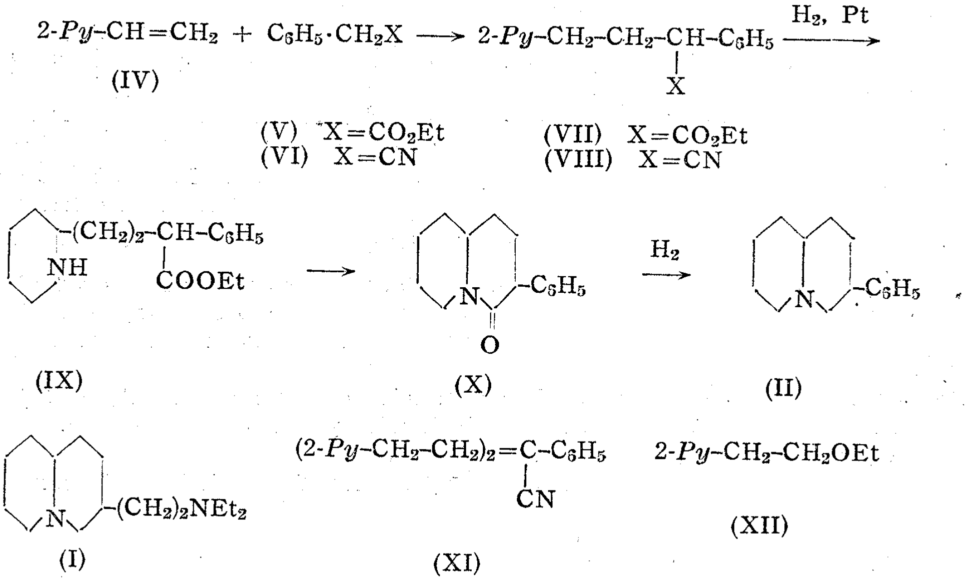
27. **Sadao Ohki and Koji Yamakawa:** Synthesis of Quinolizine Derivatives. II[1]. Syntheses of 3-Phenyl- and 3-*p*-Acetaminophenylquinolizidine.

(Pharmaceutical Institute, Medical Faculty, University of Tokyo)*

l-Sparteine, one of the lupine alkaloids, has been used as cardiac stimulant and diuretic, and more recently, as uterus contracting agent. In the previous paper[1], the authors described the synthesis of 3-β-diethylaminoethylquinolizidine (I), assumed to be an allied compound of sparteine, for the purpose of obtaining a sparteine-like substance with more powerful pharmacological actions. For the same purpose, 3-phenyl- (II) and 3-*p*-acetaminophenylquinolizidine (III) were since synthesized which are described in the following.

The synthetic procedure for (I) could utilize the method of preparing 3-substituted alkyl- or aralkyl-quinolizidine, but that for (II) and (III) was assumed to enable the utilization of the synthesis of other 3-substituted arylquinolizidines.

The synthesis of (II) was carried out as follows:



$$2\text{-}Py\text{-}CH{=}CH_2 + C_6H_5\cdot CH_2X \longrightarrow 2\text{-}Py\text{-}CH_2\text{-}CH_2\text{-}\underset{X}{\underset{|}{C}}H\text{-}C_6H_5 \xrightarrow{H_2,\ Pt}$$

(IV)

(V) $X{=}CO_2Et$
(VI) $X{=}CN$

(VII) $X{=}CO_2Et$
(VIII) $X{=}CN$

(IX) (X) (II)

(I)

$$(2\text{-}Py\text{-}CH_2\text{-}CH_2)_2{=}\underset{CN}{\underset{|}{C}}\text{-}C_6H_5$$

(XI)

$$2\text{-}Py\text{-}CH_2\text{-}CH_2OEt$$

(XII)

In order to obtain ethyl α-phenyl-γ-2-pyridylbutyrate (VII) and α-phenyl-γ-2-pyridylbutyronitrile (VIII), Michael condensation of 2-vinylpyridine (IV) and ethyl phenylacetate (V) or benzyl cyanide (VI) was attempted and following results were obtained.

