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# Saponin and Sapogenol. XI.[1] Chemical Correlation of Spergulagenin A, a New Migrated Hopane-type Sapogenol, with Hydroxyhopane

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The chemical correlation of spergulagenin A (**1**), which is a new migrated hopane-type sapogenol elucidated previously from the root of *Mollugo spergula* L., with hydroxyhopane (**2**) has been accomplished through the conversion of both to the common derivative **4a** (=**7a**).

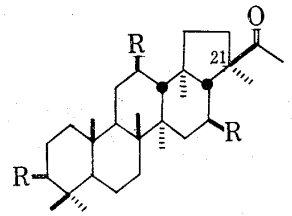
The Meerwein-Ponndorf type reduction of the methylcarbonyl moiety in spergulagenin A (**1**), which occurs on prolonged treatment with ethanolic alkali, has been described.

On the basis of the chemical and X-ray structure evidence, we have recently elucidated the structure of spergulagenin A (**1**), which is the second major sapogenol of the root of *Mollugo spergula* L. (Molluginaceae) and which is significant by the possession of the new migrated hopane-type carbon framework.[3] The principal skeletal difference between spergulagenin A (**1**) and hydroxyhopane (**2**) is that **1** possesses the geminal methylcarbonyl and the methyl functions at C-21 while **2** carries the isopropanol side chain at the same carbon. We have planned the chemical correlation of spergulagenin A (**1**) with hydroxyhopane (**2**) *via* tridesoxy-spergulagenin A (**3**),[3b] and the object has been accomplished through the elimination of the substituents at C-21 of **3** and **2** followed by the conversion to the common derivative (**4a**=**7a**) through the chemical reaction pathways as described in the present paper.

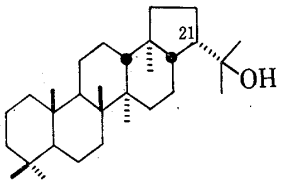
Irradiation with a 500 W high pressure mercury lamp of the *n*-hexane solution of tridesoxy-spergulagenin A (**3**) in the Pyrex tube furnished two crystalline products, **4a** (less polar) and **4b**, both of which possess the hydroxyl function as shown by the infrared (IR) absorption spectra (in $CCl_4$, 3600 $cm^{-1}$ in **4a** and 3608 $cm^{-1}$ in **4b**). Since the conspicuous fragment ions observed in the mass spectra of **4a** and **4b** could be depicted as shown in Chart 2, it has been suggested that **4a** and **4b** are respectively the bisnor-derivatives of **3** being epimeric each other at C-21. Althuogh the peak intensities of each corresponding fragment ions are not the same, the both compounds gave the similar fragmentation patterns including the identical richest ion peak at *m/e* 191 (**iii**) which is considered to be the sum of two ions mainly originated from the A/B ring (**iiia**) and from the D/E ring (**iiib**). The photochemical formation of **4a** and **4b** from tridesoxy-spergulagenin A (**3**) is assumed to have proceeded *via* **iv** which has resulted from the Norrish type I photochemical splitting[4] of the methylcarbonyl moiety at C-21. The introduction of the hydroxyl group at C-21 in **iv** is presumably brought about either by participation of water and/or oxygen, however, the detailed reaction mechanism needs further investigation.

In order to prove chemically the structures of **4a** and **4b**, the partial synthesis starting from hydroxyhopane (**2**) has been undertaken. Ozone oxidation of hop-21-ene (**5a**) gave

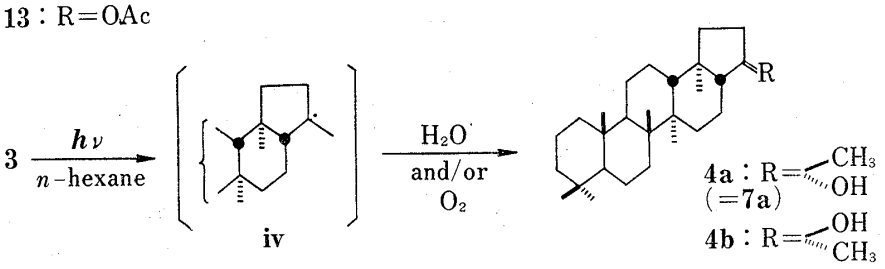
1) Part X: I. Kitagawa, Y. Imakura, T. Hayashi, and I. Yosioka, *Chem. Pharm. Bull.* (Tokyo), **23**, 1520 (1975).
2) Location: *133-1, Yamada-kami, Suita, Osaka.*
3) *a*) I. Kitagawa, H. Suzuki, I. Yosioka, T. Akiyama, and J.V. Silverton, *Tetrahedron Letters*, **1974**, 1173; *b*) I. Kitagawa, H. Suzuki, K. Kitazawa, N. Yamao, and I. Yosioka, *Chem. Pharm. Bull.* (Tokyo), **23**, 355 (1975).
4) J.G. Calvert and J.N. Pitts, Jr., "Photochemistry," John Wiley & Sons, Inc., New York, 1967, p. 377.



