11-Deoxojervine, A New Alkaloid from *Veratrum* Species[1]

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(Received January 9, 1965)

Veratrum species have been extensively investigated, and a large number of alkaloids have been isolated.[2] In connection with a study aimed at the synthesis of C-nor-D-homosteroid hormones, we have searched for alkaloids from a kind of *Veratrum* species and have found a new alkaloid to be a principal component. In a preliminary communication,[3] we reported that this alkaloid was 11-deoxojervine; the present paper will describe the details.

Benzene extracts of the alkalized, ground roots of *V. album L. var. glandiflorum Maxima. (V. glandiflorum Loesen. fil.)* which had been collected in May in the Tokachi district, Hokkaido, were subjected to separation according to a modified Jacobs' procedure.[4] The new alkaloid was isolated in a 0.30% yield, along with veratramine, rubijervine and solanidine,[5] from the basic fraction, and β-sitosterol, from the neutral fraction. While Saito and Suginome had obtained jervine,[6] together with veratramine,[7] as a major alkaloid from the plant collected in October at Nopporo, Hokkaido, no jervine was isolated in the present investigation. On the other hand, Takaoka[8] has reported the isolation of a sterol from the same plant; judging from a comparison of their melting points, the sterol seems to be the same compound as that obtained in the present research.

The new alkaloid (I) (m.p. 237—238°C, $[\alpha]_D^{23}$ −44.2°) was analyzed for $C_{27}H_{41}O_2N$; both the infrared and ultraviolet spectra indicated the absence of a carbonyl group and a conjugated diene. The acetylation of I with acetic anhydride and pyridine on a steam bath afforded the *O,N*-diacetyl derivative (Ia), which melted at 163—165°C, resolidified, and again melted at 195—197°C. The infrared spectrum showed no absorption due to a hydroxyl group in the region of 3 μ; therefore, the remaining oxygen must be an ether function. An attempted reduction of I with lithium aluminum hydride or with lithium in liquid ammonia led to a quantitative recovery of the starting material and ruled out the possibility of an epoxide group. Absorptions near 1050 cm^{-1} in the infrared spectra of I and Ia (1062 and 1037 cm^{-1} respectively) suggested[9] the

1) Part IV of "C-Nor-D-homosteroids and Related Alkaloids"; Part III; Ref. 17.

2) For reviews, see; C. R. Narayanan, "Progress in the Chemistry of Organic Natural Products," Vol. XX, Springer-Verlag, Wien (1962), p. 298; K. J. Morgan and J. A. Bartrop, *Quart. Rev.*, **12**, 34 (1958).

3) T. Masamune, Y. Mori, M. Takasugi and A. Murai, *Tetrahedron Letters*, **1964**, 913.

4) W. A. Jacobs and L. C. Craig, *J. Biol. Chem.*, **155**, 565 (1944); ibid., **160**, 555 (1945); A. Stoll, D. Stauffacher and E. Seebeck, *Helv. Chim. Acta*, **38**, 1964 (1955).

5) It appears that no paper has yet been published showing the isolation of solanidine from *Veratrum* species. Cf. H. G. Boit, "Ergebnisse der Alkaloid-Chemie bis 1960," Akademie-Verlag, Berlin (1961), p. 758.

6) K. Saito, H. Suginome and M. Takaoka, This Bulletin, **9**, 15 (1934).

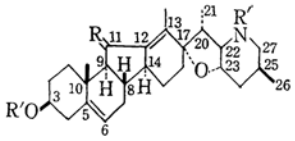
7) K. Saito, ibid., **15**, 22 (1940).

8) M. Takaoka, *J. Chem. Soc. Japan (Nippon Kwagaku Kwaishi)*, **60**, 1090 (1939).

