2H-furo-[3,2-b]pyran-2-one. The NMR. spectrum of **5** revealed signals at $\delta_{TMS}^{DMSO\text{-}d_6}$ 0.70, 0.83 (*s*, 2 gem. CH_3), 1.06 (*t*, CH_3–CH_2, $J = 7.5$ Hz), 1.60 (*m*, CH_3–CH_2), 1.70 (*d*, CH_3–CH=, $J = 7$ Hz), 2.60 (*t*, H-3, $J = 7$ Hz), 3.55 (broad, H-7), 4.10 (*d*, H-5, $J = 7$ Hz), 4.16 (*d*, H-7a, $J_{7,7a} = 4$ Hz), 5.49 (*dq*, CH_3–CH=, $J = 11$ and $J = 7$ Hz), 5.60 (*dd*, CH_3–CH$\overset{c}{=}$CH–CH$\overset{t}{=}$CH–, $J = 6$ and $J = 15$ Hz), 6.00 (*tq*, CH_3–CH$\overset{c}{=}$CH–, $J = 11$ and $J = 1.5$ Hz), 6.50 (*dd*, CH_3–CH$\overset{c}{=}$CH–CH$\overset{t}{=}$CH–, $J = 11$ and $J = 15$ Hz). Catalytic reduction of **5** gave **6a** in quantitative yield establishing the absolute stereochemistry of **6a** as that of **5**. Compound **5** exhibited λ_{max}^{EtOH} 233 nm (ε 26,800) with shifts to 233 nm (ε 27,200) and 260 nm (ε 15,700) in 0.1 N ethanolic NaOH due to conversion of **5** to **7**. Formally, compound **5** can be considered as a derivative of the hypothetical acid **1**, 2-deoxy-2-C-ethyl-6,6-di-C-methyl-7-[1(*trans*),3(*cis*)-pentadienyl]-L-*galacto*-3-heptulosonic acid, named L-goldinonic acid. The established absolute stereochemistry of tetrahydro-L-goldinonolactone **6a** permits assignment of the 3(*S*) configuration in compounds **3** and **4**.

The facile liberation of **5** from the antibiotic and **6a** from its reduced form under mild acidic conditions suggests an acid-labile linkage in the parent substance; the ease of cleavage is due to anchimeric participation of the axial hydroxyl group of the substrate, resulting in the concomitant formation of a γ-lactone.

In addition to **5**, mild acetic acid treatment of antibiotic X-5108 liberated an amine, termed goldinamine. The immediate precursor of **5** can thus be regarded as **2b**. The presence of a hemiketal in the antibiotic, suggested by the absence of a ketone absorption in the IR. spectrum, indicates possible isomerism of **2b** and **2c** *via* **2a**. The partial structure of antibiotic X-5108 is thus represented by **2b** and **2c**. Although a mechanism leading to inversion at the carbon atom bearing the ethyl group has been demonstrated by conversion of **5** to **7** and **6a** to **8**, the 97% yield of **6a** from the antibiotic confirms the preponderance of the 3(*S*) configuration of **5** in the antibiotic.

BIBLIOGRAPHY

[1] *J. Berger, H. H. Lehr, S. Teitel, H. Maehr & E. Grunberg*, J. Antibiotics, in press (1972).
[2] *A. L. Pape*, Ph.D. Thesis, Georgia Inst. Technol., 1971.

309. Antibiotic X-5108. III[1]). Structure of the Chromophore

Preliminary Communication

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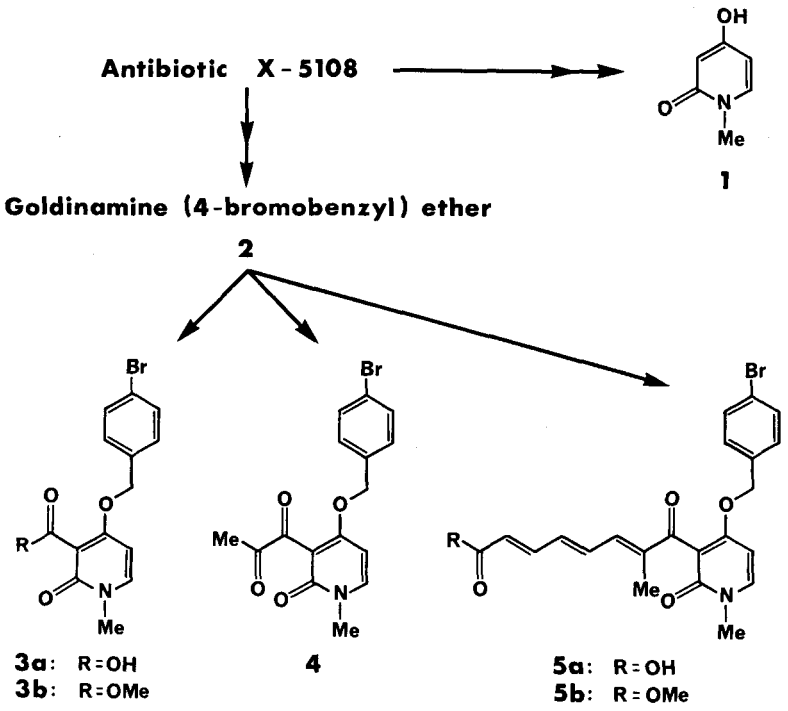
Zusammenfassung. Antibioticum X-5108 wurde in den 4-Brombenzyläther übergeführt, der, durch oxydative Spaltung mit Perjodat, eine Carbonsäure (**5a**) lieferte, deren UV.-Spektra im langwelligen Bereich denen des Antibioticums ähnlich sind. Der Chromophor des Antibioticums