1 : R=OH spergulagenin A
3 : R=H tridesoxy-spergulagenin A
9 : R=$OCOC_6H_4Br$ (*p*)
13 : R=OAc

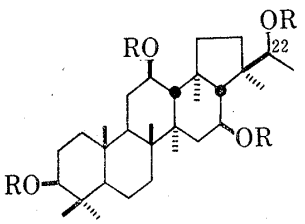


2 hydroxyhopane

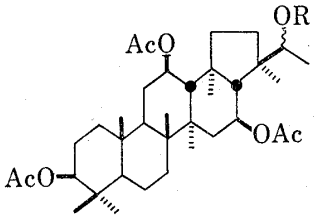


iv

4a : R=$\overset{CH_3}{\underset{OH}{}}$ (=7a)
4b : R=$\overset{OH}{\underset{CH_3}{}}$



10 : R=H
11 : R=Ac (=14b)



12a (less polar), 12b : R=H
14a, 14b : R=Ac

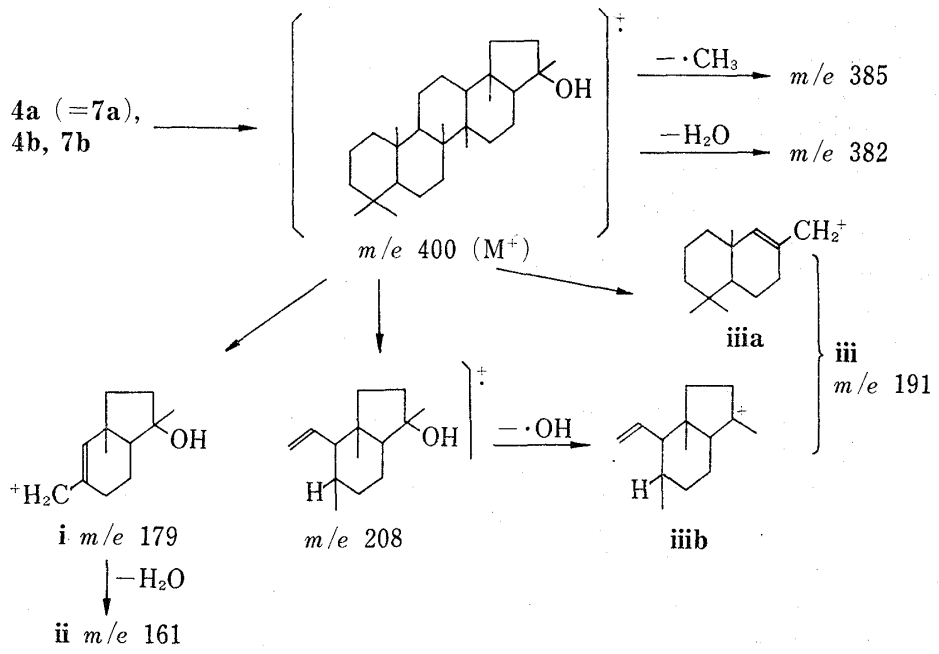
Chart 1

17$\beta$H-trisnorhopan-21-one (**6a**) and 17$\alpha$H-trisnorhopan-21-one (**6b**),[5] the latter being secondarily formed during the isolation procedure of the oxidation product and in fact **6a** is readily isomerized to **6b**,[5] for instance, on treatment in AcOH under reflux.

Reaction of **6a** with $CH_3Li$ gave a single product **7a**, whereas **6b** yielded **7b** also selectively. The mass spectra of **7a** and **7b** exhibit the similar noticeable ion peaks as those of **4a** and **4b** (Chart 2) and the structures of **7a** and **7b** are assigned on the basis of the stereochemical considerations. Thus, the stereoselective attack of the methyl anion in these reactions is rationalized by the Dreiding model examinations of **6a** and **6b**: *i.e.* the $\beta$-side of the C-21 carbonyl in **6a** is always less crowded either with the envelope or with the half-chair conformation of the E ring, while the corresponding $\beta$-side in **6b** is more crowded than the $\alpha$-side. One of the methylation products **7a** thus prepared has been identified with the aforementioned **4a** in all respects, thus the chemical correlation of tridesoxy-spergulagenin A (**3**) (*i.e.* spergulagenin A (**1**)) with hydroxyhopane (**2**) being accomplished. The isomeric structure **4b** of the other photochemical product has been inferred on the analogous basis to that of **4a**.

