Table II. The Temperature Dependence on the Half Widths (c.p.s.) for the Absorption of Methylene attached to Pyrimidine

temp. (°C) / Sample	20	40	60
BTDS	18.0	9.0	5.0
TDMP	12.0	6.5	3.0
TDS	10.0	5.5	2.5
BTMP	8.5	5.0	2.0
TDP	5.5	3.0	2.0
OBT	5.0	2.5	2.0
MT	4.0	2.0	2.0
ST	3.5	2.5	2.0
T	3.0	2.0	2.0

The temperature dependence observed on the methylene protons attached to pyrimidine ring of disulfide type thiamines would be explained as the hydrogen bonding between N-formyl group and 2-amino group of pyrimidine ring, and as the largeness of the molecular by the disulfide bond.

The author is grateful to Dr. M. Fujisawa and Dr. N. Sugimoto to this Laboratory for their helpful advice and encouragement in this work. He is also indebted to Dr. T. Fujita for the gift of the purified specimens.

Summary

Proton magnetic resonance spectra of nine Vitamin B_1 analogues were measured. The spectral differences between thiazole and disulfide type thiamine were observed on the proton chemical shifts and the temperature dependence of the methylene signals attached to pyrimidine.

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58. Genshun Sunagawa and Hideo Nakao: Studies on Seven-membered Ring Compounds. XIII.*1 Reaction of 2-Bromo-7-methoxytropone with Active Methylene Compounds.

(*Research Laboratories, Sankyo Co., Ltd.**2)

It was previously reported[1~4] that the tropone derivatives having a halogen or methoxyl group in the 2-position react with active methylene compounds to yield azulene, 1-azaazulene, 1-oxaazulene or coumarin derivatives. For example, the reaction[1] of ethyl cyanoacetate with 2-chlorotropone (I) affords diethyl 2-amino-1,3-azulenedicarboxylate, ethyl 1-cyano-2-hydroxy-3-azulenecarboxylate and coumarin derivative, and

*1 Part XII. Y. Matsumoto: Ann. Sankyo Res. Lab., **15**, 51 (1963).
*2 1-2-58 Hiromachi, Shinagawa-ku, Tokyo (砂川玄俊, 中尾英雄).
1) T. Nozoe, S. Seto, S. Matsumura, T. Asao: Proc. Japan Acad., **32**, 339 (1956).
2) T. Nozoe, S. Seto, S. Nozoe: *Ibid.*, **32**, 472 (1956).
3) S. Seto: Sci. Rept. Tohoku Univ., **37**, 367 (1953).
4) S. Seto, S. Nozoe: Proc. Japan Acad., **32**, 765 (1956).

with 2-methoxytropone (Ⅱ) affords 2-hydroxy-1,3-azulenedicarbonitrile, ethyl 1-cyano-2-amino-3-azulenecarboxylate and diethyl 2-amino-1,3-azulenedicarboxylate. Thus, the reaction products vary depend on the 2-substituent of tropone.

In order to elucidate the reaction course of troponoids with active methylene compounds, the investigation of the reaction of active methylene compounds with 2-bromo-7-methoxytropone (Ⅲ) having two functional groups at the both sides of carbonyl group of tropone was carried out. There is, however, only one report[5] in which the reaction of Ⅲ with ethyl cyanoacetate affords coumarin derivatives. The present paper deals with reaction of Ⅲ and other active methylene compounds. Initially the reaction of 2-cyanoacetamide and Ⅲ was attempted and, in the presence of sodium ethoxide, orange-red crystals (A) melting above 280° were obtained. A was very soluble in water indicating strong basicity but insoluble in organic solvents. From this fact, A seemed to be sodium salt of weakly acidic substance. Analytical values evidenced that A was a sodium salt of a compound formed by elimination of hydrogen bromide from cyanoacetamide and Ⅲ. The infrared absorption spectrum of A exhibited absorption bands at 3480, 2200,and 1670 cm^{-1} and as shown in Fig. 1 the ultraviolet absorption spectrum of A in 0.1*N* hydrochloric acid was similar to that of 8-methoxy-3-coumarincarboxylic acid (Ⅴ). Thus, A was assumed to be a rearrangement reaction product, a benzenoid compound. Neutralization of A with hydrochloric acid gave colorless crystals (B), m.p. 195°. The analytical values of B agreed with the formula $C_{11}H_{10}O_3N_2$. In the infrared absorption spectrum of B, no band appeared for the cyano group and its ultraviolet spectrum war similar to that of A in 0.1*N* hydrochloric acid as shown in Fig. 1. These facts suggested that B was 2-imino-8-methoxy-2*H*-1-benzopyran-3-carboxamide (Ⅳ). Heating B with concentrated hydrobromic acid afforded pale yellow crystals (C), m.p. 305° whose analitical values agreed with the formula $C_{10}H_6O_2$. The ultraviolet and infrared absorption spectra suggested that C was a coumarin derivative. Subsequently C was identified by mixed fussion and comparison of infrared and ultraviolet absorption spectra with 8-hydroxy-3-coumarincarboxylic acid (Ⅵ), which was synthesized by the following route. The heating of 8-methoxy-3-coumarincarboxylic acid (Ⅴ), obtained from condensation reaction of *o*-vanillin and malonic acid by the method[6] of Borche, with concentrated hydrobromic acid afforded Ⅵ. The above exrerimental results, comfirmed that structures of C, B, and A are Ⅵ, Ⅳ and sodium salt (Ⅶ) of 2-cyno-3-(2-hydroxy-3-methoxyphenyl)-acrylamide, respectively. In addition, the formation of A from the condensation of *o*-vanillin and 2-cyanoacetamide in the presence of sodium ethoxide supported Ⅶ as the structure for A. Heating Ⅳ with 10% hydrochloric acid afforded pale yellow crystals, m.p. 247°, whose analytical values agreed with the formula $C_{11}H_9O_4N$. This compound was not soluble in aqueous sodium hydroxide and heating with concentrated hydrobromic acid afforded Ⅵ. These facts indicated that this compound was 8-methoxy-3-coumarin carboxamide (Ⅷ). Recently Ⅳ was obtained by the reaction of Ⅲ and 2-cyanoacetamide by Matsumura[7]