No.	2-Vinyl pyridine (mole)	$C_6H_5CH_2X$ (mole)	Condensing agent (mole)	Solvent	Temp.	Time (hr.)	Product	Yield %
1	1	(V) 2	NaOEt 1	EtOH	Reflux	12	VII	trace
2	1	(VI) 1	NaOEt 1	EtOH	"	7	VIII XI	30 31
3	1	(V) 4	Na 1 atom	—	120~135°	5	VII	49
4	1	(VI) 5	Na ½ atom	—	100~130°	3	VIII	57

It is interesting to note that in experiment No. 1, the yield of (VII) was quite small whereas in No. 3, the compound was obtained in quite a good yield. In experiment No. 2, equimolar amount of (IV) and (VI) was used and α,α-di(β'-2-pyridylethyl)-benzyl cyanide

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[1] Part I: J. Pharm. Soc. Japan, 72, 490 (1952).

[2] W. von E. Doering, *et al.*: J. Am. Chem. Soc., 69, 2461 (1947).

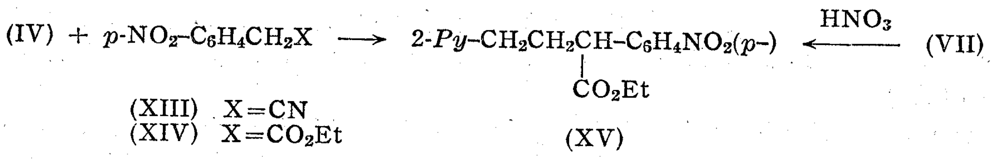
(XI) was obtained besides (VIII), as well as β-2-pyridylethyl ethyl ether (XII) as a by-product. Comparison of experiments No. 1 and No. 2 shows that there is a great deal of difference between the reactivity of (V) and (VI) against (IV). Treatment of (VIII) with ethanolic hydrochloric acid gave (VII), but a majority seemed to have remained as an imidoether compound so that it was saponified by boiling with hydrochloric acid, and then esterified to (VII).

(VII) was catalytically reduced in hydrochloric acid-alcohol solution, with Adams' platinum as a catalyst, to ethyl α-phenyl-γ-2-piperidylbutyrate (IX) which was cyclized, on being heated in an oil bath at 200~230°, to 3-phenyl-4-ketoquinolizidine (X). For the reduction of (X) to (II), following two methods were employed, i.e., reduction with lithium aluminum hydride in ether solution, and electrolytic reduction by the Tafel method. The reduction product from the first method was a colorless oil of b.p$_{4\sim5}$ 127°, which formed a picrate of yellow rhomboprisms, m.p. 152~153°. The product from the second method was a colorless oil of b.p$_3$ 105~110°, which gave a picrate of orange yellow rhomboprisms, m.p. 180~181°. The analytical values of both picrates corresponded to those of the picrate of (II). If the picrate of m.p. 152~153° is dissolved in hot water and minute crystals of the picrate of m.p. 180~181° are seeded, then the crystals that form are the picrate of m.p. 152~153°. The crystals of m.p. 152~153° were not found to transit to those of m.p. 180~181° by fusion. It follows, therefore, that the two must be stereoisomers, rather than dimorphs.

Two racemic modifications can also be assumed for the lactam (X). It is assumed, therefore, that one of the isomers had been prepared by the foregoing method, and this one had given a reduction product (II) of probably a *cis*-form, giving a picrate of m.p. 152~153°, through reduction by lithium aluminum hydride under comparatively mild conditions which was not accompanied by isomerization. On the other hand, the electrolytic reduction was carried out in sulfuric acid solution and (II) must have undergone isomerization in the acid medium to probably a *trans*-from, giving a picrate of m.p. 180~181°. This isomerization was confirmed by dissolving the product from the first method in 50% sulfuric acid, the same as the cathode solution in the electrolytic reduction, and allowed to stand at 20° for six hours, from which a substance giving a picrate of m.p. 180~181° was obtained.

Synthesis of (III) was then attempted, with considerations on the possibility of introducing various substituents in the phenyl nucleus of (II). Following the procedures for the preparation of (II), synthesis of ethyl α-p-nitrophenyl-γ-2-pyridylbutyrate (XV) was attempted by the nitration of (VII) with sulfuric and nitric acids from which a substance of b.p$_{0.4}$ 160~170° was obtained in 23.3% yield. This substance gave a picrate of pale yellow plates, m.p. 128~130°.

