**Summary**

The condensation products of arylamine (aniline, *p*-nitroaniline, *p*-aminoazobenzene, and sulfanilamide) with glucofuranurono-γ-lactone were prepared. It was established that the condensation product should have a structure of 1-arylamino-1-deoxyglucofuranurono-γ-lactone (IIa). It was found that the opening of the lactone ring in (IIa) by treatment with sodium hydroxide afforded 1-arylamino-1-deoxyglucofuranuronate, while it gave 1-arylamino-1-deoxyglucopyranuronamide with ammonia-saturated methanol.

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*UDC 547.837.6.07*

## 38. Seitaro Saeki: Quaternization of the Ring Nitrogen of Hexahydrojulolidine and its Related Compounds. II.[1] Quaternization of the Ring Nitrogen of Stereoisomers of Perhydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine.

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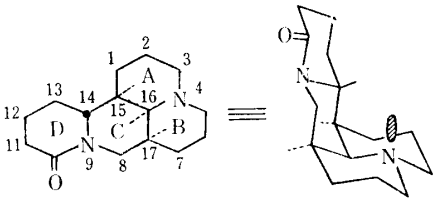
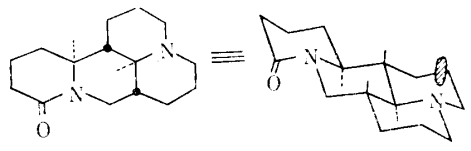
Tsuda and Mishima[2] reported that matrine (I) reacted neither with cyanogen bromide nor with methyl iodide on refluxing in ether because the ring junctures of A/C and B/C in matrine were all *cis*, and that allomatrine (II), in which the concerned junctures were all *trans*, reacted with these reagents to afford its bromocyanamide and methiodide, respectively.

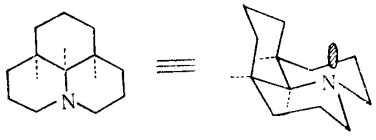
Furthermore, it was found by Tsuda and Saeki[1] that *cis-cis*-hexahydrojulolidine (III) did not react with methyl iodide when refluxed in ether, but that the *trans-trans*-isomer (IV) reacted easily under the same condition to give the methiodide.



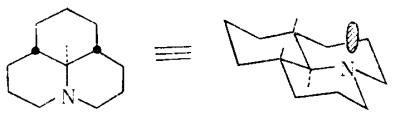

(I)




(II)




(III)




(IV)

*1 Katakasu, Fukuoka (佐伯清太郎).

1) Part I. K. Tsuda, S. Saeki: This Bulletin, **6**, 391 (1958).
2) K. Tsuda, H. Mishima: *Ibid.*, **5**, 285 (1957); *Idem*: J. Org. Chem., **23**, 1179 (1958).

In order to find the correlation between the stereoisomers of perhydro-1*H*,5*H*-naphtho-[1,2,3,-*i*,*j*]quinolizine having the same skeleton as matrine, these compounds were synthesized and their configuration and reactivity at 4-nitrogen were investigated.

The synthesis of perhydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine was achieved by the route shown in Chart 1.

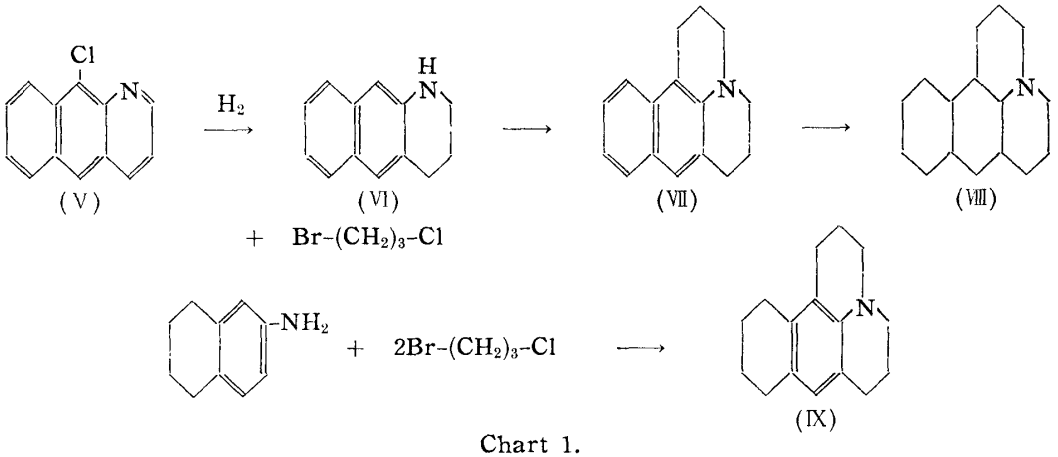



Chart 1.

