2	Knudsen	6	1418–1686	350 ± 54	375.1 ± 3.3
Searcy, 3	Knudsen	10	1608–1885	398 ± 23	379.5 ± 1.1
	Torsional	10	1608–1885	367 ± 47	377.3 ± 1.9
Nesmeyanov, 4	Open crucible	4	1270–1403	363 ± 59	378.1 ± 2.6
Tseplyaeva, 6	Knudsen	68	1263–1647	370 ± 7	367.4 ± 0.3
Timokhin, 5	Knudsen	4	1450–1755	362 ± 73	375.0 ± 5.0