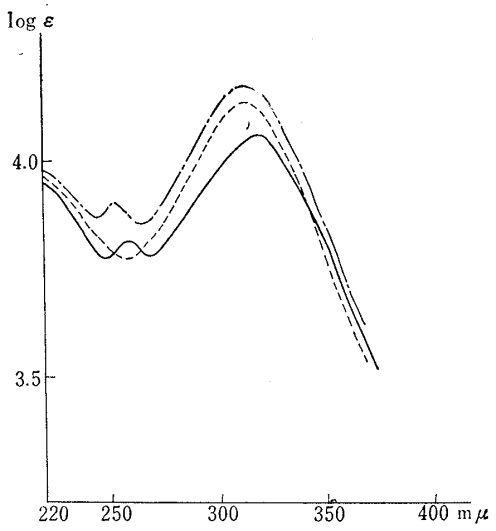

Fig. 1. Ultraviolet Absorption Spectra

——— A (in 0.1*N*HCl)
– – – – – B (in EtOH)
—·—·— V (in EtOH)

5) S. Matsumura : Bull. Chem. Soc. Japan : **35**, 672 (1962).
6) W. Borche, P. Hahn-weinheimer : Chem. Ber., **85**, 198 (1952).
7) T. Nozoe : "Dai Yukikagaku," **13**, 232 (1960), Asakura Shoten.

independently of our study, but his data has not been published. Reaction of cyanoacetomethylamide with III afforded orange-red crystals, which were assumed to be the sodium salt of N-methyl-2-cyano-3-(2-hydroxy-3-methoxyphenyl)acrylamid from its ultraviolet absorption spectrum. Neutralization of this compound with hydrochloric acid gave colorless crystals, m.p. 184°, whose analytical values corresponded to the formula $C_{12}H_{11}O_4N$. This compound was identified by mixed fussion with N-methyl-8-methoxy-3-coumarincarboxyamide (IX) obtained from V *via* 8-methoxy-3-coumarincarbonyl chloride (X) as shown in Chart 1. These experimental results show that the reactions of III with 2-cyanoacetamide or N-methyl-2-cyanoacetamide afforded 2-cyano-3-phenylacrylamide derivatives which formed by a rearrangement reaction. Seemingly the reaction mechanism is similar to that[1] of the formation of coumarin derivative from 2-chlorotropone (I) and ethyl cyanoacetate. Namely, the carbanion of 2-cyanoacetamide or its methyl-derivative initially attacks III at position 3, followed by ring contraction with liberation of hydrobromic acid.

According to previous reports,[2] both I and II react with 2-cyanoacetamide to yield mainly 3-cyancyclolohepta[*b*]pyrrol-2(1*H*)-one, and both react with ethyl cyanoacetate to yieid azulene derivatives. Thus, defferent reactions occured with 2-cyanoacetamide

