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A new alkaloid, securitine, was isolated from the root barks of Securinea suffruticosa Rumph. in Formosa, and the structure of this alkaloid was established as I.

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In continuation of the studies on constituents of Securinea species, we isolated a new alkaloid from the roots of S. suffruticosa Rehd. growing in Hou-lung (Formosa) and designated it securitine. In a preliminary communication, spectral and chemical evidences established the structure of this alkaloid as I. A full account of this work is given in this paper.

Securitine (I), yellow plates, m.p. 129–130°, [α]D = −962.3°, possesses a molecular formula C_{14}H_{15}O_{3}N. It contains an α, β, γ, δ`-unsaturated γ-lactone ring [IR bands at 1818 (sh.), 1758 and 1628 cm⁻¹; UV maximum at 257 μ (log ε 4.20)] and one methoxyl group [NMR peak at 6.75 τ (singlet, 3H)]. The nuclear magnetic resonance spectrum exhibited an octet (2H) at 4.05–3.47 τ and a singlet (1H) at 4.25 τ, typical of H₄, H₅, and H₆, respectively, of type found in securine or allosecurine. Reduction of I with sodium borohydride gave a dihydro derivative (II), m.p. 118–119°, which showed an ultraviolet absorption maximum at 215 μ (log ε 4.26).

The mass spectrum (Fig. 1) of securitine showed characteristic peaks at m/e 247 (M⁺, 15), 134 (21), 114 (79), 106 (44), 82 (34), 56 (base peak). Their empirical formulae were determined by the high-resolution mass spectrometry (Table I). The main

*1 Toneyama, Toyonaka, Osaka-fu (増田義一, 池田正和, 花岡美代子, 山内昌茂, 田村滋光).
*2 3073, Shimotoda, Todamachi, Kitaadachi, Saitama (出藤進一, 田中雅, 小寺啓司, 杉本典夫).

1) Z. Horii, M. Ikeda, Y. Tamura, S. Saito, K. Kotera, T. Iwamoto: This Bulletin, 13, 1307 (1965), and references therein.
Table I. Exact Masses and Compositions of Ions

<table>
<thead>
<tr>
<th>m/e observed</th>
<th>m/e calculated</th>
<th>composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>247.1215</td>
<td>247.1222</td>
<td>C₇H₁₂O₂N</td>
</tr>
<tr>
<td>134.0402</td>
<td>134.0408</td>
<td>C₇H₁₀O₂</td>
</tr>
<tr>
<td>114.0947</td>
<td>114.0975</td>
<td>C₆H₁₀O₂N</td>
</tr>
<tr>
<td>106.0435</td>
<td>106.0451</td>
<td>C₆H₁₀O</td>
</tr>
<tr>
<td>82.0680</td>
<td>82.0703</td>
<td>C₅H₁₀N</td>
</tr>
<tr>
<td>56.0490</td>
<td>56.0480</td>
<td>C₄H₈N</td>
</tr>
</tbody>
</table>

Chart 2.

fragmentation process of this alkaloid (Chart 2) can be rationalized on the basis of that proposed for securinine\(^{\text{5,6}}\) except for the 30 mass unit increment due to the methoxyl group, and hence the two prominent peaks at m/e 114 and m/e 82 can be explained by assuming the cleavage between C₁₈₈ and C₁₆₀ with associated hydrogen transfer to give a (m/e 114) and further elimination of methanol to b (m/e 82). This feature, in conjunction with the above-mentioned physical and chemical data, suggests securinine to be a securinine or allosecurinine derivative with one methoxyl group in the piperidine (or C) ring. A further information on the location of the methoxyl group came from the following inspection of the spectrum. Appearance of the base peak at m/e 56 (c), supposed to result from the m/e 114 ion (a), rules out the possibility that the methoxyl group is situated at C₇. Furthermore, if the methoxyl group is substituted at β-position of nitrogen, i.e. C₈ or C₁₈, the fragment ion resulting from the α-cleavage between the new oxygen function and nitrogen should be expected, as observed in the cases of securinol A\(^{\text{5}}\) or tropane alkaloids.\(^{\text{6}}\) However, this is not the case and thus the methoxyl group should be located most probably at C₇. This result was confirmed by the nuclear magnetic double resonance experiments and the synthesis of a degradation product (III).

