Tetrahedron Vol 24, pp. 5625 to 5631. Pergamon Press 1968. Printed in Great Britain

THE GUAIANOLIDES OF *AMBROSIA CUMANENSIS* HBK
THE STRUCTURES OF CUMAMBRINS A AND B[1]

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(*Received in the USA* 23 *February* 1968; *Received in the UK for publication* 4 *April* 1968)

Abstract—Cumambrins A and B isolated from *Ambrosia cumanensis* HBK were shown to be guaianolides with structures Ia and Ib.

RECENTLY, we elucidated the structure of cumanin (II),[2] a pseudoguaianolide isolated from *Ambrosia cumanensis* HBK,* now we wish to report the isolation from the same source of two guaianolides for which we propose to name cumambrins A and B. Up to now in the genus *Ambrosia* there have been found as constituents germacranolides,[4,5] pseudoguaianolides[6] and their derivatives the psilostachyins.[6] However, guaianolides had not been isolated in this genus.

Chromatography of the ethanol extract of the plant yielded two products. Cumambrin A, m.p. 178°; $[\alpha]_D$ +90° was obtained in the less polar fractions. It showed a M.W. of 306 in the mass spectrum† and analyzed for $C_{17}H_{22}O_5$. Cumambrin A (Ib) showed UV absorption of 211 mμ (ε, 11,900) and its IR spectrum had bands at 1760 and at 1660 cm^{-1} characteristic of a 5-membered lactone conjugated with an exocyclic methylene group. The presence of a OH group was inferred from IR bands at 3500 and 3600 cm^{-1}: this was assumed to be tertiary since it could not be acetylated with acetic anhydride–pyridine. The presence of an acetoxy group was suggested by an IR band at 1722 cm^{-1} and confirmed by examination of the NMR spectrum‡ of cumambrin A (Ib). It showed a pair of low field doublets at 6·20 and 5·56 corresponding to the exocyclic methylene protons. The chemical shift of a signal at 5·56 (superimposed on one of the doublets) indicates the presence in cumambrin A (Ib) of another vinylic proton. A broadened doublet (3 H, J = 2 c/s) at 1·92 is ascribed to a vinylic Me group. A sharp singlet at 2·19 corresponds to an acetyl Me group. The multiplicity of a signal centered at 5·21 attributed to the proton attached to the carbon bearing the acetoxy group suggests that this group is substituted at C-8. The tertiary OH group of cumambrin A (Ib) is bonded to a carbon carrying a Me group since the latter is found in the NMR spectrum of Ib as a singlet at 1·26. A complex signal at 4·00 with long range coupling is assigned to the proton attached to the carbon bearing the ethereal oxygen of the lactone.

* A voucher (University of Texas Herbarium, No. 252565) of the plant population from which cumanin was first isolated was subsequently described as *Ambrosia psilostachya* DC. by W. W. Payne, Department of Botany, The University of Illinois, Urbana. However cumanin is, in any case, a constituent of *A. cumanensis* DC.[3]

† The Mass spectrum was determined by Mr. Eduardo Cortés of this Institute on a Hitachi–Perkin–Elmer spectrometer.

‡ The NMR spectra were determined on a Varian A-60A spectrometer, in $CDCl_3$ soln using TMS as internal reference. All chemical shifts are reported in ppm as δ values.

Cumambrin B ($C_{15}H_{20}O_4$) m.p. 87°, $[\alpha]_D$ +81° obtained in the more polar fractions of the chromatography was easily correlated with cumambrin A (Ib). Acetylation of cumambrin B (Ia) with acetic anhydride–pyridine afforded cumambrin A (Ib). Cumambrin B (Ia) yielded a mesylate (Ic).