Several methods[3,4] have been reported for the preparation of 1,2,3,4-tetrahydrobenzo[*g*]quinoline (VI), but none of them is satisfactory because of a low yield and an attempted improvement of the synthetic method also failed. However, catalytic hydrogenation of 10-chlorobenzo[*g*]quinoline (V) with 2 moles of Raney nickel at initial hydrogen pressure of 70 atm., at 150°, in ethanol saturated with ammonia gave (VI) in 90% yield. It was identified with an authentic specimen[4a] of 1,2,3,4-tetrahydrobenzo[*g*]quinoline by mixed melting point, and by infrared and ultraviolet spectra. In the same way as for the preparation of julolidine,[5] a mixture of (VI) (1 mole) and 1-bromo-3-chloropropane (7 moles) was heated in an oil bath for 25 hours at 160° and (VII), m.p. 68~69°, UV $\lambda_{max}^{EtOH}$ mμ(log ε) : 261(4.42), 298(3.82), 310(3.80), 367(3.39), was obtained in 64% yield.

On the other hand, the reaction of 6-aminotetralin with a large excess of 1-bromo-3-chloropropane gave 2,3,6,7,9,10,11,12-octahydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine (IX) only in a few per cent yield and the ring closure of available 1,2,3,4-tetrahydrobenzo[*f*]quinoline with 1-bromo-3-chloropropane was not successful.

When the compound (VII) was hydrogenated with Raney nickel at initial hydrogen pressure of 110 atm., at 250°, in methylcyclohexane, a sterically pure but small amount (21%

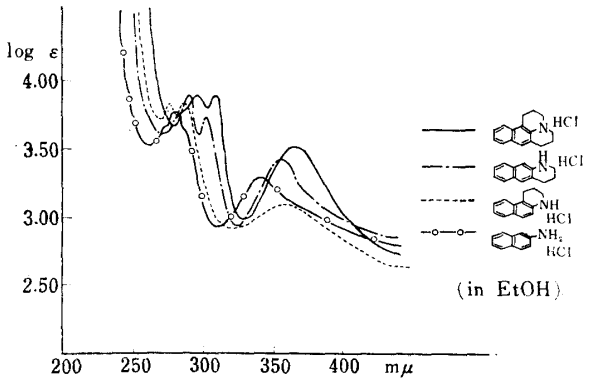



Fig. 1.

3) J. v. Braun, H. Gruber : Ber., **55**, 1716 (1922).
4) *a*) A. Etienne : Ann. chim. (Paris), [12] **1**, 1 (1946); *b*) F. H. Gerhardt, C. S. Hamilton : J. Am. Chem. Soc., **66**, 479 (1944); *c*) J. v. Braun, J. Nelles : Ber., **70**, 1760 (1937).
5) Org. Syntheses, **26**, 40.

yield) of isomer-A, m.p. 68° (picrate, m.p. 202°), was obtained. The same procedure using ethanol as the solvent in place of methylcyclohexane did not yield a single product and gave an oily mixture of the stereoisomers. Chromatographic separation on alumina gave isomer-B (picrate, m.p. 178°), isomer-C (picrate, m.p. 147°), and isomer-D (picrate, m.p. 166°), in a 3:1:1 ratio.

According to Bohlmann,[6] the compounds possessing a *trans*-quinolizidine ring exhibit characteristic infrared absorptions in the region of 2700~2800 $cm^{-1}$, but those possessing the *cis*-quinolizidine ring do not. Since all perhydro-1*H*,5*H*-naphtho[1,2,3,-*i*,*j*]quinolizines (isomers-A, -B, -C, and -D) obtained as above showed these characteristic absorptions in this region, the configuration of A/B ring in these quinolizidines was assumed to be all *trans*.