Judging from the similarity of the nuclear magnetic resonance spectra of securinine and allosecurinine, a multiplet near 6.16 T (2H) is readily assigned to H₆₈ and H₁₆₈, and a symmetrical multiplet centered at 6.41 T to CH-CH₂. As can be seen from Fig. 2, irradiation of H₆₈ near 6.16 T caused the multiplet at the highest field (8.84 T) to collapse to a quartet (J=3.5 and 14.4 c.p.s.) and irradiation near 6.41 T (CH-CH₂) caused the multiplet at 8.84 T to a quartet (J=8.5 and 14.3 c.p.s.). These findings indicate that the

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\(^{\text{5}}\) It has been found that securinine and allosecurinine showed an identical mass spectrum.\(^{\text{5}}\)

upfield multiplet, assignable to one of two methylene protons at C_15, is coupled to both H_10, and the proton attached to the carbon bearing the methoxyl group, and hence the methoxyl group must be situated at C_9. The more detailed discussion about the upfield multiplet will be done later.

Treatment of securitinine with zinc and sulfuric acid followed by lithium aluminum hydride reduction of the resulting lactam gave the oily base (I), [α]D
-89.5°, characterized as the methiodide, m.p. 242~243°. The following synthesis of the methiodide of the amine (Xb), the racemic (C), proved the structure of (I), leading to the conclusion that the methoxyl group is located at C_9 and in a 1,3-
cis relationship to the C_10a-hydrogen.

Condensation of ethyl 1,2,3,4-tetrahydro-1-isoquinolineacetate (V) with acrylonitrile followed by ethanolation, Dieckmann cyclization* and then hydrolysis with 10% hydrochloric acid gave 1,3,4,6,7, 11b-hexahydro-2H-benz[a]quinolizin-2-one (VII), in 30% overall yield. Reduction of the amino ketone (VII) with sodium borohydride in methanol gave the amino alcohol (Xa), m.p. 142~143°, after recrystallization from benzene. On the other hand, reduction of VII with aluminum isopropanoxide followed by acetylation and then column chromatography on silica gel gave the acetate (Xa), m.p. 105°, and the oily acetate (Xb). Alkaline hydrolysis of the acetates (Xa) and (Xb) gave the amino alcohols (Xa) and (Xb), m.p. 142~143°, respectively. The both amino alcohols (Xa) and (Xb) differed in the infrared or nuclear magnetic resonance spectra and depressed on admixture.

The configurational assignments of the epimeric alcohols (Xa) and (Xb) were made on the basis of the nuclear magnetic resonance data. As can be seen from Table II, the C-2 proton signal of (Xa) (or Xa) appeared at higher field than the corresponding one on (Xb) (or Xb). In addition, this proton can be regarded as forming the X portion of the system approximating to A, B, and it was found that in the former series the signal was split into a heptet (J=10 and 5 c.p.s), while in the latter series the signal into a quintet (J=3 c.p.s). These findings indicate that (Xa) and (Xb) possess equatorial and axial hydroxyl groups, respectively.*

This result also establishes the trans ring fusion for the quinolizidines (Xa) and (Xb), since a cis ring fusion should permit each epimer to be assumed a predominant equatorial conformation for the respective hydroxyl groups; the trans ring fusion was supported by the fact that both compounds showed Bohlmann's bands in their infrared spectra. Unfortunately, since the C-2 proton signal of (II) was overlapped by other signals, we could not use it for these assignments.

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* The location of the ester group in (II) at C_3 was assigned on the basis of the positive ferric chloride test and lack of bands above 1700 cm^{-1} in the infrared spectrum.  
Table II. NMR Spectral Data for C-2 Protons of Ka, b and Xa, b

<table>
<thead>
<tr>
<th>Compound</th>
<th>Configuration of OH or OAc</th>
<th>Chemical shift ((\tau))</th>
<th>Splitting</th>
<th>J (c.p.s.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ka</td>
<td>equatorial</td>
<td>6.21</td>
<td>heptet</td>
<td>(J_{aa}=10, J_{ab}=5)</td>
</tr>
<tr>
<td>Xa</td>
<td>equatorial</td>
<td>5.08</td>
<td>heptet</td>
<td>(J_{aa}=10, J_{ab}=5)</td>
</tr>
<tr>
<td>Kb</td>
<td>axial</td>
<td>5.78</td>
<td>quintet</td>
<td>(J_{ee}=J_{oo}=3)</td>
</tr>
<tr>
<td>Xb</td>
<td>axial</td>
<td>4.76</td>
<td>quintet</td>
<td>(J_{ee}=J_{oo}=3)</td>
</tr>
</tbody>
</table>