The relative position of the secondary OH group of cumambrin B (Ia) was elucidated when chromium trioxide oxidation of the latter was accompanied by isomerization of the double bond to endocyclic conjugation with the keto group as shown by the spectral properties of the resulting product (III). It exhibited an UV maximum at 246 mμ (ε, 10,000). In the IR spectrum it had bands at 1690 and at 1640 cm^{-1} due to the α,β-unsaturated cycloheptanone. The tertiary OH group of III is responsible for an IR band at 3600 cm^{-1}. The NMR spectrum of the ketone III exhibited a quadruplet (J = 2 c/s) at 5·68 ascribed to the vinylic proton. The signal corresponding to the proton attached to the carbon carrying the ethereal oxygen of the lactone is coupled with the C-5 hydrogen and appears as a doublet (J = 8·5 c/s) at 5·03. It is splitted and broadened suggesting homoallylic coupling with the C-11 vinylic Me group. The latter group and the C-4 vinylic Me are responsible for a doublet (J = 2 c/s) at 2·21 and for a broadened doublet (J = 2 c/s) at 1·96, respectively. A singlet at 1·37 is assigned to the C-10 Me group.

The position at C-3 of the unconjugated olefinic double bond of cumambrin A (Ib) could be elucidated in the following way: oxidation of Ib with *m*-chloroperbenzoic acid gave the epoxide IV which still contained the double bond conjugated with the lactone as shown by end UV absorption at 211 mμ (ε, 10,200). The NMR spectrum of the epoxide IV did not exhibit signals corresponding to a vinylic proton or a vinylic Me group, instead singlets at 3·30 (1 H) and at 1·60 (3 H) were attributed to a proton and a Me group attached to the C atoms bearing the epoxide. A pair of doublets at 6·20 and 5·52 were assigned to the exocyclic methylene protons. The singlets at 1·18 and at 2·22 are ascribed to the C-10 and the acetyl Me groups.

Treatment of the epoxide IV with BF_3-etherate yielded the ketone V. Its IR spectrum showed a strong band at 1740 cm^{-1} corresponding to a 5-membered ketone and the acetyl group. In the Me region of the NMR spectrum of the ketone V are observed two singlets at 2·18, at 1·28 and a doublet at 1·22 (partially superimposed on one of the singlets) ascribed to the acetyl Me group, the C-10 and the C-4 Me groups, respectively.

Hydrogenation of cumambrin A (Ib) in the presence of Pd–C afforded a dihydroderivative (VIb) which only contains the unconjugated double bond. It did not show strong end UV absorption. The NMR spectrum of VIb did not exhibit the low field doublets corresponding to the exocyclic methylene protons. It showed a quadruplet (J = 2 c/s) at 5·50 assigned to the vinylic proton and a broadened doublet (J = 2 c/s) at 1·83 ascribed to the vinylic Me group. A secondary Me group is responsible for a doublet at 1·24 partially superimposed on the singlet assigned to the C-10 Me group.

Tetrahydrocumambrin A (VIIb) was obtained by hydrogenation of cumambrin A (Ib) in the presence of PtO_2 or by acetylation of the oily tetrahydrocumambrin B (VIIa) prepared by Pd–C catalyzed hydrogenation of cumambrin B (Ia). The NMR spectrum of the tetrahydro derivative VIIb did not show the signals attributed to the CH_3—C=CH— group present in the NMR spectrum of VIb. Two doublets at 1·27 and 1·10 are ascribed to two secondary Me groups. In the NMR spectra of VIb and VIIb the signal corresponding to the proton attached to the carbon bearing the ethereal oxygen of the lactone is observed as a clean triplet at 4·08 characteristic of a lactone

oriented at C-6. The proton on the carbon linked to the acetoxy group appears as a multiplet at 5·15.

Dehydration of tetrahydrocumambrin A (VIIb) with thionyl chloride afforded an anhydro derivative which resisted crystallization even after chromatography. However, mild alkaline hydrolysis of the latter resulted in the crystalline free alcohol (VIII). It showed a OH IR band at 3610 cm^{-1}. The alcohol VIII contains an exocyclic methylene group as shown by IR absorption at 1650 and 900 cm^{-1}. The NMR spectrum of VIII exhibited a doublet at 5·07 assigned to two vinylic protons. A doublet of triplets at 3·68 are attributed to the C-9 protons. A triplet at 4·00 indicates that the lactone group is oriented at C-6.

Aromatization of cumambrin A (Ib) gave in good yield chamazulene (IX), characterized as its TNB adduct, giving a proof of the distribution of groups in the perhydroazulene skeleton.

