The Base-catalyzed Oxidation of Friedelin with Molecular Oxygen

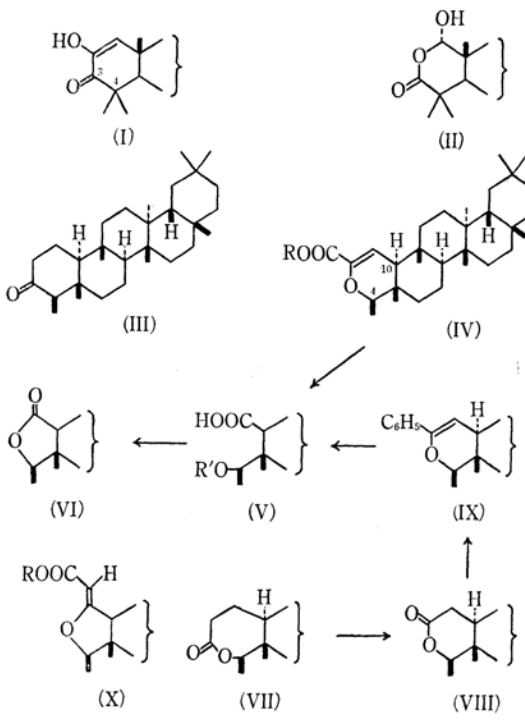
By Tadaaki NISHIHAMA and Takeyoshi TAKAHASHI

Department of Chemistry, Faculty of Science, The University of Tokyo, Hongo, Tokyo

(Received December 2, 1965)

The autoxidation of 3-ketotriterpenes and 3-keto-4,4-dimethylsteroids in the presence of potassium *t*-butoxide has been reported by Hanna and Ourisson, who also recorded the isolation of the corresponding 2,3-dione (I) together with lactol (II).[1)]

We now wish to report the oxidation of friedelin (III) under the same conditions, this oxidation leads to a product of a different type. Oxygen was passed into a solution of friedelin in *t*-butyl alcohol in the presence of a ten-molar excess of potassium *t*-butoxide at room temperature for 40 hr. The residue obtained, when methylated with diazomethane, gave, after separation by chromatography, an unsaturated ester (IV, R=CH_3), m. p. 214.5—215°C, λ_{max}^{EtOH} 253 mμ (ε, 8900), IR: $\nu_{C=O}$ 1720 (ester), $\nu_{C=C}$ 1640 cm^{-1}, NMR: τ 7.92 (doublet, J=2 c. p. s., 1 H, C=CH-CH), τ 6.21 (singlet, 3 H, $COOCH_3$), τ 6.08 (quartet, J=7 c. p. s., 1 H, -O-CH-CH_3) and τ 3.99 (doublet, J=2 c. p. s., 1 H, C=CH-CH), $C_{31}H_{50}O_3$ (Found: C, 78.70; H, 10.79. Calcd.: C, 79.10; H, 10.71%), whose mass spectrum shows a peak at *m/e* 470 (M^+), together with other peaks due to skeletal fragmentations.



The oxidation of IV (R=CH_3) with ozone and hydrogen peroxide gave V (not isolated); on partial reduction with lithium aluminum hydride, followed by treatment with hydrochloric acid, this afforded a lactone (VI), m. p. 269°C, $\nu_{C=O}$ 1765 cm^{-1}. The same γ-lactone was also obtained by an alternative route. 3-Keto-3a-oxa-A-homofriedelane (VII) was, by the Barbier-Wieland procedure, converted into 2-keto-3-oxa-friedelane (VIII), m. p. 263—266°C, $\nu_{C=O}$ 1735 cm^{-1}. VIII was, then, submitted to a Grignard reaction using phenylmagnesium bromide; it yielded 2-phenyl-3-oxa-1-friedelene (IX), m. p. 223—225°C, $\nu_{C=C}$ 1640 cm^{-1}, NMR: τ 7.88 (doublet, J=2 c. p. s., 1 H, C=CH-CH), τ 6.03 (quartet, J=7 c. p. s., 1 H, -O-CH-CH_3) and τ 4.79(doublet, J=2 c. p. s., 1 H, C=CH-CH), $C_{35}H_{52}O$ (Found: C, 86.22; H, 10.71. Calcd.: C, 86.00; H, 10.72%). The oxidation of IX with chromium trioxide afforded V (R'=COC_6H_5); on partial reduction with lithium aluminum hydride and subsequent treatment with dilute hydrochloric acid, this gave a lactone, m. p. 273—273.5°C, $\nu_{C=O}$ 1765 cm^{-1}, $C_{28}H_{46}O_2$ (Found: C, 81.40; H, 11.17. Calcd.: C, 81.10; H, 11.18%), identical (IR, m. p. and mixed m. p.) with γ-lactone (VI).

The γ-lactone (VI) obtained by either procedure described above gave one spot on a thin-layer chromatogram, while an alkaline saponification of V (R'=COC_6H_5), followed by acidification, afforded γ-lactone which showed one more spot on the same chromatogram. This indicates that the configuration at C_{10} in VI is the same as that of friedelin, and that a partial isomerization at C_{10} has taken place under alkaline conditions. On the other hand, in a conversion of VII into VI, the configuration at C_4 is untouched. Along with the information obtained from the NMR data, these results established the constitution and stereochemistry of the unsaturated ester (IV, R=CH_3). As no γ-lactone was isolated on the normal ozonolysis of the unsaturated ester, the alternative structure (X, R=CH_3) for this unsaturated ester could be eliminated. Thus the structure of IV (R=H) for the unsaturated acid initially formed was established.

1) R. Hanna and G. Ourisson, *Bull. Soc. Chim. France*, **1961** 1945.