The configurations at C-21 of **7a** (=**4a**) and **7b** have been further examined by the proton magnetic resonance (PMR) spectroscopy. Among seven tertiary methyl signals observed in the PMR spectrum of **7a**, the lowest one at $\delta$ 1.27 (3H, s) is assigned to 21-$CH_3$ which is geminal to the hydroxyl. When the PMR spectra of **7a** have been taken while changing the volume ratio of $CDCl_3$ to $d_5$-pyridine (from 1 : 0 to 0 : 1), the significant low-field shift of the signal due to 18$\alpha$-$CH_3$ ($\delta$ 0.90→$\delta$ 1.20) is observed along with the similar shift of the signal due to 21$\beta$-$CH_3$ ($\delta$ 1.27→$\delta$ 1.47). However, the other methyl signals are seen with the little

5) *a*) G.V. Baddely, T.G. Halsall, and E.R.H. Jones, *J. Chem. Soc.*, **1959**, 1715; *b*) G. Berti, F. Bottari, A. Marsili, J.-M. Lehn, P. Witz, and G. Ourisson, *Tetrahedron Letters*, **1963**, 1283.




| m/e | Compound | | |
|---|---|---|---|
| | 4a(=7a) | 4b | 7b |
| 400($M^+$) | 41% | 18[a] | 5 |
| 385 | 17 | 5 | 3 |
| 382 | 16 | 4 | 42 |
| 208 | <1 | <1 | <1 |
| 191(iii) | 100 | 100[a] | 100 |
| 179(i ) | 47 | 70[a] | 5 |
| 161(ii ) | 53 | 37[a] | 60 |

*a*) The compositions were confirmed by high resolution mass spectrometry.

solvent-induced shift (Chart 4). These observations substantiate the 1,3-diaxial orientation of 18α-$CH_3$ and 21α-OH[6] and consequently establish the configuration at C-21 of **7a**. On the other hand, the similar solvent-induced effect has been observed only for the signal due to 21α-$CH_3$ in the case of **7b** (Chart 5).

Next, the direct chemical correlation of **7a** and **7b** has been made by treatment of both with $POCl_3$-pyridine to furnish the common hydrocarbon **8** which exhibits no olefinic proton signal in its PMR spectrum. In the IR spectrum of **8** ($CCl_4$), no hydroxyl absorption band is observed, but a three-proton singlet due to the newly formed vinyl methyl is observed at δ 1.54 in the PMR spectrum of **8** and the mass fragmentation pattern as shown in Chart 6 (base peak (v) at *m/e* 231[7]) supports the formulation of **8**. It should be pointed out here that the facile dehydration of **7a** and **7b** also supports the *trans* geometry of 17β-H and 21α-OH in **7a** and 17α-H and 21β-OH in **7b**.

Finally, we wish to mention briefly about the uncommon reactivity of the carbonyl function in spergulagenin A (**1**) towards the alcoholic alkali. As reported in the previous chemical

6) *a*) K. Tori and K. Aono, *Ann. Rep. Shionogi Res. Lab.*, **14**, 136 (1964); *b*) P.V. Demarco, E. Farkas, D. Doddrell, B.L. Mylari, and E. Wenkert, *J. Am. Chem. Soc.*, **90**, 5480 (1968); *c*) I. Kitagawa, M. Yoshikawa, and I. Yosioka, *Tetrahedron Letters*, **1974**, 469.

7) K. Shiojima and H. Ageta, presented at the 9th Symposium of Mass Spectrometry of Organic Compounds, Japan, Sendai, Oct. 2—4, 1974. Abstract Paper, p.100.

