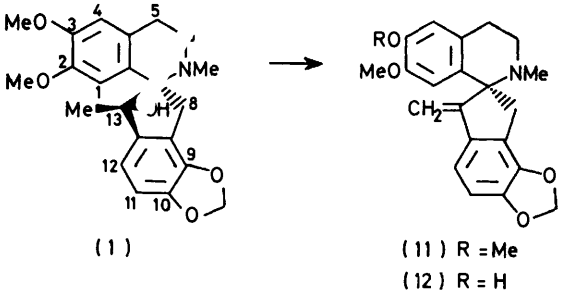
Studies on the Syntheses of Heterocyclic Compounds. Part 682.† Six New Isoquinoline Alkaloids from *Corydalis ochotensis* var. *raddeana*

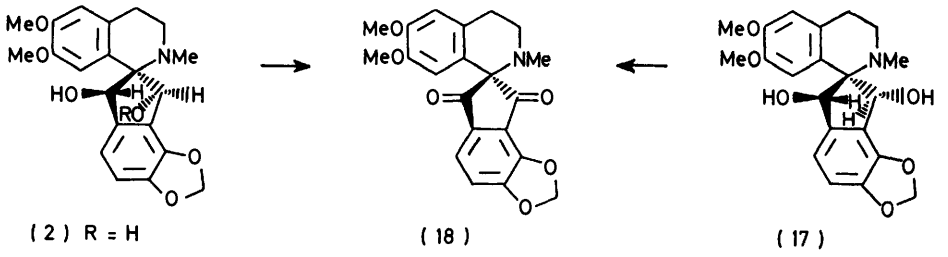
By **Tetsuji Kametani,* Makoto Takemura, Masataka Ihara,** and **Keiichiro Fukumoto,** Pharmaceutical Institute, Tohoku University, Aobayama, Sendai, Japan

Separation of the alkaloids from *Corydalis ochotensis* yielded six new isoquinoline alkaloids, raddeanamine (1), raddeanine (2), raddeanidine (3), raddeanone (4), aobamine (5), and aobamidine (6), along with the known alkaloids protopine (7), adlumidine (8), bicuculline (9), dihydrosanguinarine (10), ochotensimine (11), ochotensine (12), cheilanthifoline (13), scoulerine (14), sinoacutine (15), and pallidine (16).

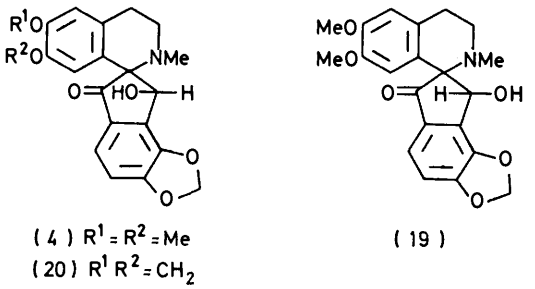
Corydalis ochotensis var. *raddeana* (Papaveraceae) is distributed widely in Japan. We report here the isolation from this plant and identification of six new isoquinoline alkaloids (1)—(6) and the known alkaloids (7)—(16).



(1) (11) R = Me (12) R = H



(2) R = H (3) R = Ac (18) (17)



(4) $R^1 = R^2 = Me$ (20) $R^1R^2 = CH_2$ (19)

The plant was collected in Sendai in September 1975, and the basic extract was separated into phenolic and non-phenolic bases, which were characterised after separation by silica gel column chromatography, followed by purification using preparative t.l.c. or reverse phase high-pressure liquid chromatography, if necessary.

From the non-phenolic fraction, six new alkaloids, raddeanamine (1), raddeanine (2), raddeanidine (3), raddeanone (4), aobamine (5), and aobamidine (6), were isolated along with the known alkaloids, protopine (7),

† Part 681, T. Kametani, H. Nemoto, M. Takeuchi, M. Takeshita, and K. Fukumoto, preceding paper.

adlumidine (8), bicuculline (9), dihydrosanguinarine (10), and ochotensimine (11), the structures of which were confirmed by direct comparison with authentic samples.