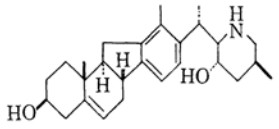
9) A. R. H. Cole, R. N. Jones and K. Dobroner, *J. Am. Chem. Soc.*, **74**, 5571 (1952).

presence of a Δ^5-3β-hydroxyl group, a probability of which was supported by the NMR spectrum. The NMR spectrum of Ia closely resembled that of diacetyljervine[10] (IIa), but two new sharp peaks appeared at τ 8.29 and 9.06; these were comparable to the signals due to C-18 methyl (τ 7.81) and C-19 methyl groups (τ 8.99) of IIa. Furthermore, the treatment of I with sulfuric acid in the presence of ferric sulfate yielded veratramine (III), although the yield was low. All these results strongly suggested that I was 11-deoxojervine.

The structure was confirmed by the removal of the oxygen on C-11 of jervine (II).

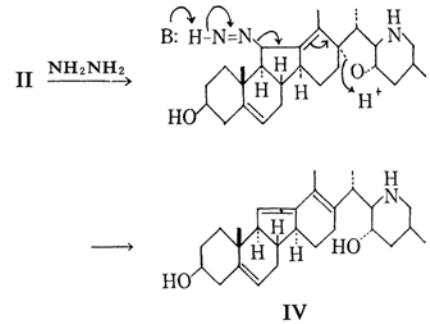


(I) R=H$_2$, R′=H
(Ia) R=H$_2$, R′=Ac
(II) R=O, R′=H
(IIa) R=O, R′=Ac



(III)

The carbonyl group of II is sterically hindered[11] and formed no oxime, even under severe conditions.[12] The Clemmensen reduction of 12, 13-dihydrojervine[13] gave rise to no crystalline substances beside the starting material. However, the Wolff-Kishner reduction of II according to the procedure by Barton[14] resulted in the formation of two crystalline compounds IV, m. p. 211—213°C, and V, m. p. 236—238°C. The former, IV, had a molecular formula of $C_{27}H_{41}O_2N$, and its infrared (1615 cm^{-1}) and ultraviolet spectra (λ_{max} 245 mμ, ε 25500) showed that it was a conjugated diene. The diene was converted to the corresponding *O*, *O*, *N*-triacetyl derivative (IVa), m. p. 116—118°C. The NMR spectrum of IVa had a broad peak centered at τ 4.53 (2H), a broad multiplet which consisted of three peaks centered at τ 4.93, 5.25 and 5.36 (3H),[15] and a singlet at τ 8.29, indicating that two olefinic protons were present, that a methyl group was attached to olefinic carbon, and also that the cleavage of the ether linkage of II was taking place. On the basis of these facts, the formula IV seems to be the most favorable structure for the compound with a m. p. of 211°C, as the reaction has been considered to proceed through the following sequence:[16]



IV

This diene was also obtained by the treatment of jervine-11β-ol with sodium and butanol. On the other hand, the compound V has been shown to be identical with the compound I by a mixed melting point determination and by a comparison of the infrared spectra; thus, the new alkaloid is 11-deoxojervine. While the configuration of the B/C juncture has been established to be *trans* in the previous communication,[17] the direct transformation of the deoxojervine into veratramine also supports the α-configuration of the hydrogen on C-9.

Experimental

The melting points are uncorrected. The optical rotations and the ultraviolet spectra were measured in 95% ethanol and 99% ethanol, and the infrared spectra in Nujol unless otherwise stated. The NMR spectra were taken in deuterochloroform at 60 Mc., using tetramethylsilane as an internal standard.

The Extraction and Fractionation of the Roots.[4] —The ground, dried roots of *V. grandiflorum Loesen. fil.* (29 kg.), collected in May at Toyoni, Tokachi, Hokkaido, were moistened with about 1 N aqueous ammonia (16 l.) and extracted with benzene (116 l.) at room temperature for 5 days. During the extraction, the entire mixture was shaken several times a day. The extracts were drained through filter pads and found to amount to 60 l.

