Synthesis of *o*-Phthalic Acid Di-Esters of Choline and Related Compounds

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The preparation and physiological effects of a large number of choline esters and other types of quaternary alkylammonium compounds are dealt with in the literature.^{1,2} Fusco *et al.*³ prepared the bis-choline esters of the three phthalic acids and Bovet-Nitti⁴ reported that β -diethylaminoethyl phthalate bis-ethiodide (306 I.S.) was a powerful inhibitor of pseudochoolinesterase but not of true cholinesterase.

As part of an investigation on the inhibition of cholinesterases carried out by our institute,⁵ the bis-methiodides and bis-ethiodides of the tertiary amines I, II and III were prepared.

Experimental *. *Phthalyl chloride*. This was prepared as described by Kyrides⁶ from phthalic anhydride and thionyl chloride. B. p. 119–122°/4 mm.

β -*Dimethylaminoethyl phthalate* (I)³. A solution of phthalyl chloride (0.04 mole) in dry ether (75 ml) was added dropwise to a solution of 2-dimethylaminoethanol (0.1 mole) in dry ether (50 ml) under vigorous stirring and cooling in cold water. The mixture was heated under reflux for 2 h and left overnight at room temperature. After evaporating the ether under reduced pressure, the residue was dissolved in water (20 ml). A chilled solution of potassium carbonate (15 g) in water (20 ml) was then added, and the mixture was extracted with five portions of 25 ml of ether. The combined ether extracts were dried for two days with anhydrous potassium carbonate, filtered and the ether evaporated under reduced pressure. Distillation of the residue *in vacuo* gave a light yellow oil. Yield 7.3 g (59 %); b. p. 168–169°/0.55 mm. (Reported by Fusco: 187°/2.5 mm.) No analyses were taken of this compound.

α -*Methyl - β - dimethylaminoethyl phthalate* (II). The ester II was prepared from 10.3 g (0.1 mole) of 1-dimethylamino-2-propanol and 8.1 g (0.04 mole) of phthalyl chloride in the same way as described for the preparation of I. Distillation *in vacuo* gave a colourless oil. Yield 7.0 g (52.5 %); b. p. 132–134°/0.1 mm. The dipicrate of II was prepared with a saturated solution of picric acid in absolute ethanol,

* Melting points and boiling points are uncorrected.

Table 1. Chemical data of the bis-quaternary methiodides and ethiodides with the general formula $o\text{-C}_6\text{H}_4(\text{COOCHR}'\text{CH}_2\text{N}^+(\text{R}'')_2\text{R}''')_2 \cdot 2\text{I}^-$

No.	R'	R''	R'''	M. p. °C	Found				Calculated			
					% C ^a	% H ^a	% N ^a	% I	% C	% H	% N	% I
IV ^b	H	CH ₃	CH ₃	230 ^c				41.5				42.8
V	H	CH ₃	C ₂ H ₅	217	38.9	5.65	4.55	40.6	38.7	5.53	4.52	40.9
VI	CH ₃	CH ₃	CH ₃	249	39.2	5.58	4.53	39.7	38.7	5.53	4.52	40.9
VII	CH ₃	CH ₃	C ₂ H ₅	222	40.5	5.89	4.47	38.8	40.7	5.90	4.32	39.1
VIII	CH ₃	C ₂ H ₅	C ₂ H ₅	207	44.7	6.68	4.23	35.5	44.3	6.58	3.98	36.0
IX	CH ₃	C ₂ H ₅	CH ₃	190	42.4	6.29	4.16	36.9	42.6	6.26	4.14	37.5

a The average of two analyses.

b 330 I.S. first prepared by Fusco.

c The same melting point is reported by Fusco.

and recrystallized from dry ethanol. M. p. 136—146°. (Found: N 13.92. Calc. for $C_{30}H_{30}O_{18}N_8$: N 14.10.)

a - Methyl - β - diethylaminoethyl phthalate (III). The ester III was prepared from 26.2 g (0.2 mole) of 1-diethylamino-2-propanol and 16.2 g (0.08 mole) of phthalyl chloride following the same procedure as for I. The ester seemed to be partly decomposed by distillation. It was a yellow oil. B.p. 145—147°/0.05 mm. The dipicrate was recrystallized from absolute ethanol. M. p. 148—149.5°. (Found: N 13.50 and 12.73. Calc. for $C_{34}H_{42}O_{18}N_8$: N 13.18.)

Bis-methiodides and bis-ethiodides of I, II and III. The bis-quaternary alkylidides of I, II and III were prepared in an acetone solution. The alkylidides formed were dissolved in hot methanol and ethyl acetate was added slowly until a precipitate appeared. The solution was then chilled overnight in a refrigerator. For the preparation of the compounds IV, V and VI a solution of the tertiary amine and excess of methyl iodide or ethyl iodide in acetone was left overnight at room temperature. Compound VII was formed when a solution of II in acetone was heated with ethyl iodide under reflux for 3 h. In preparing the ethiodide of III (VIII), the reaction mixture was left at room temperature for eight days, and the methiodide of III (IX) was prepared by keeping the reaction mixture at 37° for three days. All the quaternary compounds (IV—IX) prepared, decomposed on melting. They were analysed for iodine by potentiometric titration with silver nitrate.

Melting points and analytical data of the bis-quaternary compounds are listed in Table I.

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M. Delépine's Nitrido-Iridium(III,IV) Sulphate Complexes with Nitrogen Bound to Three Iridium Atoms

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Delépine¹ prepared green salts from $(NH_4)_3IrCl_6$ boiled with concentrated sulphuric acid. These salts are aquo acids, forming red-brown hydroxo complexes in alkaline solution by a reversible reaction, consuming one OH^- per Ir. They are distinctly different from Lecoq de Boisbaudran's blue-green sulphates,² formed by boiling, e.g., K_3IrCl_6 with H_2SO_4 without the presence of NH_4^+ . The latter salts can have the composition $K_{10}Ir_3(SO_4)_6 \cdot O, H_2O$ (private communication from Professor Delépine) and may have further H_2O of crystallization. Delépine³ found later that the green salts, prepared in the presence of NH_4^+ , contain one nitrogen atom for each three iridium atoms. Then, he proposed one of two formulae:

- I. $K_4[N\{Ir(H_2O)(SO_4)_2\}_3]$
- II. $K_4H_2[N\{Ir(H_2O)(SO_4)_2\}_3]$

I contains two tetravalent and one trivalent iridium atom, while II assumes that all three iridium atoms are trivalent. Since Pascal and Pacault found that the nitrogen salts are diamagnetic, while Lecoq de Boisbaudran's salts are paramagnetic and according to the analysis contains one Ir(IV) and two Ir(III), it was concluded that II was probably true. During the study of the absorption spectra of Delépine's many interesting complexes,⁴ the present author was surprised by the strong colour of a pure Ir(III) salt as II, and further by the presence of two hydrogen ions even in the hydroxo salts $K_7H_2[N\{Ir(OH)(SO_4)_2\}_3]$. This note shall present evidence that I is correct. The magnetochemical criterion is not very certain; even compounds with an odd number of electrons may be diamagnetic in certain cases (e.g. NO at low temperatures) where the gyromagnetic factor g accidentally is zero. But the case of I with an even number of electrons has a great chance for