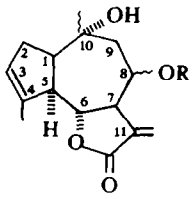
Chromium trioxide oxidation of the crude tetrahydrocumambrin B (VIIa) afforded the cycloheptanone X. It still contains the tertiary OH group as shown by IR absorption at 3610 cm^{-1}. A carbonylic band at 1710 cm^{-1} corresponds to the keto group.

Thionyl chloride dehydration of the ketone X resulted in a crude anhydro derivative XI which appears to contain the double bond conjugated with the ketone as shown by IR absorption bands at 1665 and 1620 cm^{-1} corresponding to a cycloheptenone chromophore. The NMR spectrum of XI had a quadruplet (J = 1 c/s) at 5·97 ascribed to a vinylic proton and a triplet (J = 1 c/s) at 2·04 assigned to a vinylic Me group. When the crude anhydro derivative (XI) was chromatographed on alumina a crystalline product (XII) was obtained. Its spectral properties indicate that the double bond had migrated to a β-γ-position. The ketone (XII) (λ_{max} 294 mμ; ε, 100) had a cycloheptanone band at 1715 cm^{-1}. The quadruplet ascribed to the vinylic proton in the NMR spectrum of the conjugated ketone (XI) is not present in the spectrum of the lactone XII. In the latter is observed the signal corresponding to the vinylic Me group displaced to higher field at 1·71.

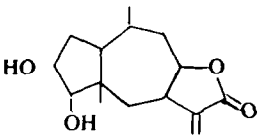
Pd–C catalyzed hydrogenation of cumambrin B mesylate (Ic) afforded the dihydro derivative VIc.* Treatment of the mesylate VIc with γ-collidine resulted in a product ($C_{15}H_{20}O_3$) whose IR spectrum did not show OH bands. A carbonyl band at 1775 cm^{-1} corresponds to the 5-membered lactone. Its NMR spectrum exhibited the following signals: A broad singlet at 5·51 (vinylic proton). A pair of doublets at 4·53 partially superimposed on a broad signal centered at 4·44 (C-6 and C-8 protons). A quadruplet (J = 2 c/s) at 1·88 (vinylic Me group). A singlet at 1·38 (C-10 Me group). A doublet at 1·22 (secondary Me group). Signals corresponding to vinyl protons were not observed.

LAH reduction of this product followed by aromatization gave linderazulene (XIII). The lactone resulting from the reaction of the mesylate VIc with γ-collidine appears to contain an oxygen bridge. However the data described above does not permit to distinguish with certainty between structures XIV and XV. A further proof of the structure of the cumambrins was obtained as follows. Chemical reduction of (Ia) with $NaBH_4$ gave the dihydroderivative (VIa). The latter without further purification was oxidized with chromium trioxide followed by dehydration with thionyl chloride. The resulting product (XVI) (λ_{max} 239 mμ; ε, 11,200) had IR bands at 1775 cm^{-1} (γ-lactone) and at 1660 cm^{-1} (cycloheptenone). Correlation of the cumam-

* Mesylates of this type may undergo hydrogenolytic cleavage.[7]



I a. R = H
b: R = Ac
c: R = Ms



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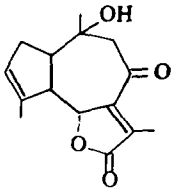

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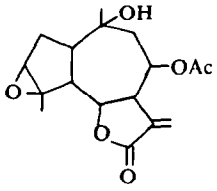

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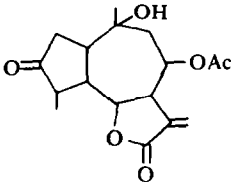

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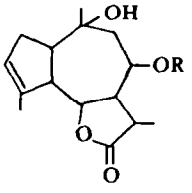
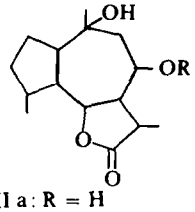


VI a: R = H
b: R = Ac
c: R = Ms



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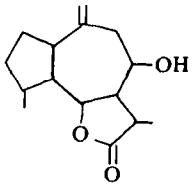
b: R = Ac