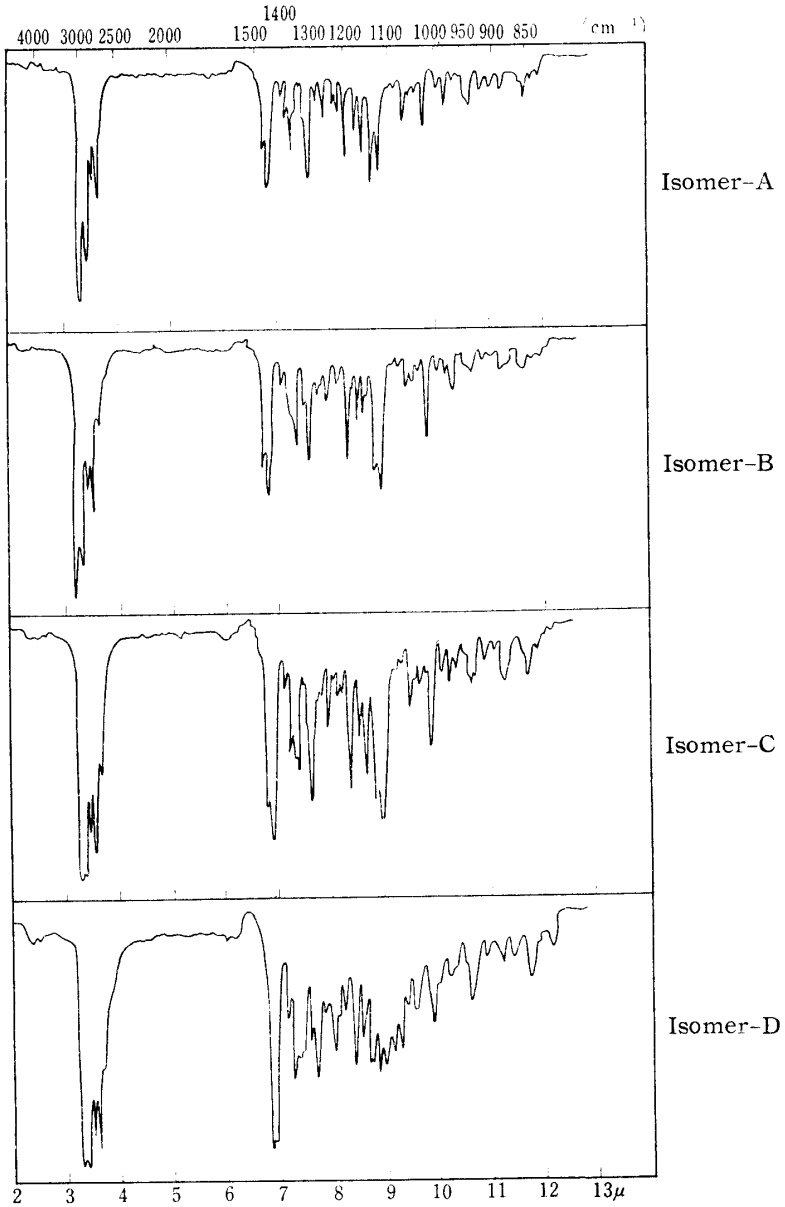


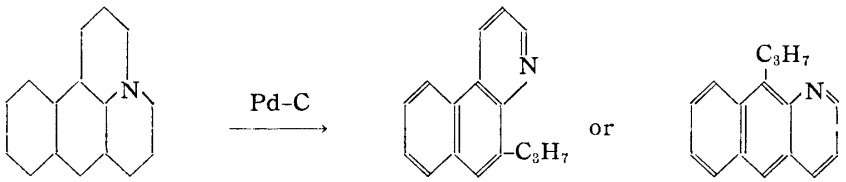

Fig. 2. Infrared Spectra (in $CCl_4$)

6) F. Bohlmann, *et al.* : Chem. Ber., **90**, 653 (1957); **91**, 2157 (1958); *Idem* : Angew. Chem., **69**, 642 (1957).

Treatment of isomer-B with aluminium chloride at 220° in nitrogen atmosphere, converted it into isomer-A. Treatment of isomer-C with aluminium chloride at 220° also afforded isomer-A. Therefore, it was concluded that isomer-A takes the most stable conformation, i.e. all-*trans* ring juncture.[7,8] To elucidate the configurations of A/C and B/C rings in stereoisomeric perhydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizines, their reaction with methyl iodide was examined. When isomer-D was refluxed for 7 hours with methyl iodide in ether, the starting material was recovered almost quantitatively, as in the case of *cis-cis*-hexahydrojulolidine, while both isomers-A and -C readily gave the corresponding methiodides on refluxing with methyl iodide in ether for one hour, similarly to the case of *trans-trans*-hexahydrojulolidine. In the case of isomer-B, the starting material was recovered on refluxing for one hour while its methiodide was obtained in 90% yield when refluxed for seven hours.