Table III. Composition of Mixtures resulting from Reductions of the Amino Ketone (\(\text{VII}\))

<table>
<thead>
<tr>
<th>Reducing agent</th>
<th>Ka</th>
<th>Products Kb</th>
<th>(%(^{10}))</th>
<th>Starting material ((\text{VII}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>H$_2$, PtO$_2$ in AcOH</td>
<td>83</td>
<td>17</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>NaBH$_4$ in MeOH</td>
<td>89</td>
<td>11</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Na in toluene-EtOH</td>
<td>84</td>
<td>16</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Al(iso-PrO)$_3$ in benzene</td>
<td>52</td>
<td>41</td>
<td>7</td>
<td>--</td>
</tr>
</tbody>
</table>

a) The analyses were made by gas-liquid chromatography as the acetates (see Experimental).
The configurational assignments as given above are compatible with behavior of the amino ketone (\(\text{II}\)) towards the reducing agents summarized in Table III. It is well known\(^{10}\) that in the reduction of a non-hindered six-membered ketone thermodynamic control will govern the stereochemistry of metal hydride or metal-alcohol reductions and it was found that the more stable equatorial isomer (\(\text{Ka}\)) was formed in more than 80% yield by the use of sodium borohydride or sodium-alcohol. However, when the amino ketone (\(\text{II}\)) was reduced with aluminum isopropoxide in benzene at 40° for 15 min., some kinetic control should be exerted and it was found that the amount of the less stable axial isomer (\(\text{Kb}\)) increased.

Compounds \(\text{Ka}\) and \(\text{Kb}\) thus obtained were treated with dimethyl sulfate and potassium hydroxide and then potassium iodide to give the methiodide of the amine (\(\text{Xa}\)), m.p. 221~223°, and that of the amine (\(\text{Xb}\)), m.p. 210~212°, respectively. The latter methiodide was found to be identical with the methiodide of \(\text{III}\) in the infrared spectrum (chloroform solution).

The relative configurations at \(\text{C}_{10\alpha}\) and \(\text{C}_{1\beta}\) in securinine were established on the following grounds: i) Securinine showed the second ultraviolet absorption maximum at 308 m\(\mu\) (log \(\varepsilon\) 3.33) and 302 m\(\mu\) (log \(\varepsilon\) 3.47) in ethanol and methanol, respectively, which disappeared by addition of hydrochloric acid and shifted to 341 m\(\mu\) (log \(\varepsilon\) 3.21) in dioxane. It has been already pointed out in the studies\(^{11}\) of securinine and allosecurinine that this absorption band is due to “homoconjugation” between the nitrogen and the conjugated system and that in allosecurinine the absorption maximum is solvent-dependent, while in securinine this remains almost unaffected. An application of this situation to securinine suggests that the stereochemistry at \(\text{C}_{1\beta}\) and \(\text{C}_{1\beta}\) is the same as that of allosecurinine. ii) The unusually low chemical shift for \(\text{H}_{1\beta}\) (near 6.16\(\tau\)) in the nuclear magnetic resonance spectrum of securinine is interpreted by the magnetic anisotropy of the conjugated system,\(^{12}\) leading to the same conclusion. Therefore, the structure of securinine should be represented by I or its antipode.

This structure accounts for the high-field signal in the nuclear magnetic resonance spectrum of securinine, which showed a multiplet centered at 8.84\(\tau\), being equivalent to one proton. As mentioned earlier, spin–spin decoupling experiments on securinine revealed that the multiplet in question was a signal of one of two methylene protons at \(\text{C}_{1\beta}\). Examination of a Dreiding model of securinine based on the stereochemistry depicted in I, indicates that two methylene protons at \(\text{C}_{1\beta}\) are strongly shielded by the conjugated system, and hence this must be responsible for the upfield multiplet. However, if the Dreiding model was made on the basis of a securinine-type stereochemistry, the \(\text{C}_{1\beta}\) methylene protons lie close to the plane of zero shielding, and thus this structure can not satisfactorily account for the observed chemical shift.