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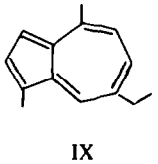

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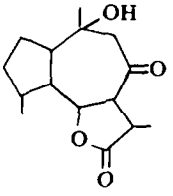

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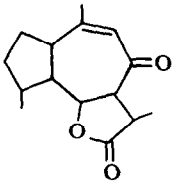

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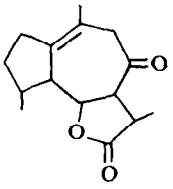
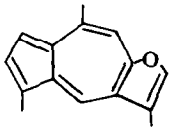


XII



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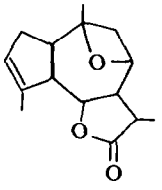
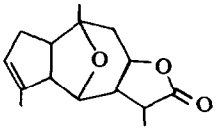


XIV



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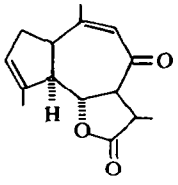
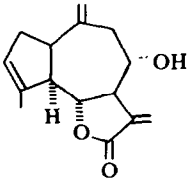
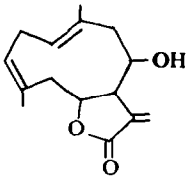


XVI



XVII



XVIII

brins with ligustrin (XVII)[8] was achieved when this product (XVI) was identified as a conjugated ketone obtained in the ligustrin series.[8] Ligustrin (XVII) has been in turn correlated with guaianolides of known structure and stereochemistry at C-5, C-6 and C-7.[9–12] Therefore the cumambrins possess the asymmetric centers at C-5, C-6 and C-7 oriented as shown in formula Ia.

The cumambrins (Ia and Ib) are easily derived from the germacranolide chamissonin (XVIII),[4] (a constituent of *Ambrosia chamissonis*) in the biogenetic scheme postulated by Geissman *et al.*[4] occurring in the genus Ambrosiae.

EXPERIMENTAL*

Isolation of the lactones. Ambrosia cumanensis HBK was collected in the neighbourhood of Tamuin (State of San Luis Potosí) in July 1967.† The dried plant (330 g) was extracted twice with EtOH (3 l.) for 12 hr. The combined extracts were concentrated to 500 ml and treated with lead acetate (20 g) dissolved in water (500 ml). The mixture was left for 2 hr at room temp, filtered, diluted with water (2 l.) and extracted with $CHCl_3$. The chloroformic extract was evaporated to dryness and the residue (9·2 g) chromatographed on alumina. In the less polar fractions eluted with benzene, benzene-hexane 1:1, 2:1, 3:1 and benzene, Ib was obtained (350 mg) as prisms from chloroform–isopropyl ether m.p. 178 $[\alpha]_D$ +90; λ_{max} 211 mμ; ε, 11,900; IR bands at 3600 and 3500 cm^{-1} (OH group), at 1760 with a shoulder at 1725 cm^{-1} (γ-lactone and acetyl groups), at 1660 cm^{-1} (exocyclic methylene). (Found: C, 66·46; H, 7·19; O, 25·97. Calc. for $C_{17}H_{22}O_5$: C, 66·65; H, 7·24; O, 26·11%).

The IR spectrum of Ib determined in CH_3CN showed bands at 1758 cm^{-1} (γ-lactone) and at 1722 cm^{-1} (acetyl group).

The crystalline polar fractions eluted with benzene and increasing proportions of AcOEt afforded Ia (420 mg). Small prisms from AcOEt–ether, m.p. 87°; $[\alpha]_D$ +81° (dioxan); λ_{max} 212 mμ; ε, 12,200; IR bands (KBr) at 3500 cm^{-1} (OH groups); 1750 cm^{-1} (γ-lactone) and at 1660 cm^{-1} (exocyclic methylene). (Found: C, 68·25; H, 7·79; O, 24·33. Calc. for $C_{15}H_{20}O_4$: C, 68·16; H, 7·63; O, 24·21%).

Acetylation of Ia with Ac_2O–pyridine on the steam bath for 1 hr yielded Ib m.p. 178°. Undepressed on admixture with material isolated from the plant. The IR spectra were superimposable.