These experiments indicate that the nitrogen atom at 4 in isomer-D is shielded from the attack of reagent and shielded a little in isomer-B, while in both isomers-A and -C, it is open to the attack. In order to confirm these findings in detail, the reaction rate was measured of the isomers (A, B, C, D) and *trans-trans*- (IV) and *cis-cis*-hexahydrojulolidine (III), with methyl iodide or propyl iodide, and the results are presented in Table I.

As a consequence, it is now possible to assume that both ring junctures A/C and B/C are *trans* in isomers-A and -C, and *cis* in isomer-D, and that although they are *trans* in isomer-B, its nitrogen atom at 4 is slightly schielded from the attack of reagents by the D-ring. Furthermore, the ease with which these perhydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]-quinolizines were dehydrogenated in the presence of palladium-charcoal supported the above fact. The dehydrogenation velocity of isomer-B and -C was faster than that of isomer-A, and the dehydrogenation product was 5-propylbenzo[*f*]quinoline (Xa) or 10-propylbenzo[*g*]quinoline (Xb), m.p. 65~66°; UV $\lambda_{max}^{EtOH}$ mμ(log ε): 215(4.50), 235(4.58), 270 (4.28), 317(3.14), 333(3.30), 349(3.32).*2




(Xa) (Xb)

Chart 2.

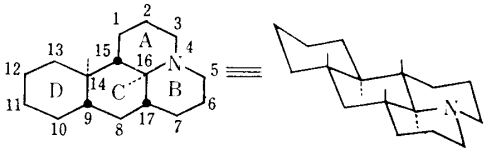
Table I.

| | *trans-trans*-Hexahydrojulolidine | Isomer-A | Isomer-B | Isomer-C | *cis-cis*-Hexahydrojulolidine | Isomer-D |
|---|---|---|---|---|---|---|
| Rate* of reaction with MeI ($K \times 10^4$) | 10.74 | 9.77 | 7.08 | 9.57 | 0.267 | 0.234 |
| Rate* of reaction with PrI ($K \times 10^4$) | 0.331 | 0.322 | 0.238 | 0.318 | | |
| IR | *trans*-quinolizidine type | | | | | |
| Reaction with $AlCl_3$ | | | Isomerized into isomer-A | | Isomerized into *trans-trans* compound | Isomerized into isomer-A |
| Dehydrogenation | | slow | fast | fast | | |

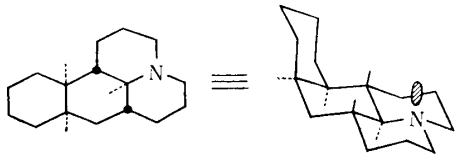
* All experiments were made at 35°±0.1°.

*2 These absorption maxima are quite similar to those of benzo[*f*]quinoline (Jikken Kagaku Koza, **1**, 208) and this dehyrogenation product is assumed to be 5-propylbenzo[*f*]quinoline (Xa).

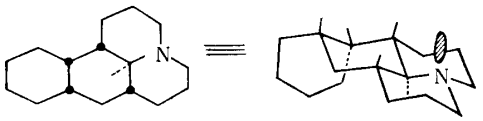
7) F. Galinovsky, P. Knoth, W. Fischer: Monatsh., **86**, 1014 (1955).
8) K. Tsuda, H. Mishima: J. Org. Chem., **23**, 1179 (1958).



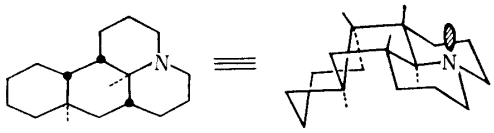
Isomer A



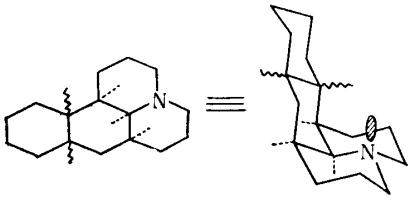
Isomer B



or



Isomer C



Isomer D

This result of dehydrogenation indicates that isomer-B and isomer-C contain a larger number of *cis*-hydrogens than isomer-A.[9]

In conclusion, it is considered that structure 8,12,12a,12b,12c-perhydro-1*H*,5*H*-naphtho-[1,2,3-*i*,*j*]quinolizine should be assigned to isomer-A, 8,12,12a,12b,12c-perhydro structure to isomer-B, 8,12,12a,12b,12c-perhydro or 8,12,12a,12b,12c-perhydro structure to isomer-C, and 8,12,12a,12b,12c-perhydro structure to isomer-D.

