1745, 1730, 1630, *Anal*. Calcd. for $C_{27}H_{38}O_7$: C, 68.33; H, 8.07. Found : C, 68.36; H, 8.08.

For the purpose of comparing biological activity 15-oxodigitoxigenin (Ⅷ) was also prepared by acid hydrolysis of Ⅶ. m.p. 215～217°, $[\alpha]_D^{23}$ +12.7° ($CHCl_3$), IR ν_{max}^{KBr} cm^{-1} : 3550, 3400, 1775, 1750, 1735, 1708, 1618, *Anal*. Calcd. for $C_{23}H_{32}O_5$: C, 71.10; H, 8.30. Found : C, 71.45 : H, 8.22.

Preliminary experiments[*2] using the isolated frog's heart (Straub's preparation) showed that Ⅲ and Ⅷ possessed a definite and an indefinite cardiotonic action respectively, while Ⅴ did not any cardiotonic activity.

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[*2] The experiments were performed by Prof. T. Shigei and co-workers, Department of Pharmacology, Institute for Cardiovascular Diseases, Tokyo Medical and Dental University, to whom the author's thanks are due.

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The Chemical Proof of Hopane Skeleton of Zeorin

In 1958, Barton and co-workers[1] proposed I for the structure of zeorin, a widely distributed triterpene alcohol in the lichen family,[2] although the configurations at C-17 and C-21 were remained unsettled. Later on, an attempt was made by Huneck[3] on the subject to obtain the definite stereostructure of zeorin, but the problem has yet been left pending. Huneck and Lehn[4], in 1963, reported the nuclear magnetic resonance study of zeorin and its derivatives in relation to the related triterpene homologues and established spectroscopically the stereostructure of zeorin as Ⅱ possessing hopane skeleton. However, the definite chemical proof on the hopane skeleton of zeorin is still lacking. The present communication describes the chemical approach (Chart 1) to solve the stereochemical problem on the carbon skeleton of zeorin, and concludes that zeorin belongs indeed to the hopane group and is expressed by Ⅱ.

On treatment with phosphorus oxychloride in pyridine overnight at room temperature, zeorinone (Ⅲ) prepared by the chromium trioxide oxidation of zeorin, afforded a mixture of two double bond position isomers, zeorininone-a and -b, both corresponding respectively to hopene-a and -b types.[5] These isomers were successfully separated by silver nitrate impregnated silica gel column chromatography.[6] The earlier fraction (eluted by *n*-hexane-benzene, 10:1 mixture) gave zeorininone-a, $C_{30}H_{48}O$, m.p.[*1] 196.5～

[*1] All the melting points were taken on the Yanagimoto micromelting point apparatus (a hotstage type) and recorded uncorrected.

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2) Y. Asahina, S. Shibata : "Chemistry of Lichen Substances," 34 (1954). Japan Society for the Promotion of Science, Tokyo.
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197.5°, whose structure is reasonably assigned as IV having an isopropylidene side chain at C-21 by its physical properties, *i.e.*,; IR $(CHCl_3)$: 1699 cm^{-1} (C=O), NMR $(CDCl_3$, τ-values): 9.35, 9.12, 9.05, 8.97, 8.82, 8.72 (3H respectively, six tertiary (methyls), 8.22, 8.37 (3H respectively, $>C=C(C\underline{H}_3)_2$). Zeorininone-b, $C_{30}H_{48}O$, m.p. 215~215.5°, obtained from the later eluant, was proved to be an isopropenyl derivative (V) on the basis of its physical data; IR $(CHCl_3)$: 1699 cm^{-1} (C=O), 1635, 889 cm^{-1} $(>C=CH_2)$, NMR $(CDCl_3$, $\tau)$: 9.21, 9.13, 9.05, 8.97, 8.89, 8.72 (3H each, six tertiary methyls), 8.19 (3H, $>C=\overset{|}{C}-C\underline{H}_3$), 5.18 (2H, $>C=C\underline{H}_2$).