[1]) Part II, s. [1].

ist somit mit der Carbonsäure **5a** verwandt, die als 8-[4-(4-Brombenzyloxy)-1,2-dihydro-1-methyl-2-oxo-3-pyridyl]-7-methyl-8-oxo-2(*trans*),4(*trans*),6(*trans*)-octatriensäure identifiziert wurde.

The hydrogenated antibiotic sodium salt, heated in aqueous ethanol, liberated *1-methyl-4-hydroxy-2*(1H)*-pyridone* **1** [2], isolated as colorless prisms[2]), mp. 168–170°, pK_a 1.30 and 6.68 (water), $C_6H_7NO_2$, calcd. mol. wt. 125; found: *m/e* (%) 125 (100), $\delta_{TMS}^{CD_3OD}$ 3.45 (*s*, CH_3), 5.84 (*d*, H-3, $J_{3,5} = 3$ Hz), 6.02 (*dd*, H-5, $J_{3,5} = 3$ and $J_{5,6} = 8$ Hz), 7.46 (*d*, H-6, $J_{5,6} = 8$ Hz). The involvement of the dissociable enolic hydroxyl group of **1** in the acid function of the antibiotic was suggested by similar pK_a values. Thus, the antibiotic sodium salt was reacted with 4-bromobenzyl bromide to yield a neutral mono(4-bromobenzyl) ether of the antibiotic which, upon treatment with acetic acid, afforded L-goldinono-1,4-lactone-3,7-hemiketal [1] and the 4-bromobenzyl ether of goldinamine, **2**.

Oxidation of **2** with periodate and permanganate yielded *4-(4-bromobenzyloxy)-1-methyl-1,2-dihydro-2-oxopyridine-3-carboxylic acid*, **3a**, as colorless prisms, mp. 224°, calcd. for $C_{14}H_{12}BrNO_4$ mol. wt. 338, found: *m/e* (%) 337, 339 (9), 169, 171 (100), $\delta_{TMS}^{CD_3OD,\ ND_3}$ 3.45 (*s*, CH_3), 5.14 (*s*, CH_2), 6.29 (*d*, H-5, $J_{5,6} = 8$ Hz), 7.36, 7.46 (AA', BB', 4, $J_o = 9$ Hz), 7.48 (*d*, H-6, $J_{5,6} = 8$ Hz), $\lambda_{max}^{2\text{-propanol, 1\% DMSO}}$ 255 (ε 5060), 308 (ε 7200), λ_{max} 258 (ε 5180), 306 (ε 6530) in 0.1N HCl containing 1% DMSO, 293 (ε 6000) at pH 7 and 293 nm (ε 5960) in 0.1N KOH containing 1% DMSO. Acid **3a** was converted to colorless needles of methyl ester **3b**, mp. 180°, $C_{15}H_{14}BrNO_4$, calcd.



[2]) Satisfactory elemental analyses were obtained for all crystalline compounds.

mol. wt. 352; found: *m/e* (%) 351, 353 (16), 169, 171 (100). Ozonolysis of **2** gave colorless needles of *4-(4-bromobenzyloxy)-1-methyl-3-pyruvoyl-2(1H)-pyridone* **4**, mp. 193–194°, $C_{16}H_{14}BrNO_4$, calcd. mol. wt. 364; found: *m/e* (%) 320, 322 (41) ($M^+ - CH_3CO$), 169, 171 (100), $\delta_{TMS}^{CDCl_3}$ 2.44 (*s*, CH_3CO), 3.50 (*s*, CH_3–N), 5.17 (*s*, CH_2), 6.12 (*d*, H-5, $J_{5,6} = 8$ Hz), 7.52 (*d*, H-6, $J_{5,6} = 8$ Hz), 7.34, 7.58 (AA', BB', 4, $J_o = 9$ Hz), $\lambda_{max}^{2\text{-propanol}}$ 222 (ε 25,400), 266/7 (ε 4000) and 338 nm (ε 7000).