Dehydrocumambrin B (III). A soln of Ia (200 mg) in acetone (8 ml) at 5° was treated with 8N CrO_3 until the persistence of an orange colour. After 5 min the soln was diluted with AcOEt, washed with water, dried and evaporated to dryness. The residue crystallized from $CHCl_3$–isopropyl ether. This yielded 120 mg m.p. 120–123°, further crystallizations from acetone–isopropyl ether raised the m.p. to 128°; $[\alpha]_D$ +162°; λ_{max} 246 mμ; ε, 10,000; IR bands at 3600 cm^{-1} (OH group), at 1755 cm^{-1} (γ-lactone), at 1690 cm^{-1} (α,β-unsaturated cycloheptanone) and at 1640 cm^{-1} (C=C double bond). (Found: C, 68·83; H, 7·01; O, 24·22. Calc. for $C_{15}H_{18}O_4$: C, 68·68; H, 6·92; O, 24·40%).

Mesylate of cumambrin B (Ic). A soln of Ia (200 mg) in pyridine (6 ml) was treated at 5° with mesyl chloride (1 ml), left at room temp for 2 hr poured in ice-water and extracted with AcOEt. The organic extract was washed with dil HCl, $NaHCO_2$ aq, dried and evaporated to dryness. Crystallization from $CHCl_3$–isopropyl ether afforded prisms m.p. 173° dec; $[\alpha]_D$ +50°; λ_{max} 208 mμ; ε, 9400; IR bands at 3615 cm^{-1} (OH group), at 1775 cm^{-1} (γ-lactone) and at 1670 cm^{-1} (exocyclic methylene). (Found: C, 56·30; H, 6·38; O, 27·87; S, 9·41. Calc. for $C_{16}H_{22}O_6S$: C, 56·13; H, 6·48; O, 28·05; S, 9·34%).

Epoxide of cumambrin A (IV). A soln of Ib (250 mg) in $CHCl_3$ (20 ml) was treated with *m*-chloroperbenzoic acid (300 mg) heated under reflux for 1·5 hr, washed with $NaHCO_3$ aq, dried and evaporated. Crystallization from $CHCl_3$–ether yielded prisms (160 mg), m.p. 245–251°. Further crystallizations from MeOH–ether raised the m.p. to 258–260°; $[\alpha]_D$ +54°; λ_{max} 211 mμ; ε, 10,200; IR bands at 3590 cm^{-1} (OH group), at 1760 cm^{-1} (γ-lactone), at 1740 cm^{-1} (acetyl group) and at 1660 cm^{-1} (C=C double bond). (Found: C, 63·33; H, 7·00; O, 29·79. Calc. for $C_{17}H_{22}O_6$: C, 63·34; H, 6·88; O, 29·78%).

* Mp's are uncorrected. Analyses by Dr. F. Pascher, Bonn, Germany. UV spectra: 95% EtOH soln, Beckman DK2 spectrophotometer. IR spectra: $CHCl_3$ soln, Perkin–Elmer 21 double beam spectrophotometer. Rotations in $CHCl_3$ at 20°.

† We are grateful to Miss Silvia del Amo of the Instituto de Biología (U.N.A.M.) for the collection and identification of the plant. Voucher No. A-23. Herbario Nacional de la U.N.A.M. (MEXU).

Ketodihydrocumambrin A (V). The epoxide IV (100 mg) dissolved in benzene (10 ml) and AcOH (5 ml) was treated with BF_3-etherate (1 ml) and left 4 hr at room temp. The mixture was diluted with AcOEt, washed with water, $NaHCO_3$ aq, dried and evaporated. Crystallization from $CHCl_3$–ether afforded prisms (25 mg) m.p. 227–229°; $[\alpha]_D$ −8°; λ_{max} 210 mμ; ε, 8725; IR bands at 3600 cm^{-1} (OH group), at 1770 cm^{-1} (γ-lactone), at 1740 cm^{-1} (double strength, 5-membered ketone and acetyl group) and at 1660 cm^{-1} (C=C double bond). (Found: C, 63·23; H, 6·79; O, 29·87. Calc. for $C_{17}H_{22}O_6$: C, 63·34; H, 6·88; O, 29·78%).