## Experimental

**1,2,3,4-Tetrahydrobenzo[*g*]quinoline (VI)**—A mixture of 8 g. (0.07 mole) of 10-chlorobenzo[*g*]-quinoline[4] (V), and 5 g. (0.084 mole) of Raney Ni in 100 cc. of dehyd. EtOH saturated with $NH_3$ was submitted to hydrogenation at 150° and 90 atm. (initial $H_2$ pressure) for 2 hr. The reaction mixture was filtered and the catalyst was washed with benzene. The washing and filtrate were mixed. After evaporation of the solvent *in vacuo*, white crystals that separated were recrystallized from benzene-ligroine to white cubic crystals, m.p. 156°. Yield, 6.5 g. (92%). A mixed m.p. with the sample prepared by the method of Braun[3] showed no depression. *Anal.* Calcd. for $C_{13}H_{13}N$ : C, 85.20; H, 7.15; N, 7.64. Found : C, 85.12; H, 7.35; N, 7.84.

Hydrochloride : m.p. 229°. UV $\lambda_{max}^{EtOH}$ mμ (log ε) : 280 (3,37), 290 (3.89), 330 (3.76), 355 (3.44).

**2,3,6,7-Tetrahydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine (VII)**—A mixture of 8 g. (0.043 mole) of (VI) and 50 g. (0.318 mole) of $Br(CH_2)_3Cl$[10] was refluxed at 160° for 20~25 hr. in an oil bath. After cool, crystals were collected by filtration. The filtrate was shaken with 10% HCl and crystals that separated were collected by filtration. Both crops of crystals were combined, treated with 10% NaOH, extracted with $Et_2O$, the extract was dried over $Na_2SO_4$, and distilled, $b.p_6$ 208°.

This oil was recrystallized from ligroine to white cubic crystals, m.p. 68~69°. Yield, 7 g. (64%). UV $\lambda_{max}^{EtOH}$ mμ (log ε) : 261 (4.42), 298 (3.82), 310 (3.80), 367 (3.89). *Anal.* Calcd. for $C_{16}H_{17}N$ : C, 86.05; H, 7.67; N, 6.27. Found : C, 85.74; H, 7.53; N, 6.36.

Picrate : Yellow prisms (from EtOH), m.p. 162°. *Anal.* Calcd. for $C_{16}H_{17}N \cdot C_6H_3O_7N_3$ : C, 58.40: H, 4.46; N, 12.36. Found : C, 58.64; H, 4.70; N, 12.13.

**2,3,6,7,9,10,11,12-Octahydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine (IX)**—A mixture of 1.47 g. (0.01 mole) of 6-aminotetralin[11] and 10 g. (0.063 mole) of $Br(CH_2)_3Cl$ was refluxed at 160° for 20 hr. in an oil bath. The reaction mixture was extracted with 10% HCl solution. After washing the extract

9) B. Wikop : J. Am. Chem. Soc., **70**, 2617 (1948); R. P. Linstead : J. Chem. Soc., **1937**, 1146; W. Bunge : Ber., **67**, 1715 (1934).
10) N. J. Puthochin : Ber., **55**, 2748 (1922).
11) G. Schröter : Ann., **426**, 57 (1922).

with $Et_2O$, the aqueous layer was made alkaline with 20% NaOH solution, the oil that separated was extracted with $Et_2O$, and the extract was distilled to give an oil, b.$p_4$ 180°. On standing in air, this compound immediately colored. Yield, 200 mg. as a picrate.
Picrate : Yellow needles (from MeOH), m.p. 156~158° (decomp.). *Anal.* Calcd. for $C_{16}H_{21}N \cdot C_6H_3O_7N_3$: C, 57.89; H, 5.30; N, 12.28. Found : C, 58.11; H, 5.22; N, 12.65.

**Reduction of 2,3,6,7-Tetrahydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine (VII) in Methylcyclohexane**—A mixture of 7 g. of (VII) and 5 g. of Raney Ni in 100 cc. of methylcyclohexane was submitted to hydrogenation at 250° and at 190 atm. (initial $H_2$ pressure) for 6 hr. The reaction mixture was filtered. After concentration of the solvent, the residue was extracted with 10% HCl. The acid solution was washed with $Et_2O$ and made alkaline with 20% NaOH solution. An oil that separated was extracted with $Et_2O$, the extract was dried over $Na_2SO_4$, and evaporated. The residue was distilled, b.$p_3$ 145~155°. Yield, 3 g. Chromatography of this oil on 300 g. of alumina and elution with the indicated solvents gave the following results :

| Fraction No. | Fraction cc. | Solvent | Product |
|---|---|---|---|
| 1 | 1500 | light petroleum | nil |
| 2 | 1000 | light petroleum-benzene (1:1) | nil |
| 3 | 1000 | light petroleum-benzene (1:3) | 2 g. white crystals |
| 4 | 500 | benzene | nil |
| 5 | 500 | benzene-$Et_2O$ (1:1) | nil |
| 6 | 500 | $Et_2O$-MeOH (4:1) | 300 mg. resinous subst. |