The upfield multiplet is an octet and its pattern could be explained by assuming \(\text{H}_9, \text{H}_{1\beta}, \text{H}_{10\beta}\) and \(\text{H}_{1\alpha}\) to form an ABXY system: \(\text{H}_{10\beta}\) (or \(\text{H}_{1\alpha}\)) gives a quartet, as X portion of an ABX system, which is further split by a geminal coupling to the octet. Decoupling experiments mentioned before bore out the validity of this assumption and further gave the following approximate coupling constants: \(\text{J}_{10\alpha-10\beta}=8.5, \text{J}_{10\beta-\alpha}=3.5, \text{J}_{10\alpha-10\alpha}=14.3\) c.p.s. The large vicinal coupling constant (8.5 c.p.s.) found for \(\text{H}_{1\beta}\) and \(\text{H}_{1\alpha}\) requires the dihedral angle between these two protons to be near 180°, i.e. \(\text{H}_{1\beta}\) and \(\text{H}_{1\alpha}\) are diaxial, and the multiplet in question must be assigned to \(\text{H}_{1\alpha}\).

Finally, the optical rotatory dispersion curve of securinine showed a strong negative Cotton effect (\(a=-8.2\times10^4\)) in dioxane, indicating that this alkaloid belongs to

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securinurine (or allosecurinurine) group but not to virosecurinurine group. The full stereostructure of securinurine is, therefore, represented by I.

Recently, Parello, et al. have isolated a new alkaloid phyllantine from Phyllanthus discoides and proposed the structure (II), which showed that phyllantine is a diastereoisomer of securinurine.

Experimental

Isolation of Securinurine—Dried and finely powdered root barks of S. suffruticosa (1 kg.) were extracted with CH₂CH₂Cl₂ (3.5 L.) containing 10% NH₄OH (130 mL) at room temperature for 20 hr. The extract was evaporated in vacuo under 60° to give a dark green residue (26 g.), which was chromatographed on alumina (500 g.). Elution with ether gave a neutral oil (11.5 g.), securinurine (trace) and allosecurinurine (3.0 g.). Continued elution of the column with ether gave yellow plates of securinurine (I, 1.4 g.), m.p. 129–130°, after recrystallization from AcOEt. [α]₉0° = -952.3° (c, 1, EtOH). IR ν₇₀₃ cm⁻¹: 1818 (sh.), 1758, 1628, 860; UV λmax nm (log ε): 257 (4.20), 308 (3.33); ORD (c, 0.043, dioxane): [α]max = -2840°, [α]min = -3180°, [α]max = -19600°, [α]min = -26500°, [α]max = +54500°, [α]min = +31400°. Anal. Calcd. for C₁₄H₁₉O₉N: C, 67.99; H, 6.93; N, 5.66. Found: C, 67.96; H, 7.13; N, 5.77.

4-Dihydrosecurinurine (II)—A solution of securinurine (0.126 g.) in MeOH (4 mL) was added dropwise at room temperature with stirring to a solution of NaBH₄ (0.113 g.) in MeOH (5 mL). The yellow color of reaction mixture changed gradually into colorless. After stirring for 2 hr., the mixture was treated with AcOH (1 mL.) and evaporated in vacuo. The residue was dissolved in H₂O (15 mL), made alkaline with K₂CO₃ and extracted with ether. The dried extract was evaporated and the residue was recrystallized from iso-PrO₂H to give colorless needles of II (0.089 g., 72%), m.p. 118–119°. IR ν₇₀₃ cm⁻¹: 1915 (sh.), 1750, 1630; UV λmax nm (log ε): 215 (4.15); NMR: 4.4 (singlet, 1H), 6.75 (singlet, 3H, OCH₃). Anal. Calcd. for C₁₃H₁₉O₈N: C, 67.44; H, 7.68; N, 5.62. Found: C, 67.33; H, 7.88; N, 5.81.