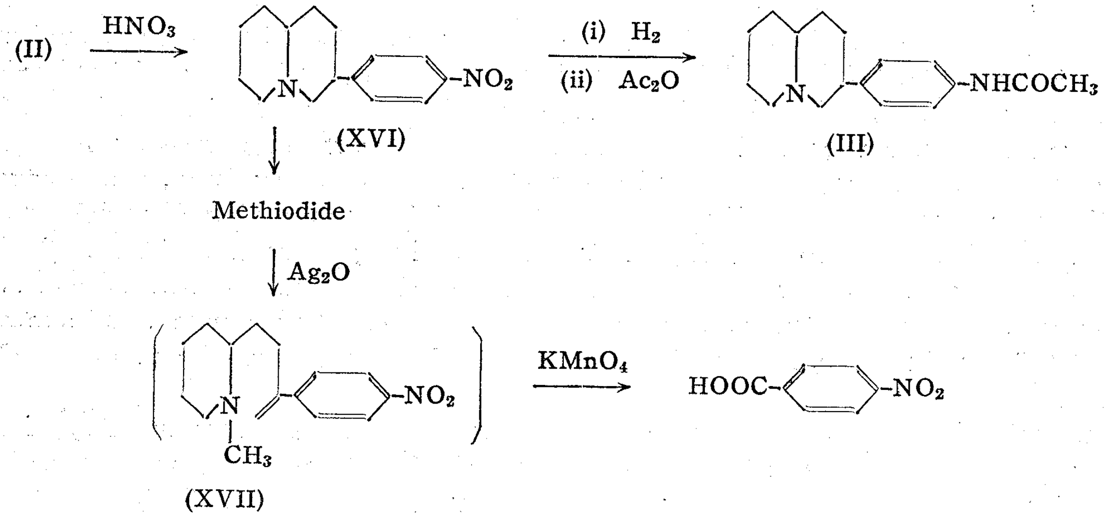
Michael condensation of (IV) with p-nitrobenzyl cyanide (XIII) or ethyl p-nitrophenylacetate (XIV) was then carried out, first in alcoholic solution with sodium alcoxide as the condensation agent, and then with metallic sodium, but the expected results could not be obtained, the product being a resinous substance, with the recovery of a small amount of (IV). Only in the condensation of (IV) and (XIV), with sodium, a small amount of oily substance was obtained, whose picrate, m.p. 128~130°, was found identical with the picrate of m.p. 128~130° formed from the nitration product of (VII). It seems certain, therefore, that the substance of b.p$_{0.4}$ 160~170° is the expected objective compound (XV). There still remains the necessity of examining the temperature, reaction time, etc., in the foregoing Michael condensation but the few experimental results obtained to date seemed to indicate that (XIII) and (XIV) take the form of sodium salts of pseudo-acid and prevent further progress of the reaction. The condensation of (IV) and (XIV), therefore, was carried out in hydrochloric acidity but only a small amount of unknown substance, which gave a picrate of m.p. 200~201°, was the sole product. The condensation of (IV) and *p*-acetaminobenzyl cyanide or ethyl *p*-acetaminophenylacetate was also unsuccessful.



$$\text{(IV)} + p\text{-NO}_2\text{-C}_6\text{H}_4\text{CH}_2\text{X} \longrightarrow 2\text{-}Py\text{-CH}_2\text{CH}_2\underset{\text{CO}_2\text{Et}}{\underset{|}{\text{CH}}}\text{-C}_6\text{H}_4\text{NO}_2(p\text{-}) \xleftarrow{\text{HNO}_3} \text{(VII)}$$

(XIII) X=CN
(XIV) $X=CO_2Et$
(XV)

Since (XV) could not be obtained in a good yield, (II) was directly nitrated with sulfuric and nitric acids from which crude 3-mononitrophenylquinolizidine (XVI) was obtained in approximately 43% yield. Catalytic reduction of (XVI) with platinum catalyst, followed by acetylation gave (III) which formed a picrate of orange yellow plates, m.p. 220~222°. The position of the acetamino group in (III) was confirmed as 3-*p*-acetaminoquinolizidine by the Hofmann degradation of the methiodide of (XVI), followed by oxidation with aqueous solution of potassium permanganate to *p*-nitrobenzoic acid, which, in turn, confirmed (XVI) to be 3-*p*-nitrophenylquinolizidine. The methine base was assumed to be (XVII) but no confirmatory evidence could be obtained due to the minute amount of the sample available. It was also assumed that the direct oxidation of (XVI) would provide *p*-nitrobenzoic acid but this also could not be proved due to the lack of material.