The above white crystals were treated with picric acid in $Et_2O$ and 3 g. of prisms (from EtOH) was obtained.
Picrate : Yellow prisms (from EtOH), m.p. 202°. *Anal.* Calcd. for $C_{16}H_{27}N \cdot C_6H_3O_7N_3$ : C, 57.13; H, 6.54; N, 12.12. Found : C, 56.85; H, 6.55; N, 11.98.

The picrate (3 g.) was treated with 15% HCl solution, separated picric acid was filtered off, the filtrate was made alkaline with 40% KOH solution, and extracted with $Et_2O$. After drying, the solvent was distilled off and the residue was recrystallized from hexane. Yield, 1.5 g. (21%) of (IX), (isomer-A), white leaflets, m.p. 68°. *Anal.* Calcd. for $C_{16}H_{27}N$ : C, 82.34; H, 11.66; N, 6.00. Found: C, 82.06; H, 11.91; N, 5.76. IR $\nu_{C-H}$ $cm^{-1}$ : 2933, 2857, 2801, 2747 ($CCl_4$).

**Reduction of 2,3,6,7-Tetrahydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine (VII) in EtOH**—A mixture of 6 g. (0.027 mole) of (VII) and 3 g. (0.051 mole) of Raney Ni in 60 cc. of dehyd. EtOH was submitted to hydrogenation at 250° and 110 atm. (initial $H_2$ pressure) for 3 hr. The reaction mixture was filtered, the solvent was evaporated *in vacuo*, and the residue was extracted with 10% HCl solution. The extract was washed with $Et_2O$, made alkaline with 20% NaOH solution, and extracted with $Et_2O$. After evaporation of the solvent, the residue was distilled in a reduced pressure. The oil obtained was treated with $Et_2O$ solution containing 1 g. of *p*-nitrobenzoyl chloride in order to remove the secondary and primary amines.

The $Et_2O$ solution was washed with 10% $K_2CO_3$ solution and extracted with 10% HCl. This acid solution was made alkaline with 20% NaOH solution and the oil that separated was extracted with $Et_2O$. After evaporation of the solvent, the residue was distilled, b.$p_3$ 145~155°. Yield, 3 g.

Chromatography of this oil on 300 g. of alumina and elution with the indicated solvent gave the following fractions (each fraction was converted to the picrate and weighed) :

| Fraction No. | Fraction cc. | Solvent | Product |
|---|---|---|---|
| 1 | 2000 | light petroleum | 50 mg. oil |
| 2 | 500 | light petroleum | nil |
| 3 | 1500 | light petroleum-benzene (4:1) | 270 mg. picrate, m.p. 166° |
| 4 | 500 | light petroleum-benzene (4:1) | nil |
| 5 | 1000 | light petroleum-benzene (4:1) | 5 mg. picrate, m.p. 227° |
| 6 | 500 | light petroleum-benzene (1:1) | nil |
| 7 | 2000 | light petroleum-benzene (1:3) | 250 mg. picrate, m.p. 147° |
| 8 | 1000 | benzene | nil |
| 9 | 2000 | benzene-$Et_2O$ (1:2) | 700 mg. picrate, m.p. 178° |
| 10 | 1000 | $Et_2O$ | |
| 11 | 500 | MeOH | nil |