Treatment of **2** with periodate liberated a yellow, acidic fragment **5a** which crystallized as a 1:1 adduct with chloroform. Crystals of **5a** are monoclinic, space group $P2_1/a$, with unit cell dimensions of a = 14.107, b = 22.497, c = 8.128 Å, β = 91.37°, d_{obs} = 1.47 g cm^{-3}. The structure was determined by single crystal X-ray analysis. The final R value is 4.8% after full matrix least square refinement with all atoms anisotropic except hydrogen.

Oxidation product **5a**, *8-[4-(4-bromobenzyloxy)-1,2-dihydro-1-methyl-2-oxo-3-pyridyl]-7-methyl-8-oxo-2,4,6-octatrienoic acid*, mp. 220–222°, $\delta_{TMS}^{DMSO\text{-}d_6}$ 1.94 (*s*, CH_3–C=), 3.36 (*s*, CH_3–N), 5.16 (*s*, CH_2), 5.98 (*d*, H-2, $J_{2,3} = 15$ Hz), 6.35 (*d*, H-5', $J_{5',6'} = 7.5$ Hz), 6.67 (*dd*, H-4, $J_{3,4} = 11$ and $J_{4,5} = 14$ Hz), 6.81 (*d*, H-6, $J_{5,6} = 11$ Hz), 7.13 (*dd*, H-5, $J_{4,5} = 14$ and $J_{5,6} = 11$ Hz), 7.20, 7.48 (AA', BB', 4, $J_o = 8.5$ Hz), 7.32 (*dd*, H-3, $J_{2,3} = 15$ Hz and $J_{3,4} = 11$ Hz), 7.76 (*d*, H-6', $J_{5',6'} = 7.5$ Hz), exhibits UV. spectra similar to that of the antibiotic, λ_{max} (ε) 209 (39,400), 225 infl. (24,000), 296 infl. (16,300), 332 (40,200) in 0.1N HCl; 209 (41,400), 225 infl. (27,200), 269 infl. (16,500), 341 (40,300) at pH 7; 225 infl. (27,200), 296 infl. (16,800) and 341 nm (41,600) in 0.1N KOH. Acid **5a** was converted to the *methyl ester*, **5b**, yellow needles, mp. 164°, $\delta_{TMS}^{DMSO\text{-}d_6}$ 1.98 (*s*, CH_3–C=), 3.34 (*s*, CH_3–N), 3.73 (*s*, CH_3–O), 5.18 (*s*, CH_2), 6.12 (*d*, H-2, $J_{2,3} = 15$ Hz), 6.41 (*d*, H-5', $J_{5',6'} = 8$ Hz), 6.74 (*dd*, H-4, $J_{3,4} = 11$ and $J_{4,5} = 14.5$ Hz), 6.87 (*d*, H-6, $J_{5,6} = 11$ Hz), 7.25 (*dd*, H-5, $J_{4,5} = 14.5$ and $J_{5,6} = 11$ Hz), 7.26, 7.54 (AA', BB', 4, $J_o = 8.5$ Hz), 7.47 (*dd*, H-3, $J_{2,3} = 15$ and $J_{3,4} = 11$ Hz), λ_{max} (ε) 208/9 (41,000), 229 infl. (22,500), 296 infl. (17,000), 333/4 (42,000), 342 infl. (41,000) in 0.1N HCl and at pH 7, 228 (23,500), 295 infl. (16,000), 332 infl. (39,200) and 341/2 nm (40,000).

The chromophore of the antibiotic is thus related to **5a** and is represented by 8-(1,2-dihydro-4-hydroxy-1-methyl-2-oxo-3-pyridyl)-7-methyl-8-oxo-2,4,6-octatriene, with undetermined oxidation state of C(1) at the side chain.

BIBLIOGRAPHY

[1] *H. Maehr, J. F. Blount, R. H. Evans Jr., M. Leach, J. W. Westley, T. H. Williams, A. Stempel & G. Büchi*, Helv. *55*, 3051 (1972).

[2] *H. J. Den Hertog & D. J. Buurman*, Rec. Trav. chim. Pays-Bas *75*, 257 (1956).