Dihydrocumambrin A (VIb). A soln of Ib (500 mg) in AcOEt (70 ml) was hydrogenated in the presence of 5% Pd–C (80 mg). The absorption of hydrogen ceased after the uptake of one equivalent. The soln was filtered and evaporated to dryness. The residue crystallized from $CHCl_3$–ether yielding prisms (410 mg) m.p. 170–173°; $[\alpha]_D$ +35°; IR bands at 3600 cm^{-1} (OH group), at 1770 cm^{-1} (γ-lactone) and at 1735 cm^{-1} (acetyl group). (Found: C, 66·06; H, 8·06; O, 25·79. Calc. for $C_{17}H_{24}O_5$: C, 66·21; H, 7·84; O, 25·95%).

Mesylate of dihydrocumambrin B (VIc). The mesylate Ic (100 mg) dissolved in AcOEt (20 ml) was hydrogenated with 5% Pd–C (60 mg). Only one equivalent of H_2 was consumed. The soln was filtered and evaporated. Crystallization of the solid residue from $CHCl_3$–ether yielded prisms m.p. 156–157°; $[\alpha]_D$ +43°; IR bands at 3600 cm^{-1} (OH group) and at 1775 cm^{-1} (γ-lactone). (Found: C, 55·97; H, 6·98; O, 27·83; S, 9·37. Calc. for $C_{16}H_{24}O_6S$: C, 55·80; H, 7·02; O, 27·89; S, 9·29%).

Tetrahydrocumambrin A (VIIb). Cumambrin Ib (160 mg) dissolved in MeOH (20 ml) was hydrogenated in the presence of PtO_2 (20 mg) until the absorption of H_2 ceased. Crystallization from acetone–hexane yielded material (145 mg) m.p. 167–168°; $[\alpha]_D$ + 14°; IR bands at 3590 cm^{-1} (OH group), at 1765 cm^{-1} (γ-lactone) and at 1735 cm^{-1} (acetyl group). (Found: C, 65·54; H, 8·33; O, 26·00. Calc. for $C_{17}H_{26}O_5$: C, 65·78; H, 8·44; O, 25·78%).

The hydrogenation of Ia (250 mg) in AcOEt with 5% Pd–C afforded VIIIa (220 mg) as a gummy product which resisted crystallization even after chromatography. Acetylation with acetic anhydride–pyridine for 1 hr on the steam bath gave VIIb. Undepressed on admixture with the derivative obtained by hydrogenation of Ib. The IR spectra were superimposable.

Aromatization of cumambrin A (Ib). A mixture of Ib (1 g), Nujol (8 ml) and 5% Pd–C (1·5 g) was heated for 15 min at 290–295°, diluted with hexane and filtered. The soln was chromatographed on alumina (80 g). The blue fractions were combined, evaporated and converted to the trinitro benzene adduct. Crystallization from MeOH yielded dark brown needles (105 mg) m.p. 126–128°. Further crystallizations raised the m.p. to 129–130·5°. Undepressed on admixture with an authentic specimen. The UV and NMR spectra were identical.

Anhydrotetrahydrocumambrin B (VIII). Compound VIIb (160 mg) dissolved in pyridine (5 ml) was treated at 5° with $SOCl_2$ (1 ml) for 10 min. The soln was poured in ice-water and extracted with AcOEt. The organic layer was washed with dil HCl, water, dried and evaporated to dryness. The residue did not crystallize after chromatography. The gummy residue (110 mg) dissolved in MeOH (6 ml) was mixed with $KHCO_3$ (150 mg) in water (2 ml), heated under reflux for 30 min, acidified with AcOH and evaporated to dryness. Crystallization from acetone–hexane yielded VIII (35 mg) m.p. 160°; $[\alpha]_D$ +34°; IR bands at 3610 cm^{-1} (OH group), at 1765 cm^{-1} (γ-lactone), at 1650 and 900 cm^{-1} (exocyclic methylene). (Found: C, 72·25; H, 8·96; O, 18·86. Calc. for $C_{15}H_{22}O_3$: C, 71·97; H, 8·86; O, 19·17%).