The mass spectrum of raddeanamine (1), $C_{22}H_{25}NO_5$, $[\alpha]_D^{20}$ +166°, was similar to that of ochotensimine (11), except for peaks at *m/e* 383 (M^+) and *m/e* 368 ($M^+ - 15$), and dehydration of raddeanamine by heating with potassium hydrogen sulphate did in fact give ochotensimine (11). A hydroxy-band at 3 240 cm^{-1} in the i.r. spectrum and a quaternary methyl n.m.r. signal at δ 1.23 (3 H, s) indicated that a hydroxy-group existed at C-13, oriented *syn* to nitrogen.

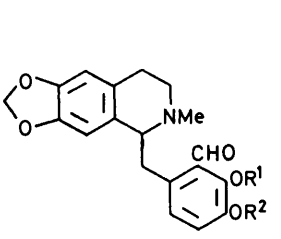
Raddeanine (2), $C_{21}H_{23}NO_6$, $[\alpha]_D^{20}$ +79.4°, showed a mass spectrum similar to that of yenhusomine (17), recently isolated from *C. ochotensis* (Turcz.) in Taiwan.[1] Oxidation of raddeanine (2) with Jones reagent yielded orange prisms, whose spectral data were identical with those of the diketone (19) derived from yenhusomine (17).[2] Raddeanine (2) exhibited a hydroxy-band at 3 590 cm^{-1} in the i.r. spectrum ($CHCl_3$) and n.m.r. signals ($CDCl_3$) for two methine protons at δ 5.21br (1 H, s, 13-H) and 5.42br (1 H, s, 8-H) suggesting the presence of two hydroxy-groups *anti* to the nitrogen atom.

The i.r. and n.m.r. spectra of raddeanidine (3), $C_{23}H_{25}NO_6$, $[\alpha]_D^{20}$ +82.7°, revealed the existence of an acetyl group [$\nu_{max.}$ ($CHCl_3$) 1 740 cm^{-1}; δ ($CDCl_3$) 1.93 (3 H, s)]. Hydrolysis of raddeanidine (3) furnished raddeanine (2). A single hydroxy band at 3 580 cm^{-1} in the i.r. spectrum and n.m.r. signals for two methine protons at δ 5.15br (1 H, s, 13-H) and 6.57 (1 H, s, 8-H) ($CDCl_3$) proved that the acetoxy-group was at C-8.

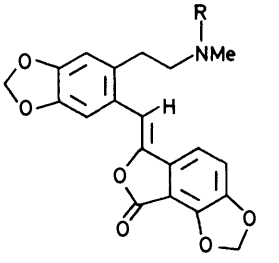
Raddeanone (4), $C_{21}H_{21}NO_6$, $[\alpha]_D^{20}$ 0°, displayed the u.v. and mass spectra (M^+ 383) similar to those of yenhusomidine (19) isolated from *C. ochotensis*.[1] N.m.r. signals ($CDCl_3$) for two aromatic protons appeared at 7.01 (1 H, d, *J* 8 Hz, 11-H) and 7.51 (1 H, d, *J* 8 Hz, 12-H), indicating the carbonyl group to be at C-13.[3] The observation of one hydroxy-band at 3 570 cm^{-1} in the i.r. spectrum ($CHCl_3$), and n.m.r. signals for an *N*-methyl group at δ 2.37 (3 H, s) and a methine proton at 5.65br (1 H, s), resembling those of sibiricine (20),[3] suggested that the hydroxy-group at C-8 was *anti* to the nitrogen atom. Thus the stereochemistry at C-8 of the three new alkaloids (2)—(4) is the reverse of that of the alkaloids (17) and (19) isolated from *C. ochotensis* in Taiwan.[1]

Aobamine (5) proved to be unstable. Its mass spectrum, *m/e* 353 ($C_{20}H_{19}NO_5$, M^+) and 190 (21, base peak), indicated a 1-benzylisoquinoline structure. The i.r. spectrum ($CHCl_3$) showed a formyl band at 1 680 cm^{-1} and the n.m.r. spectrum ($CDCl_3$) exhibited signals for an *N*-methyl group at δ 2.35 (3 H, s), two methylenedioxy-groups at 5.87 and 6.07 (each 2 H, s), four aromatic protons at 6.48 (2 H, s), 6.50 (1 H, d, *J* 8 Hz), and 6.80 (1 H, d, *J* 8 Hz), and a formyl group at 10.06 (1 H, s). On the basis of comparison of spectral data with those of canadaline (22), recently isolated from *Hydrastis canadensis*,[4] the structure (5) was assigned of aobamine.