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Experimental

Condensation of 2-vinylpyridine and benzyl cyanide—Ethanolic solution of sodium ethoxide was prepared from 0.45 g. of metallic sodium and 10 cc. of absolute ethanol, to which 2.25 g. of benzyl cyanide was gradually added. To this was added, slowly, 2.0 g. of 2-vinylpyridine (containing a small amount of *p*-hydroquinone) in 5 cc. of absolute ethanol, and the whole mixture was refluxed on a water bath for 7 hours, resulting in a dark brown solution. Ethanol was removed under a reduced pressure, ice-water added to the residue which was basified with sodium carbonate, salted out with potassium carbonate, and extracted with ether. The ether solution was dried over sodium sulfate, and ether removed. The residue was distilled under a reduced pressure and the following three fractions were obtained: (i) 0.42g. of $b.p_{10}$ 92~94° (ii) 1.3 g. of $b.p_2$ 160~165° (iii) 0.95 g. of $b.p_{0.035}$ 220~240° (oil bath).

The first distillate (i) was a colorless oil which gave a picrate of golden yellow needles, m.p. 106°, which coincided with the picrate of β-2-pyridylethyl ethyl ether (XII) obtained by Doering, *et al.*[2]. *Anal.* Calcd. for $C_9H_{13}ON \cdot C_6H_3O_7N_3$: N, 14.73. Found: N, 14.68.

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The second fraction, (ii), was a pale brown, slightly viscous oil which gave a picrate, as recrystallized from ethanol, of yellow rhomboprisms, m.p. 136°, whose analytical values corresponded to those of α-phenyl-γ-pyridylbutyronitrile (VIII). *Anal.* Calcd. for $C_{15}H_{14}N_2 \cdot C_6H_3O_7N_3$: C, 55.89; H, 3.77; N, 15.52. Found: C, 55.15; H, 3.57; N, 15.52.

The third fraction, (iii), was a pale brown, viscous oil which was found to be α,α-di-(β'-2-pyridylethyl)-benzyl cyanide (XI). This substance formed a dipicrate, as recrystallized from glacial acetic acid, of yellow rhomboprisms, m.p. 172°. *Anal.* Calcd. for $C_{22}H_{21}N_3 \cdot 2C_6H_3O_7N_3$: C, 52.00; H, 3.44; N, 16.04. Found: C, 52.71; H, 3.61; N, 15.81.

Ethyl α-phenyl-γ-2-pyridylbutyrate (VII)—To a mixture of 10.5 g. (0.1 mole) of 2-vinylpyridine (containing a small amount of *p*-hydroquinone) and 65.6 g. (0.4 mole) of ethyl phenylacetate, 2.3 g. (0.1 mole) of metallic sodium was added, and the mixture was stirred at room temperature for about 2 hours until the majority of sodium had dissolved. The mixture was then heated for 5 hours at 120～135° and allowed to cool. The reaction mixture, which became dark brown, was added with a small amount of ice-water and 80 cc. of ether, and extracted completely with 10% HCl. The excess of ethyl phenylacetate remains in the ether layer. The hydrochloric acid layer was basified with sodium carbonate, salted out with potassium carbonate, and extracted with ether. After washing with water and drying over sodium sulfate, ether was distilled off, and the residue was distilled under a reduced pressure. The first distillate, 3.8 g. of b.p$_{30}$ 70～72°, was the recovered 2-vinylpyridine. The second fraction, 13.2 g. of pale rose-colored, viscous oil, b.p$_2$ 165～168°, was the objective (VII). Yield, 49%. Picrate: Yellowish green needles, m.p. 103°, as crystallized from ethanol. *Anal.* Calcd. for $C_{17}H_{19}O_2N \cdot C_6H_3O_7N_3$: C, 55.42; H, 4.62; N, 11.24. Found: C, 55.87; H, 4.77; N, 11.64. The third fraction, 0.36 g. of b.p$_2$ 205～207°, has not been examined as yet.

α-Phenyl-γ-2-pyridylbutyronitrile (VIII)—To a mixture of 1.0 g. of 2-vinylpyridine (containing a small amount of *p*-hydroquinone) and 5.5 g. of benzyl cyanide, 0.05 g. of metallic sodium was added, the mixture slowly heated and allowed to reflux for about 2 hours at 100～110°, and for about 1 hour at 130°. The dark brown reaction mixture was treated as in the foregoing and 1.2 g. of a fraction of b.p$_2$ 162～165° was obtained. Yield, 57%. Picrate of m.p. 136° was identical with the picrate, m.p. 136°, of (VIII) obtained previously.