The extraction was repeated nine times; each time 40 l. of benzene was added anew, and 45 l. of the extracts were percolated every 4 days. The roots, after extraction with benzene, were finally treated with 95% ethanol (40 l.) for 1 week; the

10) T. Masamune, M. Takasugi, M. Gohda, H. Suzuki, S. Kawahara and T. Irie, *J. Org. Chem.*, **29**, 2282 (1964).
11) L. F. Fieser and M. Fieser, "Steroids," Reinhold Publishing Corporation, New York, N. Y. (1959), p. 871.
12) Cf. N. L. Hosansky and O. Wintersteiner, *J. Am. Chem. Soc.*, **78**, 3126 (1956).
13) Cf. J. Fried and A. Klingsberg, ibid., **75**, 4929 (1953).
14) D. H. R. Barton, D. A. J. Ives and B. Thomas, *J. Chem. Soc.*, **1955**, 2056.
15) Cf. Ref. 10, footnote 33a.
16) Cf. H. H. Szmant and C. M. Harmuth, *J. Am. Chem. Soc.*, **86**, 2909 (1964), and the references cited there.
17) T. Masamune, M. Takasugi and Y. Mori, *Tetrahedron Letters*, **1965**, 489.

alcoholic extracts were designated fraction A.

The benzene extracts were shaken seven times (15 min. each time) with 5% aqueous tartaric acid (500 ml. per 10 l. of the benzene extracts). The tartaric acid solutions were made alkaline to pH 9 with 20% aqueous sodium carbonate below 12°C, and an amorphous mixture of the bases thus separated was collected by filtration. The basic mixtures were then combined and dried, yielding 650 g. The aqueous filtrate was shaken with chloroform (3 l. per 10 l. of the aqueous filtrate), and the chloroform extracts were washed with water, dried, evaporated to dryness and combined (fraction B).

The entire alkaloidal mixture was divided, by treatment with seven portions of 9 l. of benzene, into benzene-soluble and benzene-insoluble fractions. These fractions were worked up as will be described in parts a and b below. During the fractionation of the mixture of alkaloids, the content and homogeneity of each fraction were always checked by paper chromatography.[18]

a) The benzene-soluble fraction (65 l.) was shaken twice with equal volumes of a 0.1 M aqueous citrate buffer solution (pH 6.0). The buffered solutions were extracted with chloroform after having been made alkaline to pH 9 with 20% aqueous sodium carbonate; the chloroform extracts left 155 g. of a tarry material (fraction C) when the solvent was removed.

The benzene solution which was separated from the buffered solutions was washed, dried, and evaporated to dryness. The residue was dissolved in 10% aqueous acetic acid (5 l.) and filtered to remove intractable tarry matters. To the acidic solution was added a saturated aqueous solution of ammonium sulfate (1.1 l.), yielding gelatinous precipitates which were collected by filtration. The aqueous filtrate was made alkaline with ammonia and extracted with chloroform. The chloroform extracts were washed with water, dried over sodium sulfate, and evaporated to dryness, leaving 50 g. of tarry substances (fraction D).

The precipitates of the sulfates were suspended in 10% aqueous sodium hydroxide and then shaken with chloroform (total 4.7 l.) vigorously and repeatedly, until the precipitates disappeared completely. The combined chloroform extracts were washed with water, dried, and evaporated to dryness, leaving 178 g. of an amorphous solid. The solid was dissolved in ethanol (1 l.) and concentrated hydrochloric acid (35 ml.) was added, yielding crystalline hydrochlorides, which were then collected by filtration. The filtrate was designated as fraction E. When the crystalline hydrochlorides were dissolved in boiling 65% aqueous ethanol (350 ml.), made alkaline with concentrated aqueous ammonia and then allowed to stand overnight, crude 11-deoxojervine (m. p. 224—227°C) was regenerated and collected by filtration (yield 15 g.).

b) The benzene-insoluble fraction left after the removal of the benzene-soluble part was fractionated in a way similar to that used for the benzene-soluble part; it was dissolved in 10% aqueous acetic acid (7.5 l.) and treated with a saturated solution of ammonium sulfate (800 ml.) to yield 225 g. of the precipitates of sulfates, which were then filtered. Regeneration from the filtrate with concentrated aqueous ammonia and extraction with chloroform gave 33 g. of a crystalline solid (fraction F).