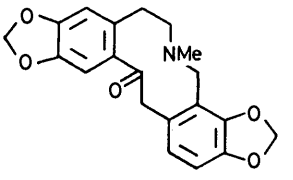
The i.r. spectrum ($CHCl_3$) of aobamidine (6), $C_{21}H_{19}NO_6$, *m/e* 381 (M^+), showed a five-membered ring lactone absorption at 1 760 cm^{-1}. The n.m.r. spectrum ($CDCl_3$) showed the existence of two *N*-methyl groups [δ 2.32



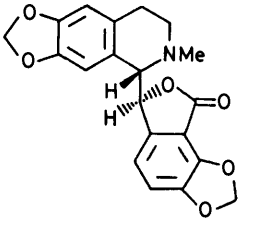
(5) $R^1R^2 = CH_2$
(22) $R^1 = R^2 = Me$



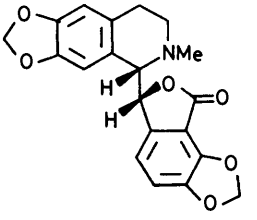
(6) R = Me
(24) R = *p*—$BrC_6H_4 \cdot CO_2$



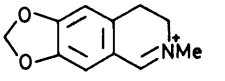
(7)



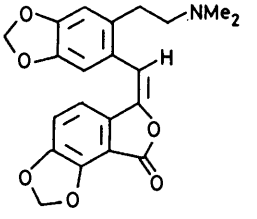
(8)



(9)



(21)



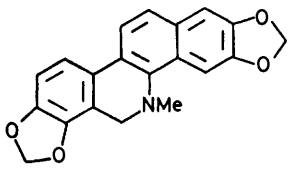
(23)

(6 H, s)], two methylenedioxy-groups [δ 5.94 and 6.20 (each 2 H, s)], and four aromatic protons and one olefinic proton [δ 6.45 (1 H, s), 6.68 (1 H, s), 7.61 (1 H, s), 7.07 (1 H, d, *J* 8 Hz), and 7.25 (1 H, d, *J* 8 Hz)]. The stereochemistry was deduced by the similarity of its u.v. spectrum [$\lambda_{max.}$ (EtOH) 227 (log ε 4.38), 240sh (4.32), 308 (4.10), 337sh (3.94), and 390 nm (4.28)] to that of the urethane (24), whose structure has been determined by

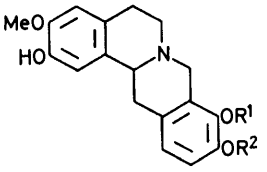
[1] S. T. Lu, T. L. Su, T. Kametani, A. Ujiie, M. Ihara, and K. Fukumoto, *J.C.S. Perkin I*, 1976, 63.
[2] F. Šantavý, L. Hruban, V. Šimánek, and D. Walterová, *Coll. Czech. Chem. Comm.*, 1970, **35**, 2418.
[3] R. H. F. Manske, R. Rodrigo, D. B. MacLean, D. E. F. Gracey, and J. K. Sunders, *Canad. J. Chem.*, 1969, **47**, 3585.
[4] J. Gleye, A. Ahond, and E. Stanislas, *Phytochemistry*, 1974, **13**, 675.

X-ray analysis.[5] This assignment was confirmed as follows. The methiodide of adlumidine (8) was treated with dilute aqueous sodium hydroxide to give the *E*-derivative (23), whose n.m.r. spectrum was consistent with that of adlumidiceine enol lactone, the stereochemistry of which has not been determined.[6] Irradiation of (23) in chloroform gave the *Z*-compound, which was identical with aobamidine (6) (comparisons of i.r. and n.m.r. spectra).