study on **1**, we have prepared the tri-*p*-bromobenzoate (**9**).[3b] On prolonged treatment of **9** with 1% KOH-EtOH under reflux, we have noticed that **1** initially liberated from **9** is transformed to a more polar substance (**10**). The substance **10** is also formed by direct treatment of **1** under the same alkaline conditions. Acetylation of **10** with acetic anhydride-pyridine yielded the tetraacetate [**11**, mass: *m/e* 644 ($M^+$, $C_{38}H_{60}O_8$); IR ($CCl_4$): 1748, 1249 $cm^{-1}$]. In the PMR spectrum of **11** ($CDCl_3$), is observed a signal at $\delta$ 1.20 (3H, d, $J$=7.0 Hz) ascribable to the newly formed secondary methyl in addition to the signals due to four secondary acetoxyls (acetoxyl methyls at $\delta$ 2.01, 9H, s, and $\delta$ 2.06, 3H, s; geminal proton signals at $\delta$ 4.48, 1H, t-like, $\delta$ 4.8—5.4, 2H, m, and $\delta$ 5.12, 1H, q, $J$=7.0 Hz) and the signals ascribable to seven tertiary methyls. The partial structure **vi** has been depicted for **11** on the basis of the decoupling experiments (in $CDCl_3$–$C_6D_6$=2: 1). Thus, as given in Table I, the irradiation at $\delta$ 1.20 varied the quartet at $\delta$ 5.20 (22-H) to a singlet, while the irradiation at $\delta$ 5.20 changed the doublet at $\delta$ 1.20 (22-$CH_3$) to a singlet.

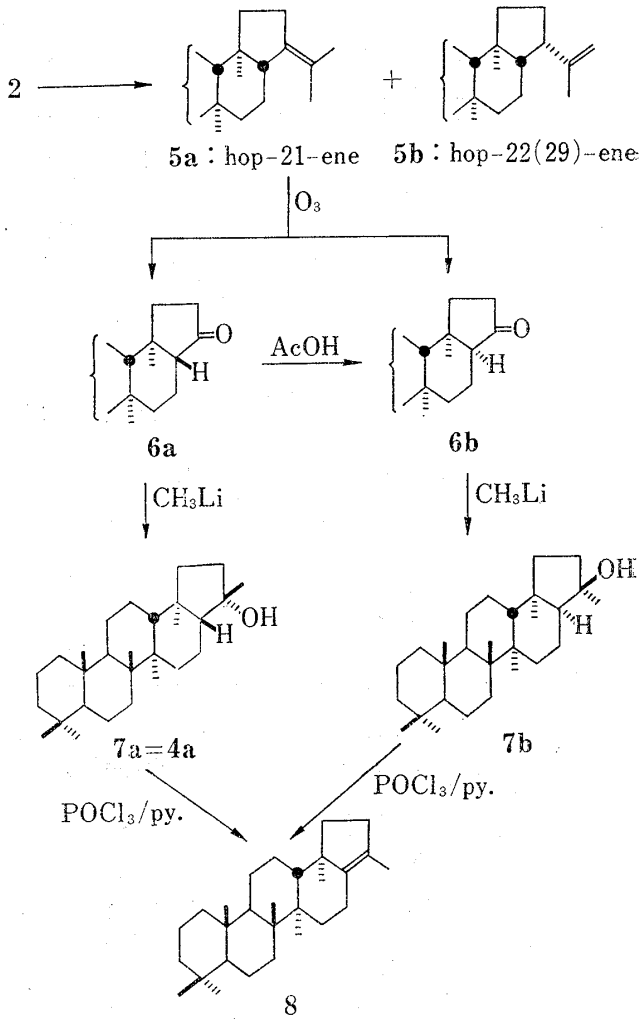
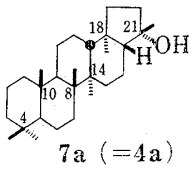
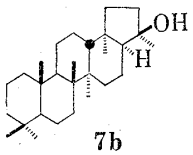



Chart 3

Therefore, the structure **11** has been assumed for the tetraacetate and the assumption has been verified by the following identification. Two monohydroxy-triacetates [**12a** (less




7a (=4a)




7b

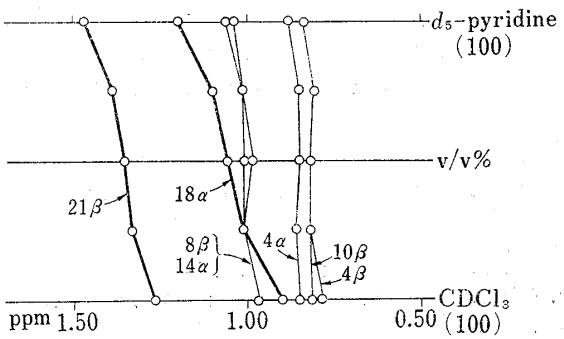



Chart 4. Solvent-induced Change of the Methyl Chemical Shifts in **7a** (=**4a**)