i) Fraction No. 3 (Isomer-D) : The free base (130 mg.) was obtained from 270 mg. of the picrate, as an oil, b.$p_3$ 145~155°; $n_D^{25}$ 1.5245. IR $\nu_{C-H}$ $cm^{-1}$ : 2940, 2857, 2805, 2747 ($CCl_4$). *Anal.* Calcd. for $C_{16}H_{27}N$: C, 82.14; H, 11.66; N, 6.00. Found : C, 82.12; H, 11.52; N, 5.80.
Picrate : Yellow needles (from EtOH), m.p. 166°. *Anal.* Calcd. for $C_{16}H_{27}N \cdot C_6H_3O_7N_3$ : C, 57.12; H, 6.54; N, 12.12. Found : C, 57.02; H, 6.90; N, 12.02.
ii) Fraction No. 7 (Isomer-C) : The free base (120 mg.) was obtained from 250 mg. of the picrate, as an oil, b.$p_3$ 145~155°; $n_D^{25}$ 1.5220. IR $\nu_{C-H}$ $cm^{-1}$ : 2933, 2857, 2801, 2747, 2667 ($CCl_4$). *Anal.* Calcd. for $C_{16}H_{27}N$ : C, 82.34; H, 11.66; N, 6.00. Found : C, 82.01; H, 11.50; N, 6.05.
Picrate : Yellow prisms (from EtOH), m.p. 147°. *Anal.* Calcd. for $C_{16}H_{27}N \cdot C_6H_3O_7N_3$ : C, 57.13; H, 6.54; N, 12.12. Found : C, 57.40; H, 6.80; N, 12.03.
iii) Fraction Nos. 9 and 10 (Isomer-B) : The free base (320 mg.) was obtained from 700 mg. of the picrate as an oil, b.$p_4$ 162°; $n_D^{25}$ 1.5238. IR $\nu_{C-H}$ $cm^{-1}$ : 2940, 2857, 2803, 2747, 2667 ($CCl_4$). *Anal.* Calcd. for $C_{16}H_{27}N$ : 82.34; H, 11.66; N, 6.00. Found : C, 82.05; H, 11.64; N, 5.74.
Picrate : Yellow prisms (from EtOH), m.p. 178°. *Anal.* Calcd. for $C_{16}H_{27}N \cdot C_6H_3O_7N_3$ : C, 57.13; H, 6.54; N, 12.12. Found : C, 56.93; H, 6.80; N, 11.98.

**Isomerization of Isomer-B with Aluminium Chloride**—A mixture of 100 mg. of isomer-B and 1 g. of $AlCl_3$ was kept at 220° for 18 hr. in $N_2$ stream. This was dissolved in ice water, basified, and extracted with $Et_2O$. The base obtained on evaporation of $Et_2O$ was purified by chromatography. The picrate (5 mg.), m.p. 198°, obtained was identified with the picrate of isomer-A.

**Isomerization of Isomer-D with Aluminium Chloride**—A mixture of 80 mg. of isomer-D and 1 g. of $AlCl_3$ was kept at 220° for 18 hr. in $N_2$ stream. This reaction mixture was treated as above. The picrate (7 mg.), m.p. 197~199°, was identified with the picrate of isomer-A.

**Reaction of Isomers-A, -B, -C, -D with MeI**—i) Isomer-A : A mixture of 50 mg. of isomer-A and 50 mg. of MeI in $Et_2O$ was refluxed for 1 hr. The white powder that precipitated was collected and recrystallized from $Me_2CO$ to white prisms, m.p. 254°. Yield, 70 mg. *Anal.* Calcd. for $C_{16}H_{27}N \cdot CH_3I$ : C, 54.40; H, 8.00; N, 3.73. Found : C, 54.54; H, 8.21; N, 3.60.
ii) Isomer-B : A mixture of 50 mg. each of isomer-B and MeI in $Et_2O$ was refluxed for 1 hr. After evaporation of the solvent, the residue was converted to a picrate and the picrate of m.p. 178° (80 mg.) was obtained. A mixed m.p. with the picrate of isomer-B showed no deperession.

A mixture of 50 mg. each of isomer-B and MeI in $Et_2O$ was refluxed for 7 hr. and the white substance that precipitated was recrystallized from $Me_2CO$, m.p. 230~232. Yield, 70 mg. *Anal.* Calcd. for $C_{16}H_{27}N \cdot CH_3I$ : C, 54.40; H, 8.00; N, 3.73. Found : C, 54.27; H, 8.29; N, 3.45.
iii) Isomer-C : A mixture of 50 mg. each of isomer-C and MeI was treated as in the case of isomer-A and oily methiodide was converted to the methopicrate as yellow prisms, m.p. 155° (from MeOH). Yield, 60 mg. *Anal.* Calcd. for $C_{16}H_{27}N \cdot C_7H_6O_7N_3$ : C, 57.97; H, 6.77; N, 11.76. Found : C, 57.81; H, 6.57; N, 11.60.
iv) Isomer-D : A mixture of 50 mg. each of isomer-D and MeI in $Et_2O$ was refluxed for 7 hr. After evaporation of the solvent, the residue was converted to a picrate (70 mg.). A mixed m.p. with the picrate of isomer-D showed no depression.