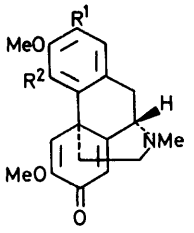
The phenolic fraction afforded the five known alkaloids cheilanthifoline (13), ochotensine (12), scoulerine (14), sinoacutine (15), and pallidine (16) after separation by silica gel column chromatography. Compounds (15) and (16) are morphinandienone alkaloids, which have also been isolated from *C. pallida* var. *tenuis* (Yatabe) and *C. incisa* (Pers), collected in Sendai.[7,8]



(10)



(13) $R^1R^2 = CH_2$
(14) $R^1 = H, R^2 = Me$



(15) $R^1 = H, R^2 = OH$
(16) $R^1 = OH, R^2 = H$

EXPERIMENTAL

I.r. and u.v. spectra were taken with a Hitachi 215 and a Hitachi 124 recording spectrometer, respectively. N.m.r. spectra were measured with a JNM-PMX-60 spectrometer. Mass spectra were taken with a Hitachi RMU-7 spectrometer. High-pressure liquid chromatography (h.p.l.c.) was carried out with a Waters Associates ALC/GPC202/R401 instrument equipped with a 1 ft × 4 in column of μ-Bondapak C_{18}.

Preliminary Separation.—Dried material (1.5 kg) from *Corydalis ochotensis* var. *raddeana*, collected in Sendai at the flowering time, was finely divided and extracted with methanol. The extract was concentrated to give a gum, to which was added 3% hydrochloric acid, and the mixture was washed several times with ether. The acidic layer was separated into non-phenolic (18 g) and phenolic (9 g) fractions, according to the previously reported procedure.[7,8]

Dihydrosanguinarine (10).—The non-phenolic gum (18 g) was separated on a column of silica gel (600 g). Elution with benzene gave dihydrosanguinarine as pale yellow prisms (30 mg), m.p. 192—194° (from ethanol) (lit.,[9] 195—196°), identical with an authentic sample (mixed m.p., i.r., n.m.r., and u.v. spectra, and t.l.c.).

Adlumidine (8).—Further elution of the column with benzene–methanol (99.5 : 0.5 v/v) gave adlumidine as prisms (300 mg), m.p. 237—239° (from chloroform–methanol), $[\alpha]_D^{20}$ +114.7° (*c* 0.087 in $CHCl_3$) {lit.,[9] 237°, $[\alpha]_D$ +116° (in $CHCl_3$)}, identical with an authentic sample (mixed m.p., i.r., and n.m.r. spectra, and t.l.c.).

Ochotensimine (11).—Further elution of the column with benzene–methanol (99.5 : 0.5 v/v) gave ochotensimine as a syrup (4 g), $[\alpha]_D^{20}$ +46.3° (*c* 0.54 in MeOH) {lit.,[9] $[\alpha]_D$ +49.2° (in MeOH)}, identical with an authentic sample (i.r. and n.m.r. spectra and t.l.c.).

Bicuculline (9).—Further elution of the column with benzene–methanol (99.5 : 0.5 v/v) gave bicuculline as pale yellow prisms (40 mg), m.p. 190—192°, $[\alpha]_D^{20}$ + 132.7° (*c* 0.049 in $CHCl_3$) {lit.,[9] m.p. 193—195°, $[\alpha]_D$ +130° (in $CHCl_3$)}, identical with an authentic sample (m.p., i.r. and n.m.r. spectra, and t.l.c.).

Raddeanamine {1,3,3′,4′-*Tetrahydro*-6′,7′-*dimethoxy*-1,2′-*dimethyl*-4,5-*methylenedioxyspiro*-[2H-*indene*-2,1(2′H)-*isoquinolin*]-1-*ol*} (1).—Further elution with benzene–methanol (99.5 : 0.5 v/v) gave the crude raddeanamine as a yellowish syrup, which was purified by preparative t.l.c. on silica gel with chloroform–methanol (9 : 1 v/v) followed by h.p.l.c. [solvent methanol–water containing 0.5% ammonium carbonate (2 : 1 v/v); flow rate 2 ml min^{-1}; retention time 4.2 min] to give a gum (20 mg), $[\alpha]_D^{20}$ +166° (*c* 0.68 in MeOH), $\nu_{max.}$ ($CHCl_3$) 3 240 cm^{-1} (OH); δ ($CDCl_3$) 1.23 (3 H, s, Me), 2.56 (3 H, s, NMe), 3.43 (3 H, s, OMe), 3.81 (3 H, s, OMe), 5.23br (1 H, s, OH, disappeared with D_2O), 5.94 (2 H, s, O·CH_2·O), 6.19 and 6.54 (each 1 H, s, 1- and 4-H), and 6.67 and 6.83 (each 1 H, d, *J* 8 Hz, 11- and 12-H), *m/e* 383 (M^+), 368, 365, and 206.