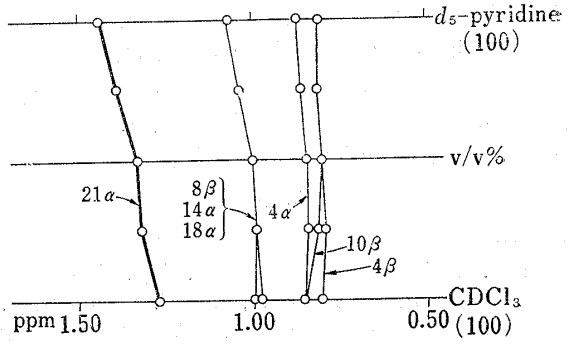



Chart 5. Solvent-induced Change of the Methyl Chemical Shifts in **7b**

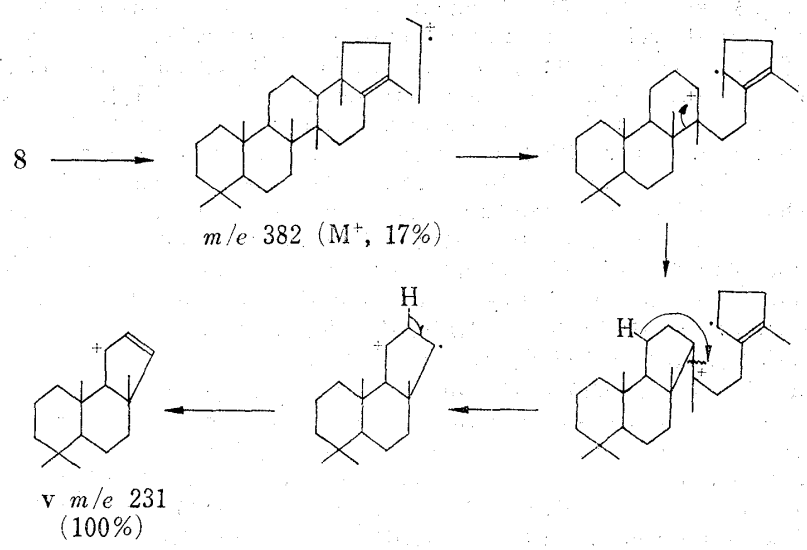
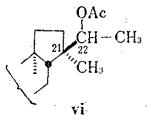



Chart 6

Table I. Spin Decoupling Experiments of **11** (in $CDCl_3$–$C_6D_6$=2:1)

| Decoupled proton | Irradiated at $\delta$ | |
|---|---|---|
| | 5.20 | 1.20 |
| 22-$CH_3$ (d) | s | — |
| 22-H (q) | — | s |




vi

polar), **12b**] previously obtained by the $NaBH_4$ reduction of spergulagenin A triacetate (**13**)[3b] were acetylated respectively to give two tetraacetates (**14a**, **14b**), one of which **14b** (prepared from **12b**) has been found identical with **11** in all respects.

As for the probable reaction mechanism in the formation of **10** from **1**, the Meerwein-Ponndorf type reduction is attractive.[8] It is worthwhile to mention that although the absolute configuration at C-22 in **10** has not yet been clarified, the alcoholic alkaline reduction of **1** furnished **10** as a single product and is distinctive as compared with the $NaBH_4$ reduction of spergulagenin A triacetate (**13**) in which two epimers (**12a**, **12b**) were obtained.

## Experimental[9]

**Photolysis of Tridesoxy-spergulagenin A** (3)——A solution of **3** (27 mg) in water-saturated *n*-hexane (27 ml)[10] was put in a Pyrex tube and irradiated externally (distance: 2 cm) for 12 hr with a 500 W high

8) *a*) G.H. Hargreaves and L.N. Owen, *J. Chem. Soc.*, **1947**, 750; *b*) D.C. Kleinfelter, *J. Org. Chem.*, **32**, 840 (1967); *c*) S. Uyeo, K. Ueda, and Y. Yamamoto, *Yakugaku Zasshi*, **86**, 1172 (1966); *d*) I. Yosioka, T. Nishimura, A. Matsuda, and I. Kitagawa, *Chem. Pharm. Bull.* (Tokyo), **19**, 1186 (1971).