The precipitates of sulfates suspended in 10% aqueous sodium hydroxide were repeatedly shaken with chloroform (total 6.9 l.); the chloroform extracts gave an amorphous solid after the solvent had been removed. The amorphous solid was dissolved in ethanol (700 ml.) and afforded, on the addition of cocentrated hydrochloric acid (40 ml.), crystalline hydrochlorides; these were then collected by filtration and found to amount to 103 g. The filtrate gave, when made alkaline with concentrated aqueous ammonia (200 ml.), 59 g. of an amorphous solid (fraction G). The regeneration of the free base from the crystalline hydrochlorides dissolved in boiling 65% aqueous ethanol (3.6 l.) with concentrated ammonia (190 ml.), cooling and filtration, afforded 80 g. of crude deoxojervine, m. p. 225—227°C.

The Isolation of Veratramine from Fraction G.—Fraction G consisted mainly of veratramine (III) and 11-deoxojervine (I); it was fractionated on the basis of the following facts; (1) the hydrochloride of I was less soluble in ethanol than that of III, and (2) I decomposed readily upon treatment with sulfuric acid in refluxing ethanol, whereas III was stable under those conditions. A part (50 g.) of fraction G was dissolved in boiling ethanol (130 ml.), cooled, and filtered. The crystalline precipitates (10.6 g.) were converted into the hydrochlorides and recrystallized three times. Each of the filtrates left after recrystallization was made alkaline to yield a mixture of bases; this mixture was collected by filtration and combined. The combined mixtures contained more III than I; they amounted to 5.8 g. after having been dried. On the other hand, water (100 ml.) was added to the filtrate after the removal of the first crystalline precipitates, separating 26.6 g. of an amorphous solid which contained more III than I. These veratramine-rich fractions (total 32.4 g.) were combined and worked up in a way similar to that mentioned above, yielding 20.2 g. of crude veratramine. To the crude veratramine dissolved in ethanol (500 ml.), concentrated sulfuric acid (20 ml.) was added under cooling; the mixture was then refluxed for 1 hr. The alkalification of the solution with ammonia (60 ml. of concentrated ammonia and 1 l. of water), followed by cooling and filtration, afforded veratramine, which was recrystallized from aqueous ethanol (200 ml. of ethanol and 140 ml. of water) and found to have a m. p. of 204—205°C. The yield was 14.3 g. Identification was made by a mixed melting point determination with an authentic sample and by a comparison of the infrared spectra and of the paper chromatograms.

The Isolation of Rubijervine from Fraction F.—Fraction F was dissolved in acetone; the concentration of the solution led to the separation of

18) The following three systems were used for paper chromatography; A) *n*-butyl acetate - *n*-butanol - formic acid - water (10 : 25 : 10 v. v.); B) ethylene chloride - Cellosolve acetate - pyridine (15 : 10 : 1), and c) *n*-butyl acetate - *n*-butanol - formic acid - water (100 : 1 : 1.5 : 0.5).

crude rubijervine (11.9 g.), m. p. 241—243°C. Recrystallization from acetone gave pure rubijervine, m. p. 246—246.5°C, which was identified by a mixed melting point determination with an authentic sample and by a comparison of the infrared spectra and of the paper chromatograms.

The Isolation of Solanidine and Veratramine from Fraction E.—One-third (350 ml.) of fraction E was evaporated in vacuo, and the residue was dissolved in water (240 ml.), made alkaline with 2 N aqueous ammonia, and extracted with chloroform (230 ml.). The chloroform solution was washed with water (300 ml.), dried over sodium sulfate, and then evaporated to dryness, leaving 45 g. of a tarry material. This was refluxed in 1 N methanolic sulfuric acid (300 ml.) for 2 hr. to remove 11-deoxojervine and cooled, and then water (400 ml.) was added. The whole mixture was made alkaline with 10% aqueous sodium carbonate and extracted with chlorom (200 ml.). The chloroform solution gave, on the removal of the solvent, 36.4 g. of a tarry material, which was then dissolved in benzene (200 ml.) and chromatographed on alumina (Merck neutral, 900 g.) in a column (diameter 50 mm.). All those fractions eluted with mixtures of benzene and ether, and all those eluted with mixtures of ether and chloroform (20 : 1 and 17 : 1) were crystallized, on the removal of the solvent and trituration with acetone, and were combined; they amounted to 350 mg. On recrystallization from acetone, pure solanidine (100 mg.), m. p. 217—219°C, was obtained.