Dehydration of Raddeanamine.—A mixture of raddeanamine (1) (10 mg) and fused potassium hydrogen sulphate (10 mg) was heated at 200 °C for 20 min. After cooling, the mixture was extracted with chloroform. The extract was washed with water, dried (Na_2SO_4), and evaporated to afford a syrup (7 mg), identical with authentic ochotensimine (11) (i.r. and n.m.r. spectra and t.l.c.).

Aobamine [1-(2-*Formyl*-3,4-*methylenedioxybenzyl*)-1,2,3,4-*tetrahydro*-2-*methyl*-6,7-*methylenedioxyisoquinoline*] (5).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave aobamine as a yellowish syrup, which was purified by h.p.l.c. as above (retention time 5.6 min) to give an unstable gum (30 mg), $\nu_{max.}$ ($CHCl_3$) 1 680 cm^{-1} (C=O); δ ($CDCl_3$) 2.35 (3 H, s, NMe), 5.87 (2 H, s, O·CH_2·O), 6.07 (2 H, s, O·CH_2·O), 6.48 (2 H, s, 2 × ArH), 6.50 and 6.80 (each 1 H, each d, *J* 8 Hz, 5′- and 6′-H), and 10.06 (1 H, s, CHO); *m/e* 353 and 190.

Raddeanidine (3).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave raddeanidine as a syrup, purified by preparative t.l.c. on silica gel with chloroform–methanol (9 : 1 v/v) and h.p.l.c. (as above but 1 : 1 v/v solvent mixture; retention time 6.2 min) to give a gum (10 mg), $[\alpha]_D^{20}$ +82.7° (*c* 0.52 in MeOH), $\nu_{max.}$ ($CHCl_3$) 3 580 (OH) and 1 740 cm^{-1} (C=O); δ ($CDCl_3$) 1.93 (3 H, s, OAc), 2.50

[5] W. Klötzer, S. Teitel, and A. Brossi, *Helv. Chim. Acta*, 1972, **55**, 2228.
[6] V. Preininger, J. Veselý, O. Gašić, V. Šimánek, and L. Dolejš, *Coll. Czech. Chem. Comm.*, 1975, **40**, 699.
[7] T. Kametani, M. Ihara, and T. Honda, *J. Chem. Soc.* (*C*), 1970, 1060.
[8] T. Kametani, M. Ihara, and T. Honda, *Phytochemistry*, 1971, **10**, 1881.
[9] T. Kametani, 'The Chemistry of the Isoquinoline Alkaloids,' Hirokawa (Tokyo)–Elsevier (Amsterdam), 1968, pp. 113, 129, 136, 143, 213.

(3 H, s, NMe), 3.42 (3 H, s, OMe), 3.81 (3 H, s, OMe), 5.15 (1 H, s, 13-H), 5.94 (2 H, s, O·CH_2·O), 6.18 (1 H, s, 1-H), 6.57 (1 H, s, 8-H), 6.65 (1 H, s, 4-H), and 6.81 (2 H, s, 11- and 12-H); *m/e* 427 (M^+), 384, 352, 338, 324, 308, and 206 (Found: M^+, 427.1622. $C_{23}H_{25}NO_7$ requires M, 427.1630).

Raddeanone (4).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave raddeanone, which was purified by preparative t.l.c. on silica gel with chloroform–methanol (9 : 1 v/v) followed by h.p.l.c. (as above with 2 : 1 v/v solvent mixture; retention time 2.2 min) to give *prisms* (40 mg), m.p. 168–170° (from acetone), $[\alpha]_D^{20}$ 0° (*c* 0.085 in MeOH) (Found: C, 65.6; H, 5.6; N, 3.8. $C_{21}H_{21}NO_6$ requires C, 65.8; H, 5.5; N, 3.65%), $\nu_{max.}$ ($CHCl_3$) 3 570 (OH) and 1 720 cm^{-1} (C=O); $\lambda_{max.}$ (EtOH) 238, 286, and 313 nm (log ε 4.85, 4.12, and 4.06); δ ($CDCl_3$) 2.37 (3 H, s, NMe), 3.53 (3 H, s, OMe), 3.84 (3 H, s, OMe), 5.56 (1 H, s, 8-H), 6.05 (1 H, s, 1-H), 6.15 and 6.20 (each 1 H, each d, *J* 1 Hz, O·CH_2·O), 6.66 (1 H, s, 4-H), and 7.01 and 7.51 (each 1 H, d, *J* 8 Hz, 11- and 12-H); *m/e* 383 (M^+), 368, 352, 338, 324, 208, and 206.