1.3.4.6.7.11b-Hexahydro-2-methoxy-2H-benzo[a]quinolin-5-one—To a stirred solution of securinurine (I, 400 mg.) in conc. H₂SO₄ (8 g.) and abs. EtOH (20 mL), Zn-dust (4 g.) was added over a period of 30 min. and the mixture stirred at room temperature for 5 hr. The inorganic material was filtered off and washed with EtOH. The filtrate and washings, made alkaline with aqueous ammonia, were concentrated, saturated with K₂CO₃ and extracted with CHCl₃. The dried extract was evaporated to give a yellow viscous oil (350 mg.), which was chromatographed on silica gel (5 g.) using CHCl₃ as eluent to furnish a colorless viscous oil (196 mg.) of the lactam. [α]₉0° = -24° (c, 0.21, EtOH). IR ν₇₀₃ cm⁻¹: 1634 (C=O). NMR: 6.48 τ (singlet, 3H, OCH₃).

Further elution with the same solvent gave the starting material (I, 80 mg.).

1.3.4.6.7.11b-Hexahydro-2-methoxy-2H-benzo[a]quinolin-5-one (III)—A solution of the above-obtained lactam (190 mg.) in anhyd. ether (15 mL) was added dropwise to a stirred suspension of LiAlH₄ (200 mg.) in anhyd. ether (25 mL). After the mixture was refluxed for 4 hr., the excess hydride was decomposed with water. The inorganic material was filtered off and washed with ether. Evaporation of the dried filtrate and distillation of the residue gave a colorless oil (150 mg.), b.p. 180° (bath temperature). [α]₉0° = -89.5° (c, 0.19, EtOH). NMR: 6.50 τ (singlet, 3H, OCH₃).

The methiodide was recrystallized from iso-PrOH, m.p. 242–243°. Anal. Calcd. for C₁₈H₂₀ONI: C, 50.15; H, 6.17; N, 3.90. Found: C, 50.05; H, 6.05; N, 3.78.

Ethyl 2-Cyaanoethyl-1,2,3,4-tetrahydro-1-isoquinolineacetate (V)—A solution of ethyl 1,2,3,4-tetrahydro-1-isoquinolineacetate (V) (N, 21.0 g.) and acrylonitrile (10.0 g.) in EtOH (50 mL) was refluxed for 3 hr. The solvent and excess acrylonitrile were removed and the residual oil was distilled to give a light yellow oil (25 g., 96%), b.p. 140–175°. IR ν₇₀₃ cm⁻¹: 2230 (C≡N). Anal. Calcd. for C₁₈H₁₉N₂O: C, 73.05.

Ethyl 2-(Carboethoxyethyl)-1,2,3,4-tetrahydro-1-isoquinolineacetate (VI)—A solution of V (25 g.) in EtOH (60 mL) was saturated with dry HCl gas at 0°. The solution was stood at room temperature overnight, then refluxed for 2 hr. The precipitated NH₄Cl was filtered off and the filtrate was evaporated to dryness. The residue was made alkaline with conc. K₂CO₃ solution and extracted with ether. The

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14) Private communication from Dr. J. Parello, Institut de Chemie des Substances Naturelles.
dried extract was evaporated and the residual oil was distilled to give a light yellow oil of VII (28.g., 97%), b.p.5, 167~170°. IR ν_{max} cm^{-1}: 1735 (C=O).

**Ethyl 1,3,4,6,7,11b-Hexahydro-2-oxo-2H-benzo[a]quinolinizine-3-carboxylate (VII)**—A solution of the diester (VII, 28.0 g.) in dry C_{6}H_{6} (25 ml.) was added to a suspension of NaH (4 g., 50% oil dispersion) in dry C_{6}H_{6} (80 ml.) and the reaction mixture was refluxed with stirring for 3 hr. After cooling, the mixture was treated with cold glacial AcOH (13 g.), water (13 g.), and 10% HCl (60 ml.). The aqueous layer was made alkaline with conc. K_{2}CO_{3} solution and extracted with ether. The dried extract was evaporated to give a crude solid (13.5 g., 56%), which was recrystallized from petroleum ether to give colorless plates of VII, m.p. 115~116°. IR ν_{max} cm^{-1}: 1666 (C=O), 1625 (C=C). *Anal.* Calcd. for C_{13}H_{10}O_{3}N: C, 70.31; H, 7.01; N, 5.13. Found: C, 70.42; H, 7.10; N, 5.19.