Found: C, 81.70; H, 11.18; N, 3.70. Calcd. for $C_{27}H_{43}ON$: C, 81.55; H, 10.90; N, 3.52%.

On treatment with acetic anhydride and pyridine at room temperature overnight, this was converted to the acetate, m. p. 205—206°C.

Found: C, 79.00; H, 10.51; mol. wt. 439 by the mass spectrum. Calcd. for $C_{29}H_{45}O_2N$: C 79.22; H, 10.32%; mol. wt. 439.66.

Identification was made by means of a comparison of the infrared spectrum with that described in Ref. 19 and by an analysis of the NMR spectra.

Fractions eluted with mixtures of ether and chloroform (4 : 1 to 1 : 8) crystallized on the removal of the solvents, which contained veratramine as a major component. Recrystallizations from acetone afforded 4.0 g. of veratramine, m. p. 202—204°C.

The Isolation of β-Sitosterol from Fraction A.—Fraction A was concentrated to 2 l., and a part (500 ml.) of the concentrate thus obtained was shaken with three poritions of 500 ml. of petroleum ether (b. p. 30—60°C) to remove any resinous substances. The concentrate separated from the petroleum ether solution was shaken with 1 N aqueous acetic acid (1 l.), centrifuged, and divided into fractions soluble and insoluble in the acidic solution. The insoluble material (35 g.) was continuously treated with ether in a Soxhlet extractor for 6 hr. The resulting ether-insoluble solid (29 g.) was further refluxed with 2 N hydrochloric acid in 95% ethanol on a water bath for 2 hr., and then cooled. After the removal of the ethanol in vacuo, the residue was extracted with ether to yield a brown oil, which was then chromatographed on alumina (Merck neutral, 30 g.). Fractions eluted with mixtures of petroleum ether and benzene (5 : 5 to 3 : 8) and those eluted with benzene crystallized on the removal of the solvent and were combined; yield 200 mg. On recrystallization from ethanol, 60 mg. of β-sitosterol, m. p. 134—136°C and $[\alpha]_D^{23}$ −32°, was obtained. The alcohol gave, when treated with acetic anhydride and pyridine at room temperature overnight, the corresponding acetate, which had a m. p. of 118—119°C and $[\alpha]_D^{23}$ −33° on recrystallization from ethanol. Identification was made by a mixed melting determination with an authentic sample and by a comparison of the infrared spectra and the NMR spectra.[20] The sterol isolated by Takaoka[8] had a m. p. of 135—136°C.

11-Deoxojervine and 3-*N*-Diacetyl-11-deoxojervine.—The recrystallization of crude deoxojervine from methanol gave a pure sample, m. p. 236—238°C, which contained the solvent and which showed an infrared spectrum different from that of the sample after drying. For analysis, this was recrystallized from methanol and dried at the temperature of boiling xylene; it thus had a m. p. of 237—238°C and $[\alpha]_D^{23}$ −44.2°; UV only end absorption; IR ν_{max} 3270, 1067, 1060 and 809 cm^{-1}.

Found: C, 78.78, 78.87; H, 10.12, 9.91; N, 3.59, 3.53. Calcd. for $C_{27}H_{41}O_2N$: C, 78.78; H, 10.04; N, 3.40%.