Protopine (7).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave a yellowish powder, recrystallisation of which from methanol afforded protopine as prisms (7 g), m.p. 205—207° (lit.,[9] 207—208°), identical with an authentic sample (m.p. and i.r. and n.m.r. spectra).

Raddeanine (2).—Further elution of the column with benzene–methanol (97 : 3 v/v) gave raddeanine, which was purified by h.p.l.c. (as above; 1 : 1 solvent mixture; retention time 4.2 min) to give *prisms* (100 mg), m.p. 200—202° (from acetone), $[\alpha]_D^{20}$ +79.4° (*c* 0.11 in MeOH) (Found: C, 65.7; H, 6.0; N, 3.9. $C_{21}H_{23}NO_6$ requires C, 65.45; H, 6.0; N, 3.65%), $\nu_{max.}$ ($CHCl_3$) 3 590 cm^{-1} (OH); δ ($CDCl_3$) 2.10br (2 H, s, 2 × OH, disappeared with D_2O), 2.60 (3 H, s, NMe), 3.40 (3 H, s, OMe), 3.81 (3 H, s, OMe), 5.21br (1 H, s, 13-H), 5.42br (1 H, s, 8-H), 5.97 (2 H, s, O·CH_2·O), 6.16 (1 H, s, 1-H), 6.65 (1 H, s, 4-H), and 6.76 and 6.80 (each 1 H, d, *J* 8 Hz, 11- and 12-H); *m/e* 385 (M^+), 370, 367, 352, 338, 324, 308, and 206.

Oxidation of Raddeanine (2).—A solution of raddeanine (20 mg) in acetone (5 ml) was shaken with freshly prepared Jones reagent (two drops) at 10—15 °C for 10 min. An excess of methanol was then added, the mixture was evaporated, and the residue extracted with ether. The extract was washed, dried (Na_2SO_4), and evaporated to give yellowish orange prisms (10 mg), m.p. 174—175° (from ethanol), identical with the oxidation product (18) of yenhusomine (17)[1] (mixed m.p., n.m.r. spectra, and t.l.c.)

Aobamidine {(Z)-3-[2-(2-*Dimethylaminoethyl*)-4,5-*methylenedioxybenzylidene*]-6,7-*methylenedioxyphthalide*} (6).—Further elution of the column with benzene–methanol (95 : 5 v/v) gave a yellowish syrup, which was rechromatographed on silicic acid with chloroform–methanol (99 : 1 v/v) as eluant to give aobamidine as a yellowish *powder* (20 mg), m.p. 195—197° (from ether), $\nu_{max.}$ ($CHCl_3$) 1 760 cm^{-1} (C=O); $\lambda_{max.}$ (EtOH) 227, 240sh, 308, 337sh, and 390 nm (log ε 4.38, 4.32, 4.10, 3.94, and 4.28); δ ($CDCl_3$) 2.32 (6 H, s, NMe_2), 5.94 (2 H, s, O·CH_2·O), 6.20 (2 H, s, O·CH_2·O), 6.45 (1 H, s, ArH), 6.68 (1 H, s, olefinic), 7.07 and 7.25 (each 1 H, d, *J* 8 Hz, 2 × ArH), and 7.61 (1 H, s, ArH); *m/e* 381 (M^+), 336, 204, 177, and 58, (Found: M^+, 381.1209. $C_{21}H_{19}NO_6$ requires M, 381.1212).

Hofmann Degradation of Adlumidine Methiodide.—After addition of aqueous 20% sodium hydroxide (2 ml) to adlumidine (8) methiodide (50 mg) in water (6 ml) and ether (20 ml), the mixture was stirred at room temperature for 10 min. The organic layer was separated, washed with water, dried (Na_2SO_4), and evaporated to give the benzylidenephthalide (23) as a yellowish syrup (30 mg), $\lambda_{max.}$ (EtOH) 362, 290, 268sh, 240sh, and 226 nm; δ ($CDCl_3$) 2.20 (6 H, s, NMe_2), 5.98 and 6.18 (each 2 H, s, 2 × O·CH_2·O), 6.65 (1 H, s) and 6.80 (2 H, s) {2 × ArH and olefinic H), and 6.68 and 6.91 (each 1 H, d, *J* 8 Hz, 2 × ArH).