9) The following instruments were used for obtaining the physical data. Melting points: Yanagimoto Micro-meltingpoint Apparatus (a hot-stage type) and recorded uncorrected; Specific rotations: Rex Photoelectric Polarimeter NEP-2 (l=1 dm); IR spectra: Hitachi IR Spectrometer EPI-G3; PMR spectra (tetramethylsilane as an internal standard): Hitachi R-22 (90 MHz) NMR Spectrometer; Mass spectra: Hitachi RMU-6D Mass Spectrometer at 70 eV. For gas-liquid chromatography (GLC), Hitachi Model 063 Gas Chromatograph was used. For thin-layer chromatography (TLC) silica gel (Camag D-5) was used and the detection was made by spraying 1% $Ce(SO_4)_2$-10% $H_2SO_4$ solution followed by heating, and for preparative TLC, the detection was made by spraying water or by keeping the TLC plate in the $I_2$ chamber.

10) Photolysis of the plain *n*-hexane solution of **3** in an open Pyrex tube proceeded similarly, but the role of water or moisture is uncertain.

pressure mercury lamp (Eikōsha PIH-500) (temperature of the reaction mixture: 29—30°). The residue obtained by evaporation of the solvent under reduced pressure was purified by preparative thin-layer chromatography (TLC) (benzene–acetone=1: 1) to afford crude **4a** (4 mg) and crude **4b** (4 mg).[11]

To a solution of crude **4a** (7 mg) in ether (5 ml) was added dropwise $LiAlH_4$ (15 mg)-ether (10 ml) solution and the total mixture was heated under reflux for 5 hr, poured into aqueous ether, and treated with water. The ether solution was taken, washed with 2N $H_2SO_4$ and water successively, and treated in the usual manner. The product was recrystallized from $CHCl_3$–MeOH to give **4a** (colorless needles) of mp 228—233°, IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 3600 (OH), which was identified with **7a** prepared below from hop-21-ene (**5a**) in all respects: mixed mp, IR, mass, and TLC [i) benzene–acetone=10: 1; ii) $CHCl_3$; iii) *n*-hexane–acetone=10: 1].

A solution of crude **4b** (12 mg) in ether (5 ml) was treated with $LiAlH_4$ (15 mg)-ether (10 ml) as above and the product was recrystallized from $CHCl_3$–MeOH to afford colorless needles of **4b**, mp 238—241°. High resolution Mass Spectrum: Found: 400.370, 191.179, 179.144, 161.135. Calcd. for $C_{28}H_{48}O$ ($M^+$): 400.371. $C_{14}H_{23}$ (**iii**): 191.180, $C_{12}H_{19}O$ (**i**): 179.144, $C_{12}H_{17}$ (**ii**): 161.133.

**Ozone Oxidation of Hop-21-ene (5a)**——A solution of hop-21-ene (**5a**) (550 mg) in dry *n*-hexane (100 ml) was cooled with ice-salt and bubbled slowly with ozonized oxygen for 1 hr. After diluting with *n*-hexane (50 ml) and EtOH (400 ml), the reaction mixture was added with $PtO_2$ (200 mg), shaken under hydrogen atmosphere for 3 hr, filtered to remove the catalyst, and evaporated under reduced pressure to give a product. Purification of the product by preparative TLC (benzene–acetone=2: 1) furnished **6a** (152 mg, less polar) and **6b** (107 mg). Recrystallization from $CHCl_3$–MeOH gave a pure sample of **6a** (colorless needles), mp 180—185°, IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 1747 (CO). Similarly, pure **6b** of mp 233—240° was obtained as colorless needles, $[\alpha]_D^{19}$ +151.6° ($c$=0.50, $CHCl_3$), IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 1745 (CO). Mass Spectrum *m/e* (%): 384 ($M^+$, 22), 369 ($M^+-15$, 12), 191 (**iiia**, 100).

A solution of **6a** (30 mg) in AcOH (5 ml) was refluxed for 4 hr, neutralized with aq. dil. $K_2CO_3$, and extracted with $CHCl_3$. Treatment of the $CHCl_3$ solution in the usual manner gave a product (29 mg), which was recrystallized from $CHCl_3$–MeOH and identified with **6b** by mixed mp, IR, and TLC ($CHCl_3$).