11-Deoxojervine (101 mg.) was treated with acetic anhydride (1 ml.) and pyridine (1 ml.) on a water bath for 2 hr., and then worked up as usual to yield the crude diacetyl derivative. On recrystallization from aqueous ethanol, 84 mg. of diacetyl-11-deoxojervine was obtained; this contained the solvent and melted at 163—164°C, resolidified, and then melted again at 195—197°C; IR: ν_{max} 3550, (solvent), 3460 (solvent), 1722, 1655 (shoulder), 1640, 1254 and 817 cm^{-1}.

Found: C, 72.97; H, 8.93; N, 2.90. Calcd. for $C_{31}H_{45}O_4N \cdot H_2O$: C, 72.48; H, 9.22; N, 2.73%.

On being dried at the temperature of boiling xylene, this had a m. p. of 195—197°C and $[\alpha]_D^{23}$ +1.1°; IR: ν_{max} 1733, 1640, 1231 and 812 cm^{-1}; NMR: a broad peak centered at τ 4.56 (1H, olefinic proton on C-6), a broad multiplet centered at τ 5.40 (1H, proton on C-3), two singlets at τ 7.90 and 7.97 (each 3H, *N*- and *O*-acetyl groups), a singlet at τ 8.29 (3H, 18-methyl group), two doublets (J=7 and 6 c. p. s.) centered at τ 8.99 and 9.06 (each 3H, two secondary methyl groups), and a singlet at τ 9.06 (3H, 19-methyl group).

Found: C, 75.26; H, 8.93; N, 2.89. Calcd. for $C_{31}H_{45}O_4N$: C, 75.11; H, 9.15; N, 2.83%.

The Treatment of 11-Deoxojervine with Sulfuric Acid.—To a solution of 11-deoxojervine (220 mg.) in methanol (50 ml.) concentrated sulfuric acid (3.1 ml.) and ferric sulfate (55 mg.) were added under cooling. The solution was then stirred for 5 hr. at room temperature. After the addition of water (100 ml.), the solution was made alkaline with 2 N aqueous ammonia and extracted with three portions of 30 ml. of chloroform. The chloroform extracts were then washed with water, dried over sodium sulfate, and evaporated to dryness,

19) S. W. Pelletier and W. A. Jacobs, *J. Am. Chem. Soc.*, 75, 4444 (1953).

20) G. Slomp and F. A. MacKellar, ibid., 84, 204 (1962).

leaving 205 mg. of an amorphous solid which showed 5 spots on the paper chromatogram. The residue was dissolved in 5% aqueous acetic acid (10 ml.) and filtered. The addition of a saturated solution of ammonium sulfate yielded resinous precipitates, which were collected by decantation and then washed with water. A suspension of the precipitates in aqueous ammonia was shaken with three portions of 10 ml. of chloroform. The chloroform extract gave, after drying and the removal of the solvent, 53 mg. of an amorphous solid, which crystallized on trituration with acetone. Recrystallization from acetone afforded veratramine (10 mg.), m. p. 201—203°C.

The Wolff-Kishner Reduction of Jervine.[14]—To freshly-distilled diethylene glycol (325 ml.) sodium (7.5 g.) was added; the mixture was then heated to 180°C and cooled. To this solution anhydrous hydrazine (45 ml.)[21] was added, and the mixture was refluxed for a while and then cooled. After the addition of jervine (5.0 g.), the entire mixture was heated at 180±5°C for 60 hr., further heated to 210°C to remove the excess hydrazine, and again refluxed for another 24 hr. To the cooled solution water (250 ml.) was added, and the whole mixture was extracted with three 250 ml. portions of chloroform. The chloroform extracts were washed with water, dried over sodium sulfate, and evaporated to dryness, yielding 5.0 g. of an amorphous solid, which was then crystallized on trituration with acetone. Fractional recrystallizations from acetone, purity of each fraction being checked by paper chromatography, led to the successful separation of two crystalline compounds. One (1.1 g.) had a m. p. of 236—238°C on recrystallization from a mixture of methanol and acetone; it was identical with 11-deoxojervine in all respects.