Irradiation of the (E)-*Benzylidenephthalide* (23).—A solution of compound (23) (30 mg) in chloroform (5 ml) was irradiated with a high-pressure mercury lamp (Pyrex filter) at 0 °C for 1.5 h under nitrogen. The solvent was then removed and the gummy residue triturated with ether to afford aobamidine (6) (10 mg), identical with the natural product (i.r. and n.m.r. spectra).

Cheilantifoline (13).—The phenolic bases (8 g) were separated on a column of silica gel (250 g). Elution with benzene–methanol (99.5 : 0.5 v/v) gave cheilantifoline as prisms (200 mg), m.p. 183—185° (from methanol). $[\alpha]_D^{20}$ −310° (*c* 0.06 in MeOH) {lit.,[9] m.p. 184°, $[\alpha]_D$ −311° (in MeOH)}. I.r., n.m.r., and mass spectra were identical with previously reported data.[10]

Ochotensine (12).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave ochotensine as crystals (3 g), m.p. 250—251° (from chloroform), $[\alpha]_D^{20}$ +51.0° (*c* 0.098 in $CHCl_3$) {lit.,[9] m.p. 252° $[\alpha]_D$ +51.7° (in $CHCl_3$)}. Methylation of ochotensine in methanol–chloroform with an excess of diazomethane gave a yellowish syrup, identical with ochotensimine (11) (i.r. and n.m.r. spectra and t.l.c.).

Scoulerine (14).—Further elution of the column with benzene–methanol (99 : 1 v/v) gave a yellowish orange syrup, which was rechromatographed on alumina with chloroform as eluant to give a powder (30 mg), m.p. 195—197° (from methanol), $[\alpha]_D^{20}$ −266° (*c* 0.4 in MeOH) {lit.,[11] m.p. 196—198°, $[\alpha]_D$ −285.2° (MeOH)}, identical with an authentic sample (m.p., i.r. and n.m.r. spectra, and t.l.c.).

Sinoacutine (15) *and Pallidine* (16).—Further elution of the column with benzene–methanol (97 : 3 v/v) gave a brown syrup, which was separated on an alumina column. Elution with benzene–chloroform (1 : 1 v/v) gave sinoacutine as prisms (20 mg), m.p. 197—198° (from methanol–ether), $[\alpha]_D^{20}$ −106° (*c* 0.34 in EtOH) {lit.,[7] m.p. 198°, $[\alpha]_D$ −112° (in EtOH)}, identical with an authentic sample (m.p., i.r. and n.m.r. spectra, and t.l.c.). Further elution with chloroform gave pallidine (16) (20 mg) as a syrup, $[\alpha]_D^{20}$ −30.5° (*c* 0.18 in EtOH) {lit.,[7] $[\alpha]_D$ −32° (in EtOH)}, identical with an authentic sample (i.r. and n.m.r. spectra, t.l.c., and h.p.l.c.).

We thank Professor K. Sohma, Tohoku University, for the classification of plant material. We are indebted to Professor R. H. F. Manske, University of Waterloo, for providing dihydrosanguinarine and ethylcheilanthifoline, Professor S. T. Lu, Kaohsing Medical College, for providing adlumidine and ochotensimine, and Dr. S. Teitel, F. Hoffmann-La Roche Co., for providing bicuculline. We are also grateful to Professor T. Nambara and Dr. K. Shimada in our Institute for their help in the use of the h.p.l.c. instrument, and to all members of our research group for collecting the plant material. We also thank Mrs. C. Koyanagi, Mrs. R. Kobayashi, Mrs. Y. Mori, Miss R. Suenaga, Miss E. Nagaoka, and Mr. K. Kawamura for microanalyses and spectral measurements.

[6/752 *Received*, 15*th April*, 1976]

[10] C. Tani, I. Imanishi, and J. Nishijo, *J. Pharm. Soc. Japan*, 1970, **90**, 1028.

[11] T. Kametani and M. Ihara, *J. Chem. Soc.* (*C*), 1968, 1305.