**Reaction of 17$\beta$H-Trisnorhopan-21-one (6a) with $CH_3Li$**——To a stirred suspension of chipped Li (600 mg, 86 mmole) in dry ether (10 ml), was added dropwise $CH_3I$ (2 ml, 32 mmole)–ether (10 ml) solution under $N_2$ atmosphere and gentle reflux continued during the period (2 hr). A solution of **6a** (50 mg, 0.13 mmole) in dry ether (4 ml) was treated with the above-prepared $CH_3Li$ solution (4 ml, 6 mmole), stirred under $N_2$ atmosphere for 6 hr, poured into an iced $NH_4Cl$ solution, and extracted with ether. After usual work-up, the ether extractive was recrystallized from $CHCl_3$–MeOH to give colorless needles of **7a** (44 mg), mp 233—236°, $[\alpha]_D^{26}$ +37.4° ($c$=0.38, $CHCl_3$). *Anal.* Calcd. for $C_{28}H_{48}O$: C, 83.93; H, 12.08. Found: C, 83.94; H, 12.09. IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 3600 (OH). PMR ($CDCl_3$) $\delta$: 0.79, 0.82, 0.85, 0.90 (3H, each, s), 0.97 (6H, s), 1.27 (3H, s) ($CH_3\times7$); ($CDCl_3$–$d_5$-pyridine=1: 1) $\delta$: 0.82 (6H, s), 0.85, 0.99, 1.01, 1.06, 1.35 (3H each, s); ($d_5$-pyridine) $\delta$: 0.84 (6H, s), 0.88, 1.04, 1.06, 1.20, 1.47 (3H each, s) (Chart 4). Mass Spectrum: as given in Chart 2. The product **7a** is identical with **4a** in all respects as described above.

**Reaction of 17$\alpha$H-Trisnorhopan-21-one (6b) with $CH_3Li$**——A solution of **6b** (60 mg, 0.16 mmole) in dry ether (4 ml) was treated dropwise with $CH_3Li$-ether solution (5 ml, 8 mmole) as above and the product was purified by preparative TLC ($CHCl_3$) to give crude **7b** (45 mg). Since the crude **7b** was contaminated with the inseparable carbonyl compound (probably recovered **6b**), 26 mg of crude **7b** was dissolved in dry ether (5 ml), treated with $LiAlH_4$ (30 mg)–ether (30 ml) and heated under reflux for 5 hr. After working-up in the usual manner, the product was purified by preparative TLC ($CHCl_3$–*n*-hexane=5: 1) to give **7b** (19 mg, colorless needles from acetone), mp 206—208°, $[\alpha]_D^{11}$ +44.6° ($c$=0.50, $CHCl_3$). *Anal.* Calcd. for $C_{28}H_{48}O$: C, 83.93; H, 12.08. Found: C, 83.79; H, 12.22. IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 3608 (OH). PMR ($CDCl_3$) $\delta$: 0.80 (3H, s), 0.85 (6H, s), 0.98 (3H, s), 1.00 (6H, s), 1.27 (3H, s) ($CH_3\times7$); ($CDCl_3$–$d_5$-pyridine=1: 1) $\delta$: 0.80 (6H, s), 0.84 (3H, s), 1.00 (9H, s), 1.33 (3H, s) ($CH_3\times7$); ($d_5$-pyridine) $\delta$: 0.81 (6H, s), 0.87 (3H, s), 1.07 (9H, s), 1.44 (3H, s) ($CH_3\times7$). (Chart 5). Mass Spectrum: as given in Chart 2.

**Dehydration of 7a with $POCl_3$-Pyridine**——To an ice-cooled solution of **7a** (19 mg) in pyridine (1.5 ml) was added dropwise $POCl_3$ (0.2 ml) and the total mixture was left standing at 15—20° for 25 hr, poured into water and extracted with $CHCl_3$ and ether. The $CHCl_3$ and ether extracts were respectively treated in the usual manner and the combined product (13 mg) was recrystallized from $CHCl_3$–MeOH to give colorless rods of **8**, mp 207—208°, $[\alpha]_D^{11}$ +43.1° ($c$=0.28, $CHCl_3$). *Anal.* Calcd. for $C_{28}H_{46}$: C, 87.88; H, 12.12. Found: C, 88.10; H, 12.10. IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: no OH. PMR ($CCl_4$) $\delta$: 0.79 (3H, s), 0.84 (6H, s), 0.85, 0.94, 1.03 (3H each s), 1.54 (3H, s, 21-$CH_3$) ($CH_3\times7$). Mass Spectrum *m/e* (%): 382 ($M^+$, 17), 367 ($M^+-15$, 13), 231 (**v**, 100), 191 (**iiia**, 63), 161 (**ii**, 52) (Chart 6). GLC (column: 3% SE-30 on chromosorb W, 3 mm×1 m; column temp.: 242°, carrier gas: $N_2$ 40 ml/sec): retention time=3′40″.