Another compound, conjugated diene (IV), had a m. p. of 211—213°C and $[\alpha]_D^{23}$ +3.5° when recrystallaized from acetone or methanol, and it amounted to 0.45 g.; UV: λ_{max} 245 mμ (ε 25500); IR: ν_{max} 3420, 1615, 1058, 878 and 815 cm^{-1}.

Found: C, 78.74; H, 10.24; N, 3.78. Calcd. for $C_{27}H_{41}O_2N$: C, 78.78; H, 10.04; N, 3.40%.

The acetylation of the conjugated diene (77 mg.) with acetic anhydride (1 ml.) and pyridine (1 ml.) on a water bath for 3 hr. afforded 48 mg. of the triacetyl derivative with a m. p. of 116—118°C and $[\alpha]_D^{23}$ +46° after recrystallization from a mixture of methanol and ethanol; UV: λ_{max} 243 mμ (ε 23800); IR: ν_{max} 1733, 1637, 1615, 1242, 1022 and 811 cm^{-1}; NMR: a broad peak centered at τ 4.53 (2H, protons on C-6 and C-11), a broad multiplet which consisted of three peaks centered at τ 4.93, 5.25 and 5.36 (3H, protons on C-3, C-22 and C-23),[15] a singlet at τ 7.98 (9H, *N*- and two *O*-acetyl groups), a singlet at τ 8.29 (3H, 18-methyl group), a doublet (J=6 c. p. s.) centered at τ 8.86 (6H, two secondary methyl groups), and a singlet at τ 8.99 (3H, 19-methyl group).

Found: C, 71.27; H, 8.58; N, 2.59. Calcd. for $C_{33}H_{47}O_5N \cdot H_2O$: C, 71.32; H, 8.89; N, 2.52%.

The Treatment of Jervine-11β-ol with Sodium and Butanol. — To a solution of jervine-11β-ol (507 mg.)[22] in boiling *n*-butanol (500 ml.), 36 g. of sodium was added over a period of 5 hr.; the mixture was then refluxed for another 1.5 hr. while being stirred and cooled. After the removal of the butanol by steam distillation, the residue was extracted with three portions of 70 ml. of chloroform, and the chloroform extracts were dried over sodium sulfate and evaporated to dryness, leaving 501 mg. of an amorphous solid. The solid was dissolved in *n*-butanol (350 ml.) and treated with sodium (29 g.) for 6.5 hr. When the reaction mixture was worked up in a way similar to that mentioned above, it left 478 mg. of the residue. Crystallization and recrystallization from a mixture of acetone and ether afforded 83 mg. of the conjugated diene (IV), m. p. 213—214°C. The paper chromatogram of the filtrate showed that it consisted of IV and the starting material, which prevented IV from further isolation because of its lower solubility in the solvent.

Found: C, 78.36; H, 10.24; N, 3.78. Calcd. for $C_{27}H_{41}O_2N$: C, 78.78; H, 10.04; N, 3.40%.

The acetylation of the diene obtained above gave the corresponding triacetyl derivative, m. p. 120—121°C. For analysis it was dried at the temperature of boiling methanol for a long time.

Found: C, 73.86, 73.56; H, 9.02, 9.08; N, 2.88, 3.06. Calcd. for $C_{33}H_{47}O_5N$: C, 73.71; H, 8.81; N, 2.61%.

The conjugated diene and the acetyl derivative were identical with the corresponding compounds obtained by the Wolff-Kishner reduction of jervine.

The authors wish to express their thanks to Professor Toshi Irie for his encouragement and also to Mr. Shigezo Shimokawa and Mr. Seiichiro Ohnishi, the Toyo Rayon Company, Ltd., for their measurement of the NMR spectra. They are also indebted to Mr. Naoyuki Sakamoto and Mr. Shoji Ueno for collecting the plants.

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21) L. I. Smith and K. L. Howard, *Org. Synth.*, **24**, 53 (1944).

22) B. M. Iselin, M. Moore and O. Wintersteiner, *J. Am. Chem. Soc.*, **78**, 403 (1956).