give a solid of m.p. 182–185°, further crystallized from methanol to m.p. 189–191°, ν_{max} (KBr) at 1700 (CH_3CO) and 1735 cm.$^{-1}$ ($COOCH_3$), n.m.r. 3.62 (CH_3O) and 2.17 p.p.m. (CH_3CO), O.R.D. trough at 305 mμ with [α] −1960°.

Anal. Calcd. for $C_{24}H_{36}O_4$: C, 74.19; H, 9.34; O, 16.47. Found: C, 74.26; H, 9.96; O, 16.54.

3β-Acetoxyisopregn-5-en-20-on-16β-ylacetic Acid (VI).—To 180 mg. of IV in 2 ml. of pyridine, 4 ml. of acetic anhydride was added, and the mixture was allowed to stand for 16 hr. at room temperature. After work-up in the usual manner there was obtained a product: m.p. 158–160°; ν_{max} 1700 (CH_3CO), 1720 (acetate), and 3350 cm.$^{-1}$ (associated acid); n.m.r. 2.12 (CH_3-CO) and 2.02 p.p.m. (acetate); O.R.D. trough at 305 mμ with [α] −1613°.

Anal. Calcd. for $C_{25}H_{36}O_5$: C, 72.08: H, 8.71: O, 19.21. Found: C, 71.79: H, 8.54; O, 19.70.

Enol Lactone of 3β-Acetoxyisopregn-5-en-20-on-16β-ylacetic Acid (VII).—To a solution of 140 mg. of the acid IV in 1 ml. of acetic anhydride, 1 mg. of *p*-toluenesulfonic acid was added. The mixture was refluxed 4 hr., then poured into water and extracted three times with ether. The ethereal layer was washed with aqueous sodium bicarbonate and water, dried over sodium sulfate, filtered, and evaporated. Thereby was obtained a crystalline solid which on recrystallization from methanol showed m.p. 165–167°, ν_{max} (KBr) 1780 (enol lactone) and 1750 cm.$^{-1}$ (acetate), n.m.r. 1.89 p.p.m. ($CH_3C{=}$), λ_{max} 210 mμ (ϵ 5340).

3β-Acetoxyisopregn-5-en-20-on-16β-ylacetamide (VIII).—To a solution of 200 mg. of diazo ketone I in 1 ml. of dioxane, 0.66 ml. of ammonia (*d* 0.9) and 0.2 ml. of 10% aqueous silver nitrate solution were added. The mixture was refluxed for 60 min. and, after cooling, filtered through a short column of 2 g. of neutral alumina. The solid obtained on evaporation was crystallized from methanol–water: m.p. 220–222°; ν_{max} 3480 (NH), 1720 (acetate), 1700 (CH_3CO), 1680 (C=C), and 1595 cm.$^{-1}$ (amide); n.m.r. 3.50 (NH_2), 2.18 (CH_3CO), and 2.02 p.p.m. (acetate).

Anal. Calcd. for $C_{25}H_{37}NO_4$: C, 72.05; H, 8.98; N, 3.37; O, 15.40. Found: C, 72.09; H, 9.08; N, 3.54; O, 15.63.

Anilide of 3β-Acetoxyisopregn-5-en-20-on-16β-ylacetic Acid (IX).—To a suspension of 200 mg. of diazo ketone I in 0.2 ml. of aniline, 0.2 ml. of 10% aqueous silver nitrate solution was added. The mixture was heated in the steam bath for 10 min., water was added, and the product was extracted with chloroform. After washing with water, the product was dried and the solvent was evaporated. The resultant product was further purified by filtration through 2 g. of neutral alumina using chloroform as eluent to yield the anilide X which was recrystallized from methanol: m.p. 255–256°; ν_{max} 3460 (NH), 1720 (acetate), 1700 (CH_3CO), and 1600 cm.$^{-1}$ (amide); n.m.r. 7.42, 7.30, and 7.20 (aromatic protons), 2.76 (NH), 2.18 (CH_3CO), and 2.08 p.p.m. (acetate).

Anal. Calcd. for $C_{31}H_{41}NO_4$: C, 75.73; H, 8.41; N, 2.85; O, 13.02. Found: C, 75.50; H, 8.64; N, 2.74; O, 13.19.

Nuclear Magnetic Resonance Spectrum of the Methiodide of 1-Methylimidazole

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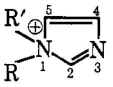
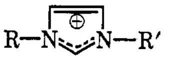
There has been a question in the literature[1] as to the structure of the product resulting from the alkylation of a 1-alkylimidazole. The two possible modes of addition could lead to 1,1-dialkyl- (I), or 1,3-dialkylimidazolium (II) salts.



I

II



III

Chemical degradation supports structures such as II.[2] However, the structure could unambiguously be demonstrated by means of n.m.r. spectrum. The simplest representative of the series was studied, *viz.*, dimethylimidazolium iodide. This iodide was prepared by several investigators,[2,3] but none reported its melting point, owing to its hygroscopic nature. Formation of the iodide in ethyl acetate and recrystallization from the same solvent led, after vacuum drying, to a compound of melting point 86.5–88°.

The n.m.r. spectrum of dimethylimidazolium iodide in D_2O exhibits three singlets centered at τ 5.99, 5.19 and 2.52 with the respective areas 6:2:1, corresponding to six methyl protons, two equivalent 4- and 5-protons, and one 2-proton. Conversely, the n.m.r. spectrum of 1-methylimidazole in chloroform-*d* revealed the magnetic nonequivalence of the 4- and 5-protons, the latter being shifted to higher field.[4] Presumably, for structures such as I a larger difference between these protons would be expected. Indeed, the methyl groups in dimethylimidazolium iodide exert a very strong shielding effect on the adjacent 4- and 5-hydrogens ($\Delta\tau = +2.32$) relative to imidazole.[4]

The symmetry of structure as revealed by n.m.r. confirms that the quaternization of 1-alkylimidazoles results in the formation of 1,3-dialkylimidazolium salts. It also rules out stabilization of the positive charge on one nitrogen such as II, but shows equal distribution between the two nitrogens such as in III. The fact that analogous observations were made for protonated imidazoles and benzimidazoles in H_2SO_4[5] suggests that the pyridine-like double-bonded nitrogen is more basic than the pyrrole-like single-bonded nitrogen. This could be expected if retention of the "aromatic sextet" is kept in consideration.

Experimental Section

1,3-Dimethylimidazolium Iodide.—To a solution of 10.2 g. (0.12 mole) of 1-methylimidazole in 60 ml. of ethyl acetate was added 43.4 g. (0.306 mole) of methyl iodide. The mixture was refluxed overnight and a yellow oil separated during the course of the reaction. After cooling, the oil solidified giving 26.9 g. (96.8% yield) of a hygroscopic solid. Two recrystallizations from ethyl acetate afforded colorless prisms, which after drying *in vacuo* at 75° had a melting point of 86.5–88°.

Anal. Calcd. for $C_5H_9IN_2$: C, 26.80; H, 4.05; I, 56.64; N, 12.50. Found: C, 26.94; H, 4.12; I, 56.89; N, 12.37.

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