Synthesis of (VII) from (VIII)—A solution of 2.3 g. of (VIII) dissolved in 10 cc. of absolute ethanol was saturated with dry hydrochloric acid gas, under ice-cooling, and the mixture was warmed for 3 hours at 60°. A small amount of white crystals, m.p. 122°, separated out which were assumed to be the hydrochloride of the imidoether compound. After the removal of ethanol, the residue was dissolved in water, basified with sodium carbonate, and extracted with ether after salting out. The ether solution was dried over sodium sulfate and ether removed by which the majority of the residue solidified. This was recrystallized from benzene to 0.8 g. of α-phenyl-γ-2-pyridylbutyroimidoethyl ether as colorless needles, m.p. 118°. *Anal.* Calcd. for $C_{16}H_{18}ON_2$: C, 75.59; H, 7.08; N, 11.02. Found: C, 76.08; H, 6.68; N, 11.39.

From the benzene recrystallization mother liquor of the imidoether compound, 0.3 g. of (VII), b.p$_2$ 160～170°, was obtained. The imidoether compound was heated in 10% HCl for 2 hours at 110°, the mixture evaporated to dryness, and the residue was esterified to (VII) with ethanolic hydrochloric acid.

Ethyl α-phenyl-γ-2-piperidylbutyrate (XI)—A solution of 2.3 g. of ethyl α-phenyl-γ-2-pyridylbutyrate (VII) dissolved in 40 cc. of absolute ethanol was catalytically reduced in hydrochloric acidity with Adams' platinum. After the removal of the catalyst, ethanol was distilled off, and the residue was dissolved in water. This solution was basified with sodium carbonate, extracted with ether, and the ether removed after drying over sodium sulfate. The dark green oily substance was obtained in 2.3 g. amount. Liebermann reaction, positive.

3-Phenyl-4-ketoquinolizidine (X)—Heating of 2.3 g. of the above piperidyl compound (IX) in an oil bath at 200～230° for 1 hour resulted in the removal of ethanol and the liquid became pale brown. After cooling, this was dissolved in ether, shaken with 10% HCl, and the ether layer was washed with water and dried over sodium sulfate. Removal of ether gave viscous oil which was distilled to give aromatic, pale yellow, viscous oil, b.p$_{0.02}$ 163～168°. Yield, 1.54 g. *Anal.* Calcd. for $C_{15}H_{19}ON$: N, 6.11. Found: N, 6.08.

Basification of the 10% HCl solution and extraction with ether gave a recovery of the piperidyl compound (IX).

3-Phenylquinolizidine (II)—(i) Reduction with $LiAlH_4$: To a solution of 1.0. g. of $LiAlH_4$ dissolved in 50 cc. of absolute ether, while chilled with ice, a solution of 3.9 g. of the lactam (X) dissolved in 20 cc. of absolute ether was dropped in slowly. White double salt precipitated immediately. After refluxing the mixture on a water bath for about 20 hours, water was slowly added, while cooling with ice, to decompose the excess of $LiAlH_4$, and then 10% H_2SO_4 was added with agitation to decompose the double salt and to extract the base into the sulfuric acid layer. The acid layer was basified with 10% NaOH, and the white turbid liquid was extracted thoroughly with ether.

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After drying over sodium sulfate, ether was removed, and the residue was distilled in vacuo. Colorless oil, b.p$_{4\sim5}$ 127°, yield, 3.2 g. or 88%, gave a picrate of yellow rhomboprisms, m.p. 152～153° (from ethanol). *Anal.* Calcd. for $C_{15}H_{21}N \cdot C_6H_3O_7N_3$: C, 56.75; H, 5.44; N, 12.61. Found: C, 57.09; H, 5.52; N, 12.42.

(ii) Tafel's electrolytic reduction: A cathode solution was 0.50 g. of the lactam (X) dissolved in 12 cc. of 50% sulfuric acid, and the anode solution, 50% sulfuric acid. Purified lead plates were used for the cathode and anode. Reduction was carried out at 0.2 A/cm^2 density, for 6 hours at 20～24°, and for 1 hour at 0.4 A/cm^2. The cathode solution was neutralized with sodium carbonate, salted out with potassium carbonate, and extracted with ether. After drying over sodium sulfate, ether was removed, and the residue was distilled under a reduced pressure. Colorless oil, b.p$_3$ 105～110°, was obtained in 0.33 g. or 70%, yield. Picrate: Orange yellow rhomboprisms, m.p. 180～181° (from ethanol). *Anal.* Calcd. for $C_{15}H_{21}N \cdot C_6H_3O_7N_3$: C, 56.75; H, 5.44; N, 12.61. Found. C, 56.82; H, 5.44; N. 12.65.