Dehydrotetrahydrocumambrin B (X). The crude VIIa (300 mg) dissolved in acetone (7 ml) was oxidized at 5° with Jones reagent. After 5 min the soln was diluted with AcOEt, washed with water, dried and evaporated to dryness. The gummy residue was chromatographed on alumina. The crystalline fractions were combined and crystallized from $CHCl_3$–isopropyl ether. This yielded X (180 mg) m.p. 172–173°; $[\alpha]_D$ +14°; IR bands at 3610 cm^{-1} (OH group), at 1770 cm^{-1} (γ-lactone) and at 1710 cm^{-1} (cycloheptanone). (Found: C, 67·75; H, 8·34; O, 23·90. Calc. for $C_{15}H_{22}O_4$: C, 67·64; H, 8·33; O, 24·03%).

Dehydration of dehydrotetrahydrocumambrin B (X). A soln of X (150 mg) in pyridine (4 ml) was treated at 5° with $SOCl_2$ (0·7 ml) for 5 min, poured into ice-water and extracted with AcOEt. The organic layer was washed with dil HCl, water, dried and evaporated. The gummy residue XI had IR bands at 1775, 1665 and 1620 cm^{-1}. It was dissolved in benzene–hexane 1:1 and chromatographed on alumina. The crystalline fractions were combined and recrystallized from acetone–hexane. This yielded XII (45 mg) m.p. 161–163°; $[\alpha]_D$ −126°; λ_{max} 294 mμ; ε, 100; IR bands at 1775 cm^{-1} (γ-lactone) and at 1715 cm^{-1} (cycloheptanone). (Found: C, 72·67; H, 8·03; O, 19·21. Calc. for $C_{15}H_{20}O_3$: C, 72·55; H, 8·12; O, 19·33%).

Treatment of the mesylate of dihydrocumambrin B (VIc) *with γ-collidine.* The mesylate VIc (300 mg) dissolved in γ-collidine (6 ml) was heated under reflux for 5 hr. The soln was diluted with AcOEt, washed with dil HCl, water, dried and evaporated to dryness. The residue was chromatographed on alumina.

Crystallization from ether–pentane yielded brilliant plates (80 mg), m.p. 121°; $[\alpha]_D$ +35°; IR band at 1775 cm^{-1} (γ-lactone). (Found: C, 72·73; H, 7·99; O, 19·36. Calc. for $C_{15}H_{20}O_3$: C, 72·55; H, 8·12; O, 19·33%).

Aromatization of lactone XIV. A soln of the lactone (220 mg) in THF (15 ml) was treated with LAH (1 g) and refluxed for 8 hr. The resulting gummy residue was mixed with Nujol (3 ml), 5% Pd–C (300 mg) and heated to 290–295° for 10 min. The mixture was extracted with hexane, filtered and chromatographed on alumina. In the more polar fractions XIII was eluted. It was converted to its TNB adduct. Crystallization from methanol yielded black needles, m.p. 144–147°. Undepressed on admixture with an authentic sample. Identified also by its UV spectrum and TLC.

Anhydrodehydrodihydrocumambrin B (XVI). A soln of Ia (160 mg) in MeOH (10 ml) was treated at 0° with $NaBH_4$ (300 mg) the mixture was stirred for 10 min acidified with AcOH and evaporated to dryness *in vacuo*. The residue was dissolved in benzene. The soln filtered and evaporated to dryness. The residue dissolved in acetone (6 ml) was oxidized with a 8N soln of CrO_3 at 5°. The soln was diluted with AcOEt, washed with water, $NaHCO_3$ aq, dried and evaporated to dryness. The residue dissolved in pyridine (5 ml) was treated at 0° with $SOCl_2$ (0·5 ml). The mixture was left at 0° for 10 min, poured in ice–water and extracted with AcOEt. The organic layer was washed with dil HCl, $NaHCO_3$ aq, dried and evaporated to dryness. The residue crystallized from ether–isopropyl ether. This yielded the conjugated ketone XVI (50 mg) m.p. 127–129° undepressed on admixture with the ketone IV[8] of the ligustrin series. The IR spectra were superimposable.

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