This alcoholic solution gave a reddish-purple color with FeCl_{3}, 1,3,4,6,7,11b-Hexahydro-2H-benzo[a]quinolinizine-2-one (VIII)**—A solution of the ketoester (VIII, 11.0 g.) in 10% HCl (80 ml.) was refluxed for 2 hr. The cooled mixture was made alkaline with conc. K_{2}CO_{3} solution and extracted with ether. The dried extract was evaporated to give a yellow solid (5.0 g., 62%), which gave a single peak by GLC analysis. IR ν_{max} cm^{-1}: 1723 (C=O).

The oxime was recrystallized from iso-ProOH to give colorless plates, m.p. 182~183° (lit.15 m.p. 180°). *Anal.* Calcd. for C_{9}H_{10}O_{3}N: C, 72.19; H, 7.46; N, 12.95. Found: C, 72.43; H, 7.50; N, 12.74.

**Reduction of the Amino Ketone (VIII)**—a) **Catalytic Hydrogenation**—The ketone (VIII, 100 mg.) was hydrogenated over PtO (10 mg.) in glacial AcOH (20 ml.) at room temperature and atmospheric pressure. After cessation of H_{2} uptake (6 hr.), the catalyst was filtered off and the solvent was removed in vacuo. The residue was made alkaline with conc. K_{2}CO_{3} solution and extracted with CHCl_{3}. The dried extract was evaporated to give a mixture (100 mg.) of the alcohols N\alpha and N\beta in ratio of 83:17, by GLC analysis.**

b) **Sodium Borohydride Reduction**—To a solution of the ketone (VIII, 100 mg.) in MeOH (10 ml.), NaNH\_ (100 mg.) was added in small portions and the reaction mixture was refluxed for 2 hr. The cooled mixture was treated with glacial AcOH, evaporated to dryness, made alkaline with conc. K_{2}CO_{3} solution and extracted with CHCl_{3}. Evaporation of the dried extract gave a mixture (100 mg.) of N\alpha and N\beta in a ratio of 89:11, by GLC analysis.**

c) **Sodium-ethanol Reduction**—A solution of the ketone (VIII, 500 mg.) in toluene (5 ml.) and abs. EtOH (5 ml.) was added to a suspension of Na (500 mg.) in dry toluene (50 ml.) over a period of 30 min. Then the reaction mixture was refluxed with stirring for 3 hr., cooled and treated with water. The toluene layer was dried and evaporated to give a reddish brown oil (500 mg.), which was shown to be a mixture of N\alpha and N\beta in a ratio of 84:16, by GLC analysis.**

d) **Aluminum-isopropoxide Reduction**—A solution of the ketone (VIII, 1.8 g.) in dry C_{6}H_{6} (35 ml.) was added to a solution of Al(iso-PrO)\_ (20 g.) in dry C_{6}H_{6} (100 ml.) at 40° over a period of 20 min. After addition was complete, the mixture was treated with 5% HCl and the acid layer was made alkaline with conc. K_{2}CO_{3} solution and extracted with CHCl_{3}. Evaporation of the dried extract gave a mixture (1.8 g.) of N\alpha, N\beta and the starting material (VIII) in a ratio of 52:41:17, by GLC analysis.**

**cis- and trans-2-Acetoxy-1,3,4,6,7,11b-hexahydro-2H-benzo[a]quinolinizine (Xa and Xb)**—A mixture of the Al(iso-PrO)\_ reduction product (1.8 g.) of VIII, AcO\_ (10 ml.) and pyridine (20 ml.) was warmed at 50° for 2 hr. After standing overnight, the pyridine and excess AcO\_ were removed in vacuo. The residue was made alkaline with conc. K_{2}CO_{3} solution and extracted with ether. Evaporation of the dried extract gave a viscous oil (1.9 g.), which was chromatographed on silica gel. Elution with CHCl\_\_ afforded a white solid, which was recrystallized from petroleum ether to give colorless plates of the cis-acetate (Xa), m.p. 105°. IR ν_{max} cm^{-1}: 2817, 2736 (trans-quinolinizidine bands), 1736 (C=O). *Anal.* Calcd. for C_{13}H_{10}O_{3}N: C, 73.44; H, 7.81; N, 5.71. Found: C, 73.67; H, 7.65; N, 5.51.