Nitration of ethyl *α*-phenyl-*γ*-2-pyridylbutyrate (VII)—(i) To 2.5 g. of (VII), a mixture of 1.0 g. of fuming nitric acid (d=1.52) and 2.0 g. of conc. sulfuric acid (d=1.83) was dropped in, under ice-cooling and vigorous stirring. The reaction mixture became orange yellow and crystals separated out. After stirring for further 30 minutes, 2.5 cc. of glacial acetic acid was added and stirred further, by which the mixture became clear and the color remained orange yellow. After allowing the mixture to stand over night, the mixture was poured into ice-water, basified with sodium carbonate, and the viscous oil that separated out was extracted with ether. After drying over sodium sulfate, ether was removed, and 1.05 g. of the oily residue was chromatographed over alumina as a carbon tetrachloride solution. A fraction of b.p$_{0.4}$ 160～170° was obtained in 0.65 g. amount. Yield, 23.3%. Picrate: Yellow plates, m.p. 128～130°. *Anal.* Calcd. for $C_{17}H_{18}O_4N \cdot C_6H_3O_7N_3$: C, 50.82; H, 3.87; N, 12.87. Found: C, 50.85; H, 4.16; N, 12.70.

(ii) A mixture of 1.19 g. of 2-vinylpyridine and 5.5 g. of ethyl *p*-nitrophenylacetate, in the presence of 0.065 g. of sodium, was heated gradually to about 130°, and maintained at that temperature for 3 hours. After cool, the mixture was treated as in the foregoing. The 10% HCl solution was basified, and the oily substance that separated out was extracted with ether. The ether residue was chromatographed over alumina as a benzene solution, and a small amount of picrate was obtained as yellow plates, m.p. 128～130°, which showed no depression of the melting point on admixture with the picrate of m.p. 128～130° obtained above.

3-*p*-Nitrophenylquinolizidine (XVI)—To 0.85 g. of (II) (picrate, m.p. 152～153°), a mixture of 0.3 g. of fuming nitric acid (d=1.52) and 0.5 g. of conc. sulfuric acid (d=1.83) was slowly added, under ice-cooling and stirring. White salts separated out. After the addition of further 1.8 g. of conc. sulfuric acid, the mixture was stirred for about 30 minutes longer, 3 cc. of glacial acetic acid added, and allowed to stand over night. The reaction mixture was poured into ice-water, basified with 10% sodium carbonate solution, salted out, and the brown solid that separated out was extracted with ether. After drying over sodium sulfate, ether was removed, and 1.0 g. of the residue was chromatographed over active alumina as a carbon tetrachloride solution. Development of the column with benzene gave the first eluate of the original material (II), followed by the mononitro compound. Its picrate was recrystallized from ethanol and yellow crystals of m.p. 215～220° (decomp.) were collected. The picrate thereby obtained was suspended in 10% NH_4OH, ether added, and the liberated base was thoroughly extracted into the ether layer. After washing with water and drying over sodium sulfate, ether was removed by distillation and 0.44 g. of brown oil was obtained. Yield, 43%. Picrate: Yellow rhomboprisms, m.p. 222° (decomp.). *Anal.* Calcd. for $C_{15}H_{20}O_2N_2 \cdot C_6H_3O_7N_3$: C, 51.76; H, 4.70; N, 14.11. Found: C, 51.43; H, 4.97; N, 14.64.