**Dehydration of 7b with $POCl_3$-Pyridine**——Treatment of **7b** (14 mg) in pyridine (1 ml) with $POCl_3$ (0.2 ml) as above yielded a product which, after recrystallization from acetone (yield: 12 mg), was identified with **8**

11) Since these crude products were contaminated with the inseparable carbonyl compounds (IR), they were treated with $LiAlH_4$ to modify the carbonyl compounds to the more polar substances.

by mixed mp, TLC [$AgNO_3$-$SiO_2$, i) *n*-hexane–benzene=8: 1; ii) petr. ether–$CHCl_3$=10: 1; iii) petr. ether–benzene=8: 1], GLC (as above), and IR.

**Treatment of Spergulagenin A (1) with Ethanolic Alkali**——A solution of **1** (50 mg) in 1 % (w/v) KOH-EtOH (50 ml) was heated under reflux for 50 hr, concentrated under reduced pressure while adding water, neutralized with 5% HCl, and extracted with $CHCl_3$. The $CHCl_3$ solution was washed with water, dried over $MgSO_4$, and evaporated to dryness to give **10** (30 mg). A solution of **10** (30 mg) in $Ac_2O$–pyridine (1 ml–1 ml) was left standing overnight at 31° and treated in the usual manner. The product (26 mg) was recrystallized from acetone to give colorless needles of **11**, mp 268—270°, $[\alpha]_D^8$ +33.9° ($c$=0.62, $CHCl_3$). IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 1748, 1249 (OAc). PMR ($CDCl_3$) $\delta$: 0.85 (9H, s), 0.94, 0.98, 1.04, 1.11 (3H each, s) ($CH_3\times7$), 1.20 (3H, d, $J$=7.0 Hz, 22-$CH_3$), 2.01 (9H, s), 2.06 (3H, s) (OAc×4), 4.48 (1H, t-like,3α-H), 4.8—5.4 (2H, m, 12α-H, 16α-H), 5.12 (1H, q, $J$=7.0 Hz, 22-H); ($CDCl_3$–$C_6D_6$=2: 1) $\delta$: 0.76 (3H, s), 0.83, 0.94 (6H each, s), 0.96, 1.04 (3H, each, s) ($CH_3\times7$), 1.02 (3H, d, $J$=7.0 Hz, 22-$CH_3$), 1.91 (9H, s), 2.03 (3H, s) (OAc×4), 4.48 (1H, t-like, 3α-H), 4.8—5.4 (2H, m, 12α-H, 16α-H), 5.20 (1H, q, $J$=7.0 Hz, 22-H). Mass Spectrum *m/e* (%): 644 ($M^+$), 584 ($M^+$—AcOH), 249 (13), 201 (42), 189 (50), 187 (100), 121 (20). The tetraacetate **11** was identified with **14b** as described below.

**Acetylation of Monohydroxy-triacetate (12a) (Less Polar One)**——A solution of **12a** (82 mg)[3b] in $Ac_2O$ (0.5 ml)–pyridine (0.5 ml) was left standing overnight at 31° and the product obtained after the ordinary work-up was treated with acetone to give **14a** (amorphous), $[\alpha]_D^{26}$ −0.51° ($c$=0.39, $CHCl_3$). *Anal.* Calcd. for $C_{38}H_{60}O_8$: C, 70.77; H, 9.38. Found: C, 70.58; H, 9.19. IR $\nu_{max}^{CCl_4}$ $cm^{-1}$: 1745, 1250 (OAc). PMR ($CDCl_3$) $\delta$: 0.84 (9H, s), 0.93, 0.96, 1.00, 1.10 (3H each, s) ($CH_3\times7$), 1.22 (3H, d, $J$=6.5 Hz, 22-$CH_3$), 2.02 (3H, s), 2.04 (6H, s), 2.06 (3H, s) (OAc×4), 4.47 (1H, t-like, 3α-H), 4.8—5.4 (2H, m, 12α-H, 16α-H), 4.98 (1H, q, $J$=6.5 Hz, 22-H).

**Acetylation of Monohydroxy-triacetate (12b)**——Seventy-two mg of **12b**[3b] was treated with $Ac_2O$ (0.5 ml)–pyridine (0.5 ml) and the product (63 mg) was recrystallized from acetone to give **14b**, mp 268—270°, $[\alpha]_D^{26}$ +49.6° ($c$=0.27, $CHCl_3$). *Anal.* Calcd. for $C_{38}H_{60}O_8$: C, 70.77; H, 9.38. Found: C, 70.85; H, 9.53. **14b** obtained here was identified with **11** by mixed mp, IR, PMR, and TLC [i) $CHCl_3$; ii) *n*-hexane–acetone=3: 1; iii) benzene–acetone=10: 1].

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