Continued elution with AcO\_ afforded a viscous oil, which was converted to the hydrochloride. Recrystallization from iso-ProOH gave white crystals of the trans-acetate (Xb), m.p. 202~203°. *Anal.* Calcd. for C_{13}H_{10}O_{3}NCl: C, 63.94; H, 7.15; N, 4.97. Found: C, 63.34; H, 7.05; N, 4.98.

The free base (Xb) recovered from the hydrochloride was shown to be homogeneous by TLC. IR ν_{max} cm^{-1}: 2811, 2764 (trans-quinolinizidine bands), 1733 (C=O).

**cis-2-Hydroxy-1,3,4,6,7,11b-hexahydro-2H-benzo[a]quinolinizine (IXa)**—a) Three recrystallizations of the crude NaBH\_ reduction product of VIII from C_{6}H_{6} gave pure colorless crystals of the cis-alcohol (Ka), m.p. 142~143°. IR ν_{max} cm^{-1}: 3620 (OH), 2818, 2748 (trans-quinolinizidine bands). *Anal.* Calcd. for C_{13}H_{10}ON: C, 78.61; H, 8.43; N, 6.89. Found: C, 78.60; H, 8.40; N, 7.12.

b) A solution of the cis-acetate (Xa, 100 mg.) and KOH (150 mg.) in MeOH (5 ml.) was refluxed for 2 hr. After removal of the MeOH in vacuo, the residue was dissolved in a small amount of water and extracted with CHCl\_\_. Evaporation of the dried extract gave a solid (45 mg.), which was recrystallized from

C₄H₆ to give colorless crystals of the cis-alcohol (Xa), m.p. 142~143°, which was identical in all respects with the product obtained by (a).

**trans-2-Hydroxy-1.3.4.6.7.11b-hexahydro-2H-benzo[a]quinolizine (IXb)**—The trans-acetate (Xb, 100 mg.) was hydrolyzed in the same way as for the cis-acetate (Xa). Recrystallization of the resulting solid from C₄H₆ gave colorless crystals of the trans-alcohol (Xb), m.p. 142~143° (depressed to 109~115° on admixture with the cis-alcohol (Xa)). IR νmax cm⁻¹: 3620 (OH), 2818, 2750 (trans-quinolizidine bands). **Anal.** Calcd. for C₁₉H₁₆ON: C, 76.81; H, 8.43; N, 6.89. Found: C, 76.62; H, 8.24; N, 6.98

**cis-2-Methoxy-1.3.4.6.7.11b-hexahydro-2H-benzo[a]quinolizine (Xla)**—To a stirred suspension of the cis-alcohol (Xa, 100 mg.) in 10% NaOH solution (10 mL), dimethyl sulfate (2 g.) was added at room temperature during a period of 30 min. After stirring at 40° for 2 hr., the mixture was neutralized with 10% H₂SO₄ and evaporated to dryness in vacuo. The residue was extracted with MeOH and the MeOH extract was evaporated. The solution was dissolved in water (5 mL), a solution of KI (1 g.) in water (10 mL) was added. The solution was stirred at room temperature for 15 min., and extracted with CHCl₃. The dried extract was evaporated to give a white solid (40 mg.) which was recrystallized from iso-PrOH-MeOH to give white needles of the methiodide of the cis-methyl ether (Xa), m.p. 221~223°. **Anal.** Calcd. for C₁₉H₁₇ONI: C, 50.15; H, 6.17; N, 3.90. Found: C, 50.36; H, 6.46; N, 3.67.

**trans-2-Methoxy-1.3.4.6.7.11b-hexahydro-2H-benzo[a]quinolizine (Xlb)**—The trans-alcohol (Xb, 100 mg.) was treated in the same way as for the cis-alcohol (Xa) to give white needles of the methiodide of the trans-methyl ether (Xb), which was recrystallized from iso-PrOH, m.p. 210~212°. **Anal.** Calcd. for C₁₉H₁₇ONI: C, 50.15; H, 6.17; N, 3.90. Found: C, 49.94; H, 5.90; N, 3.57.

The IR spectrum of this methiodide in CHCl₃ solution was identical with that of the methiodide of III derived from securtinoline.

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