**Determination of the Rate Constants**—Experimental procedure : Equal volume, usually 5 cc., of 0.2*M* MeOH solution of the amine and alkyl iodide were mixed in a glass-stoppered Pyrex tube. Immediately after mixing, 2 cc. each of this mixture was sealed in a brown ampule. The ampules were placed in a thermostat, the temperature of which was held to within 35°±0.1°. After standing, this mixture was titrated at definite intervals with 0.01*N* $AgNO_3$ solution. The rate constants were calculated from the equation : $k = 1/t \cdot x/a(a-x)$, where x is the concentration of quaternary salt attained at time *t*, and a is the initial concentration of the reactants, unit of k being in L./mole/sec.
Preparation of Reagents : MeOH which was used as the solvent throughout, was purified by prolonged treatment with NaIO, and it was distilled. The distillate was treated with Mg-metal, refluxed for several hours, and then redistilled through a column.

Table II. Reaction Rate of Isomer-A with Methyl Iodide at 35°

| *t* (min.) | 1.010*N* $AgNO_3$ soln.[a] (cc.) | x | a[b] − x | k × $10^4$ |
|---|---|---|---|---|
| 65 | 2.76 | 0.02787 | 0.07213 | 9.78 |
| 125 | 4.32 | 0.04545 | 0.05455 | 9.69 |
| 190 | 5.24 | 0.05295 | 0.04708 | 9.89 |
| 240 | 5.80 | 0.05858 | 0.04142 | 9.82 |
| 300 | 6.30 | 0.06363 | 0.03637 | 9.72 |
| | | | | 5) 48.87 |
| | | | Mean | 9.77 |

*a*) These data are shown as a typical example.
*b*) a = 0.01 mole/L.

MeI and PrI were washed successively with $H_2O$, dil. $Na_2CO_3$, $H_2O$, dil. $Na_2S_2O_3$, and finally with $H_2O$. After standing for 1 day over $CaCl_2$, the material was redistilled.

**Dehydrogenation of Isomer-A with Palladium-Charcoal**—A mixture of 100 mg. of isomer-A and 100 mg. of 30% Pd-C was heated at 280~290° and $H_2$ gas that generated was determined by azotometry. The reaction mixture was extracted with $Et_2O$ and the base obtained on evaporation of $Et_2O$ was purified by chromatography. The oil eluted with hexane-$Et_2O$ (100:1) gave a picrate, m.p. 198°. Yield, 50 mg. This picrate was identified with the picrate of isomer-A. From hexane-$Et_2O$ (10:1) eluate, 30 mg. of a crystalline substance (X) was obtained as white prisms, m.p. 65~66° (from hexane). UV $\lambda_{max}^{EtOH}$ mμ (log ε): 215 (4.50), 235 (4.58), 270 (4.28), 317 (3.14), 333 (3.30), 349 (3.32). *Anal.* Calcd. for $C_{16}H_{15}N$: C, 86.84; H, 6.83; N, 6.33. Found: C, 86.21; H, 7.02; N, 6.41.
Picrate: Yellow prisms (from EtOH), m.p. 233°. *Anal.* Calcd. for $C_{16}H_{15}N \cdot C_6H_3O_5N_3$: C, 58.66; H, 4.03; N, 12.44. Found: C, 58.87; H, 4,08; N, 12.43.

**Dehydrogenation of Isomer-B with Palladium-Charcoal**—A mixture of 150 mg. of isomer-B and 150 mg. of 30% Pd-C was treated as above. The picrate of isomer-B and 50 mg. of the picrate of (X) were obtained.

**Dehydrogenation of Isomer-C with Palladium-Charcoal**—A mixture of 100 mg. of isomer-C and 100 mg. of 30% Pd-C was treated as above. The picrate of isomer-C and 40 mg. of the picrate of (X) were obtained.

Hydrogen Gas Generated (cc.)

| Time (min.) / Sample | 5 | 10 | 15 | 20 | 25 | 30 | 35 |
|---|---|---|---|---|---|---|---|
| Isomer-A | 4 | 6 | 8 | 8 | 9 | 9 | 10 |
| Isomer-B | 7 | 14 | 20 | 22 | 24 | 26 | 28 |
| Isomer-C | 6 | 12 | 18 | 20 | 21 | 23 | 25 |

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## Summary

The four stereoisomers of perhydro-1*H*,5*H*-naphtho[1,2,3-*i*,*j*]quinolizine were synthesized. The reaction rates of these stereoisomers with alkyl iodide were measured and from this result the configuration of each was clarified.

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