

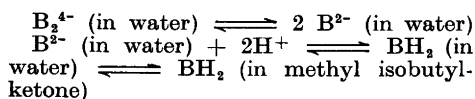
The spectrum does not shift if sodium chloride is replaced by an equimolar concentration of tris ascorbate.

Extrapolation to zero ionic strength at 25°C gives the dissociation constant 2.7×10^{-4} M, or the standard affinity of dissociation $-\Delta G_0 = -4.9$ kcal/mole.

Log K is found to be a linear function of $1/T$. From the slope is calculated $\Delta H = 18.2$ kcal/mole.

The molar standard change of entropy is $\Delta S_0 = (\Delta H - \Delta G_0)/T = 45$ cal/mole degree.

In order to confirm the existence of an equilibrium of dimerisation the phase distribution of bilirubin was studied in the system aqueous buffer-methyl isobutylketone. In this organic solvent bilirubin is soluble as the acid. The light absorption spectrum of this solution shows no change with increasing concentration. The coefficient of distribution varies with pH in quantitative agreement with the following scheme:



The coefficient of distribution at pH = 9.00 was found to vary with the concentration of bilirubin in accordance with this scheme. These findings confirm the dimerisation of the anion in the aqueous phase. The bilirubin acid is present as a monomer in the organic solvent. The numerical value of the dissociation constant, 6×10^{-4} M at 25°C and ionic strength 0.1 M, is different from the value determined above from the spectral shift. This is due to a change of dissociation constant from an aqueous medium to a medium of water saturated with methyl isobutylketone, as observed from a spectral shift which takes place when the ketone is added to the aqueous solution. Determination of the dissociation constant from phase distribution is rather inaccurate, due to instability of bilirubin in this system.

Summary. Reversible dimerisation of the divalent bilirubin anion in aqueous solution has been shown by studies of changes in the light absorption spectrum of bilirubin in buffer solutions and of phase distribution of such solutions by shaking with methyl isobutylketone. The thermodynamic constants have been determined.

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A Novel Synthesis of Isotripiperideine

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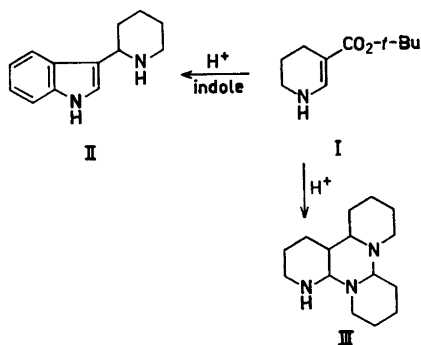
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Isotripiperideine, III, was required as starting material in the synthesis of some alkaloids.*

Schöpf and coworkers¹ have studied the synthesis of various piperideine trimers. By treatment of *N*-chloro-piperidine with ethanolic potassium hydroxide they obtained α - or isotripiperideine or sometimes mixtures of the two isomers in moderate yields.

In an earlier paper² the preparation of *t*-butyl 1,4,5,6-tetrahydronicotinate, I, was described. When this compound was treated with indole in the presence of dilute acetic acid, hydrolysis, decarboxylation, and condensation occurred with formation of 2'-(3-indolyl)-piperidine, II.

It appeared possible that simple hydrolysis of *t*-butyl ester I would give rise to trimers of piperideine. Actually treatment of I with dilute acetic acid gave a complex mixture of compounds but a large yield (81 %) of isotripiperideine, III, was obtained under somewhat more acidic conditions.



I (5.00 g) was added to a solution of ortho-phosphoric acid (10 g, 89 %, *d.* 1.75) in water (300 ml). The mixture was stirred and heated to reflux in an atmosphere of

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nitrogen until the gas evolution ceased and a clear solution resulted (0.75 h). The solution was cooled, made alkaline with potassium carbonate and extracted with ether. The combined ethereal abstracts were dried over solid potassium carbonate, filtered through a short alumina column (neutral alumina, activity IV) and evaporated. The resulting crude, crystalline tri-piperidine was crystallized once from acetone yielding 1.84 g of isotripiperidine, III, m.p. 96–98°, identical with isotripiperidine prepared according to Schöpf¹ (TLC, IR, and mixed m.p.).

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1. Schöpf, C., Komzak, A., Braun, F. and Jacobi, E. *Ann.* **559** (1948) 1.
2. Wenkert, E., Dave, K. G. and Haglid, F. *J. Am. Chem. Soc.* **87** (1965) 5461.

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Complex Formation in Concentrated Sulfuric Acid between Selenium(IV) and 1,2'-Dianthrimide

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The present paper describes the complex formation in concentrated (96.0 %) sulfuric acid between selenium(IV) and 1,2'-dianthrimide.

Instruments and equipment. A Zeiss spectrophotometer PMQ II, a Beckman DB recording spectrophotometer and 1 cm cells were employed.

All solutions were prepared and heated in 50 ml bottles (Jena Gerätglas) with ground-glass stoppers. The solutions were heated in an ordinary, thermostatically controlled drying oven.

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Reagents. 1,2'-Dianthrimide was synthesized according to the procedure given in DRP 174 699. An infrared spectrum and elemental analysis showed that the product was pure.

In all experiments selenium dioxide (Light and Co, Ltd., Great Britain) and 96.0 % sulfuric acid, both of reagent-grade quality, were used.

Standard solutions. The different standard solutions were prepared by dissolving the proper amounts of the reagents in sulfuric acid (to dissolve all of the selenium dioxide, the acid had to be heated slightly), transferring the solutions to volumetric flasks and diluting to volume with acid.

Heating time, heating temperature and concentration of sulfuric acid. On the basis of preliminary experiments, a heating time of 5 h, a heating temperature of 70°C and an acid concentration of 96.0 % were chosen.

Absorption curves. Fig. 1 shows the absorption curves recorded. The curves of

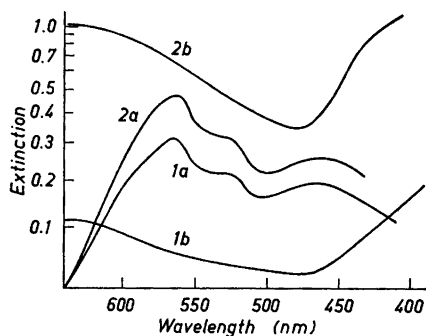


Fig. 1. Absorption curves of solutions of 1,2'-dianthrimide and of the selenium(IV) 1,2'-dianthrimide complex. The concentration of the standard solutions of the reactants was 2.00×10^{-4} M. Curve 1a: Absorption curve of a mixture of 18 ml of selenium and 2 ml of 1,2'-dianthrimide standard solutions measured against a blank solution of 2 ml of 1,2'-dianthrimide standard solution and 18 ml of sulfuric acid. Curve 1b: Absorption curve of the above blank solution measured against sulfuric acid. Curve 2a: Absorption curve of a solution containing 2 ml of selenium and 18 ml of 1,2'-dianthrimide standard solutions measured against a blank solution of 18 ml of 1,2'-dianthrimide standard solution and 2 ml of sulfuric acid. Curve 2b: Absorption curve of the latter blank solution measured against sulfuric acid.