

## Synthesis of (2-Hydroxyimino-cyclopentyl)-trimethylammonium Iodide

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Certain oximes are known to reactivate acetylcholinesterase (AChE) which has been inactivated by organophosphorus compounds.<sup>1</sup> Friess and Baldrige<sup>2</sup> showed that *cis* and *trans* (2-acetoxycyclopentyl)-trimethylammonium iodide surpass acetylcholine in fitting the active site of AChE. Oximes of cyclopentane derivatives may therefore be reactivators of inactivated AChE and in the present communication the synthesis of (2-hydroxyimino-cyclopentyl)trimethylammonium iodide is reported.

Reaction of 2-dimethylaminocyclopentanone with hydroxylamine yielded the oxime, which on further reaction with methyl iodide produced the title compound. Attempts to prepare this substance from (2-oxocyclopentyl)trimethylammonium iodide and hydroxylamine were not successful. IR and NMR spectra of the substances were in agreement with the assigned structures.

Both oximes could exist in two different forms. However, TLC and electrophoresis of the crude reaction mixtures and of the purified compounds only revealed one component. It is known that the oxime hydrogen signal in NMR spectra appears between  $\delta$  8.6–13.3 ppm in DMSO( $d_6$ ) and that *syn* and *anti* forms give signals at different  $\delta$ -values.<sup>3</sup> NMR of the amino and ammonium oximes showed, *inter alia*, signals at  $\delta$  10.42(1H) and 11.51(1H) assigned to the hydrogen of the oxime grouping. As no other signals were observed in this region, it is inferred that both oximes are pure.

As no direct assignment of *syn* or *anti* configuration is provided by NMR when only one isomer is available, isomerisation of the oximes was attempted. However, no change in the NMR spectrum was detected after the substances had been heated, illuminated, or treated (only for the ammonium oxime) with dry hydrogen chloride in acetonitrile-ether. These results indicate that the most stable isomers of the

oximes were isolated. An inspection of Dreiding models reveals that the least hindered and consequently most probable isomers are the *anti* forms.



*Experimental.* NMR spectra were obtained in DMSO( $d_6$ ) on a Varian A-60A instrument. Chemical shifts are given in ppm ( $\delta$ ) relative to sodium trimethylsilylpropanesulphonic acid as internal standard. Thin-layer high voltage electrophoresis was performed on water-cooled cellulose (Machery Nagel MN 300, 0.3 mm) plates sprayed immediately before use with a buffer. The plates (12 × 16.5 cm) were placed with the longest side in the direction of the electric field.

2-Dimethylaminocyclopentanone was prepared as previously described.<sup>2</sup> This compound, which is unstable, was reacted with methyl iodide in dry ethanol yielding (2-oxocyclopentyl)-trimethylammonium iodide, which was crystallized from ethanol, m.p. 178.5 (d). (Found: C 35.2; H 6.09; N 5.25.  $\text{C}_8\text{H}_{16}\text{NOI}$  requires: C 35.7; H 5.99; N 5.21.)

(2-Hydroxyiminocyclopentyl)dimethylamine. A mixture of hydroxylamine, from hydroxylamine hydrochloride (5.4 g) and an equivalent amount of sodium ethoxide, and 2-dimethylaminocyclopentanone (5.0 g) in ethanol (225 ml) was heated at 80° for 30 min and kept overnight at room temperature. Concentration and crystallization from ethanol yielded the pure substance (3.8 g) m.p. 107–108°. (Found: C 59.5; H 9.93; N 19.8. Calc. for  $\text{C}_7\text{H}_{14}\text{N}_2\text{O}$ : C 59.1; H 9.92; N 19.7.) TLC was performed on silica gel with either acetone-ethyl acetate-conc. ammonia (75:10:0.15)  $R_F \sim 0.2$  or propanol-conc. ammonia (8:2)  $R_F \sim 0.7$ .

(2-Hydroxyiminocyclopentyl)trimethylammonium iodide. A mixture of (2-hydroxyiminocyclopentyl)dimethylamine (7.0 g) and methyl iodide (8.75 g) in dry ethanol (100 ml) was kept at room temperature. The reaction product, which began to precipitate after 20 min, was collected after 20 h (13.0 g). Crystallization from ethanol yielded the pure substance, m.p. 197°(d). (Found: C 33.7; H 6.32; N 9.79. Calc. for  $\text{C}_8\text{H}_{17}\text{N}_2\text{OI}$ : C 33.8;

H 6.03; N 9.86.) Electrophoresis was performed with a buffer pH 6.5 (100 ml pyridine and 10 ml HOAc diluted to 1000 ml). The migration was 45 mm (15 min at 900 V and 35 mA).

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## Chemical Studies on Bryophytes\*

### 11. (—)-16 $\alpha$ -Hydroxykaurane from *Saelania glaucescens* (Hedw.) Broth.

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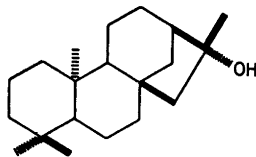
A few mosses and liverworts are recognized by a bluish green or bluish grey colour. As the specific epithet indicates this is an important taxonomic character of the moss *Saelania glaucescens* (Hedw.) Broth. The bluish grey tinge is especially pronounced when the moss grows in relatively pure tufts, and it can generally

\* Previous publications in this series have appeared under the heading "Moss Pigments". Part 10: *Acta Chem. Scand.* **23** (1969) 2910. Future papers will be published under the new heading independent of the type of compounds investigated.

be observed also on isolated plants. This special colour originates from a granular or filamentous covering on the back of the leaves (particularly the lower parts) and adjacent parts of the stem. Although the waxy character of this coating was pointed out early<sup>1</sup> some authors of modern handbooks and floras consider it to be composed of fungal or algal threads.

Recently Huneck and Vevele<sup>2</sup> identified the main component of the waxy coating on two liverworts. *Anthelia juratzkana* (Limpr.) Trev. and *Anthelia julacea* (L.) Dum. as the tetracyclic diterpene (—)-16 $\alpha$ -hydroxykaurane (I).

The present investigation shows that compound I is the main component of the white covering on *Saelania glaucescens*. Brief treatment with benzene removes the white material outside the plant completely and only minor amounts of carotenoids and chlorophylls are extracted. The infrared spectrum indicates contamination by waxes, but the main compound is sufficiently abundant to allow purification simply by sublimation and one recrystallization. A sufficient quantity of material (4 mg) was obtained from only a few grams of herbarium material available. By comparison with an authentic sample the moss compound was proved to be (—)-16 $\alpha$ -hydroxykaurane (I) (IR, MS, NMR, mixed m.p., and optical activity).



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The occurrence of triterpenes in some mosses has been reported by other authors<sup>3</sup> but 16-kauranol seems to be the first diterpene identified in a member of the Musci.

*Experimental.* Moss material (collections made in the sixties in the western parts of the province of Lycksele lappmark) was rinsed rapidly with benzene. The extract was centrifuged and evaporated to dryness. Sublimation at 110°C and 0.2 mmHg, and subsequent crystallization from a dichloromethane-meth-