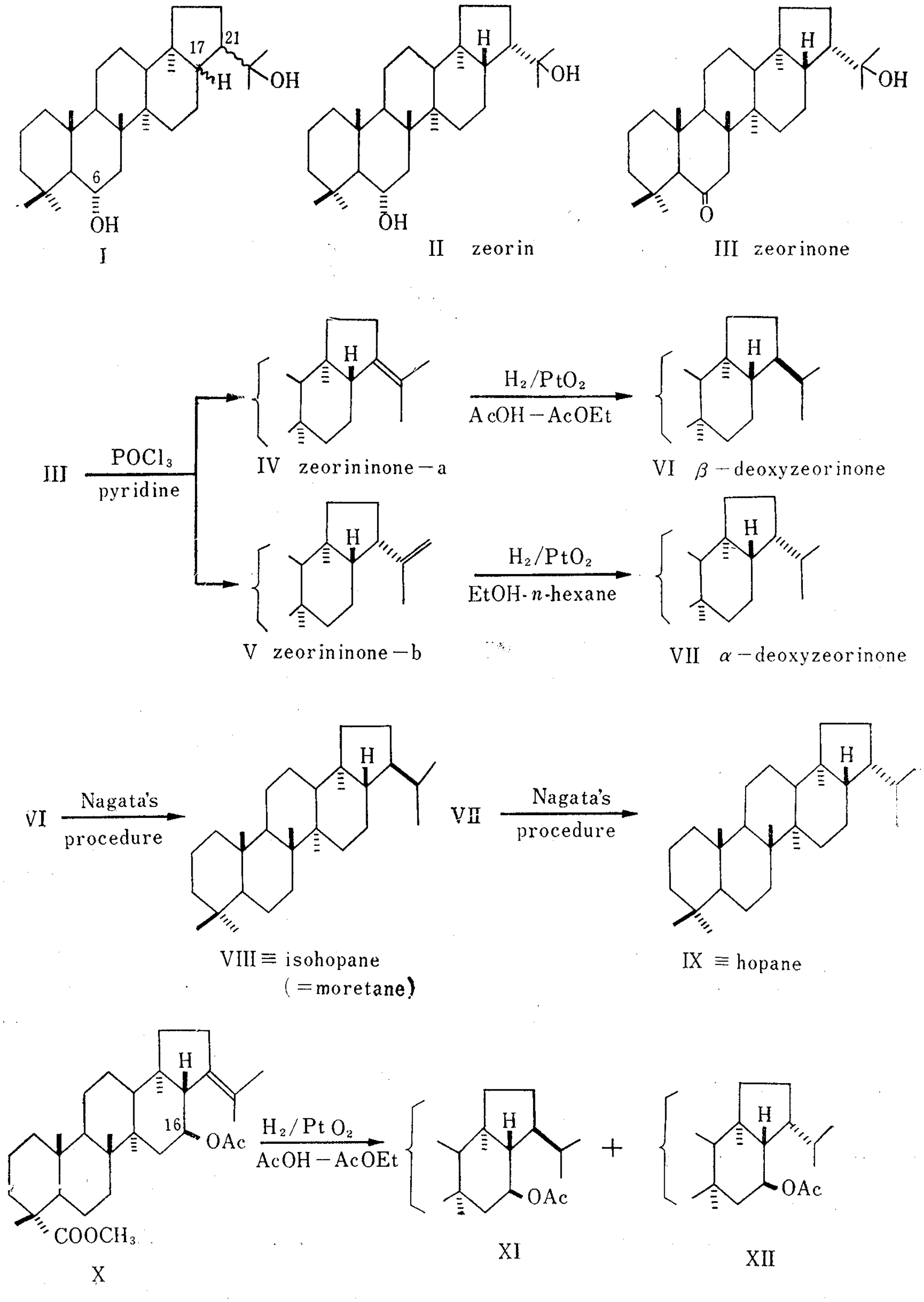

Chart 1.

Catalytic hydrogenation of V over Adams' catalyst in ethanol and *n*-hexane (2:1) mixture smoothly yielded a saturated compound, termed as α-deoxyzeorinone (VII), $C_{30}H_{50}O$, m.p. 238~239°. It is certainly believed that the compound VII retains C-21 configuration of zeorin as well as the configuration at C-17. On the other hand, the similar catalytic hydrogenation of Ⅳ in acetic acid and ethyl acetate mixture,*[2] furnished predominantly another saturated ketone, designated as β-deoxyzeorinone (Ⅵ), $C_{30}H_{50}O$, m.p. 204~207°. The both ketones, Ⅵ and Ⅶ, can be differentiated by the comparison of their melting points, infrared spectra and gas liquid chromatographic behavior (Table I). The isopropyl side chain at C-21 of Ⅵ is assumed to be β-oriented in analogy of the catalytic hydrogenation in the acidic medium of anhydroleucotylic acid derivative (X) giving the β-isopropyl compound (Ⅺ)[7] along with the α-isopropyl isomer (Ⅻ).*[3] The configurational assignment was finally confirmed by converting Ⅵ with forced Huang-Minlon reduction (Nagata's procedure B[8]) to a saturated hydrocarbon Ⅷ,*[5] m.p.*[6] 188~190°, which was proved identical with isohopane (=moretane[9]) by gas liquid chromatography (Table I). Another saturated ketone, α-deoxy-zeorinone (Ⅶ), was also subjected to the same modified Huang-Minlon reduction yielding a saturated hydrocarbon (Ⅸ), m.p.*[6] 188~191°. The identity of Ⅸ with hopane was achieved by comparison of their gas liquid chromatographical behavior (Table I).*[7]

TABLE I. Retention Time on Gas Liquid Chromatogram of Zeorinone Derivatives*[4]

Ⅵ :	14.0 min.	Ⅷ :	11.0 min.
Ⅶ :	17.7 min.	Ⅸ :	12.8 min.

Column : 1% SE-30 on chromosorb W, 2 m. temp. : 235°
Carrier gas : N_2, flow rate 60 ml./min.

The stereostructure of zeorin is consequently best represented by Ⅱ.

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*[2] The acidic medium was needed because of the tetra-substituted character of the double bond in Ⅳ.

*[3] While X gave a mixture of Ⅺ and Ⅻ on the catalytic hydrogenation in the acidic medium, Ⅳ furnished Ⅵ predominantly. The significant difference might be ascribable to C-16 O-acetyl function, however, the further study on the point is apparently needed.

*[4] Using the Yanagimoto Gas Chromatograph Model GCG-3DH, with FID.

*[5] Considering its formation procedure, zeorinane, m.p. 186.5~187.5°, $[\alpha]_D$ +12, reported by Barton and co-workers[1] is now considered to be isohopane.

*[6] Although the hydrocarbons mentioned here are gas-chromatographically pure, we were unable to raise their melting points as described in lit. 9) and 3), m.p. 192~194° for moretane and m.p. 198° for hopane respectively, due to the shortage of the material.

*[7] Gas liquid chromatography has been approved to be the most reliable method to identify these triterpene hydrocarbons.

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