3-*p*-Acetaminophenylquinolizidine (III)—Hydrochloric acid gas was passed into the solution of 0.44 g. of crude (XVI) dissolved in 20 cc. of ethanol until it was acid, and the mixture was catalytically reduced with 0.01 g. of Adams' platinum. After the removal of the catalyst, ethanol was removed with aspiration, and a hygroscopic, amorphous hydrochloride was thereby obtained. This substance gave positive color reaction for the amine by diazo reaction. Crystallization of various salts was difficult, due probably to the crude product used. This hydrochloride was, therefore, acetylated by deriving the salt to the free base, dissolved in benzene, and refluxed on a water bath for 3 hours with 0.2 cc. of acetic anhydride. After the removal of benzene, the residue was added with ice-water, basified with alkali carbonate, and the oil separated out was extracted with benzene. After drying, benzene was removed, and the oily residue was separated into hexane-soluble portion (A) and one (B) comparatively sparingly soluble in hexane. Both were separately chromatographed over alumina as benzene solutions. From (A) portion, two kinds of picrates, of m.p. 150～153°, and of m.p. 181～182°, were separated which were identified as the picrates of two types of (II). This was probably due to the occlusion of unreacted (II) in the original material (XVI). (B) portion yielded a picrate of orange yellow plates, m.p. 220～222°, whose analytical values corresponded to those of the picrate of (III). *Anal.* Calcd. for $C_{17}H_{24}ON_2 \cdot C_6H_3O_7N_3$: C, 55.09; H, 5.39. Found: C, 54.99; H, 5.79.

Oxidative decomposition of 3-*p*-nitrophenylquinolizidine (XVI)—To a solution of 70 mg. of (XVI) in methanol, methyl iodide was added and warmed, whereby its methiodide was obtained. Recrystallized from ethanol as colorless plates, m.p. 237~239° (decomp.). *Anal.* Calcd. for $C_{15}H_{20}O_2N_2 \cdot CH_3I$: C, 47.7; H, 5.7. Found: C, 47.0; H, 5.3. A solution of 70 mg. of the methiodide was thoroughly mixed with freshly prepared silver oxide, filtered, and washed consecutively with water and alcohol. The filtrate and washings were combined and warmed on a boiling water bath for about 2 hours, allowing the alcohol to distill out. When cool, the mixture was salted out, and the oily substance that separated out was taken up in ether. The ether residue was suspended in water, and saturated potassium permanganate solution was dropped in, while warming on a water bath, until the color of the permanganate persisted. After decolorizing the permanganate with the addition of a small amount of methanol, the mixture was filtered, washed well with water, and the combined filtrate and washings was again filtered. The filtrate thereby obtained was evaporated on a water bath and acidification of the residual liquid separated 20 mg. of crude crystals. Purification by sublimation yielded colorless plates of m.p. 233~236°, which failed to give any depression of the melting point on admixture with authentic specimen (Kahlbaum preparation) of *p*-nitrobenzoic acid, m.p. 234~237°.

Summary

3-Phenyl- (II) and 3-*p*-acetaminophenylquinolizidine (III) were prepared by the following procedures. Condensation of 2-vinylpyridine and ethyl phenylacetate gave ethyl α-phenyl-γ-pyridylbutyrate (VII) whose reduction and cyclization yielded 3-phenyl-4-ketoquinolizidine (X). Reduction of (X) with lithium aluminum hydride or electrolytically, gave two different forms of 3-phenylquinolizidine (II) giving picrates of m.p. 152~153° and of m.p. 180~181°, from which the presence of stereoisomers was assumed. Nitration of (II) with sulfuric and nitric acids, followed by acetylation gave 3-*p*-acetaminophenylquinolizidine (III).

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28. Tatsuo Kariyone* and Takao Matsuno**: Studies on the Constituents of Orange Oil. I. On the Structure of Auraptene.

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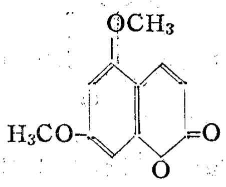
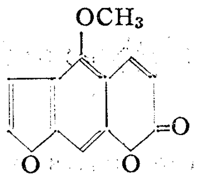
The oil of Citrus genera contains a minute quantity of coumarin derivatives, such as citraptene (I) in lemon oil and bergaptene (II) in bergamot oil, besides over 95% of *d*-limonene.



(I)



(II)

Komastu and Tanaka[1] first isolated, in 1930, a crystalline compound melting at 68° from the oil of *Citrus aurantium Natsudaidai* and named it auraptene. They considered it to be 7-hydroxycoumarin heptyl ether (III) without synthetic confirmation.

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[1] S. Komatsu, *et al*: J. Chem. Soc. Japan, **51**, 478 (1930).
[2] H. Böhme, G. Pietsch: Arch. Pharm., **276**, 482 (1938); Ber., **72**, 773 (1939); *ibid.*, **72**, 780 (1939).

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