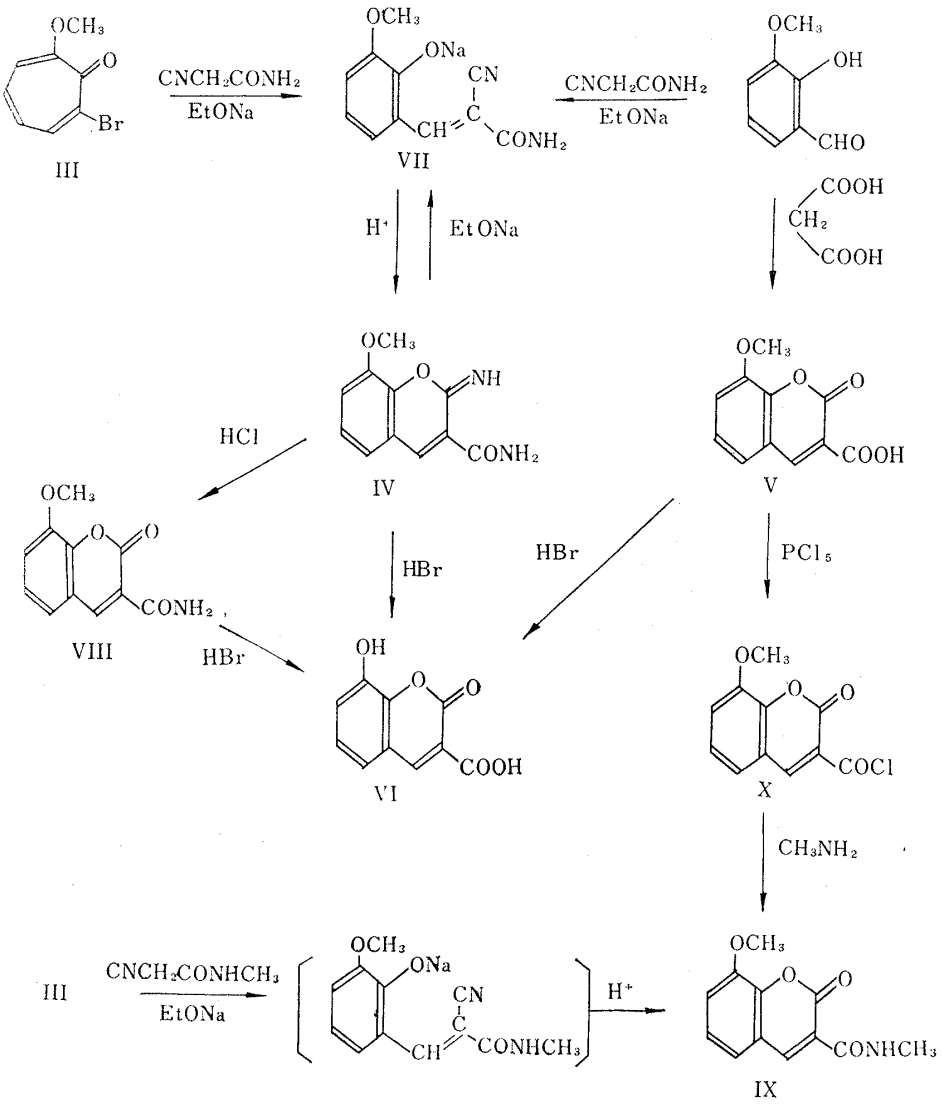

Chart 1.

and ethyl cyanoacetate. On the other hand, the reaction of III with 2-cyanoacetamide is essentially similar to that with ethyl cyanoacetate.

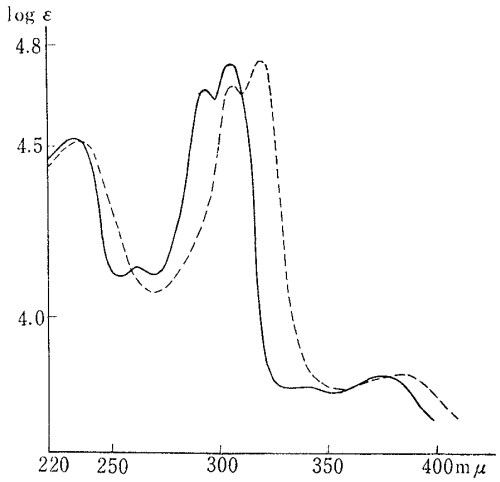

Fig. 2. Ultraviolet Absorption Spectra in Ethanol

——— XV
– – – – – 2-Amino-1,3-azulenedicarbonitrile

Reaction of III with other active methylene compounds were then carride out. Treatment of III with the sodium salt of diethyl malonate in ether afforded ethyl 8-methoxy-3-coumarincarboxylate (XI), which was confirmed by comparison with authentic specimen, synthesized by the condensation reaction of *o*-vanillin and diethyl malonate. Furthermore, ethyl *p*-nitrophenylacetate and III, in the presence of sodium ethoxide, gave 3-(*p*-nitrophenyl)-8-methoxycoumarin (XII), m.p. above 280°. However, III failed to react with ethyl carbamoylacetate, 2-cyanoacetophenone or cyanoacetone. The reactions of I with these active methylene compounds afforded crystals of m.p. 274° (D), 269° (E), and 271° (F), respectively. Compound D was identified as 2-oxo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XIII) by comparison of infrared and

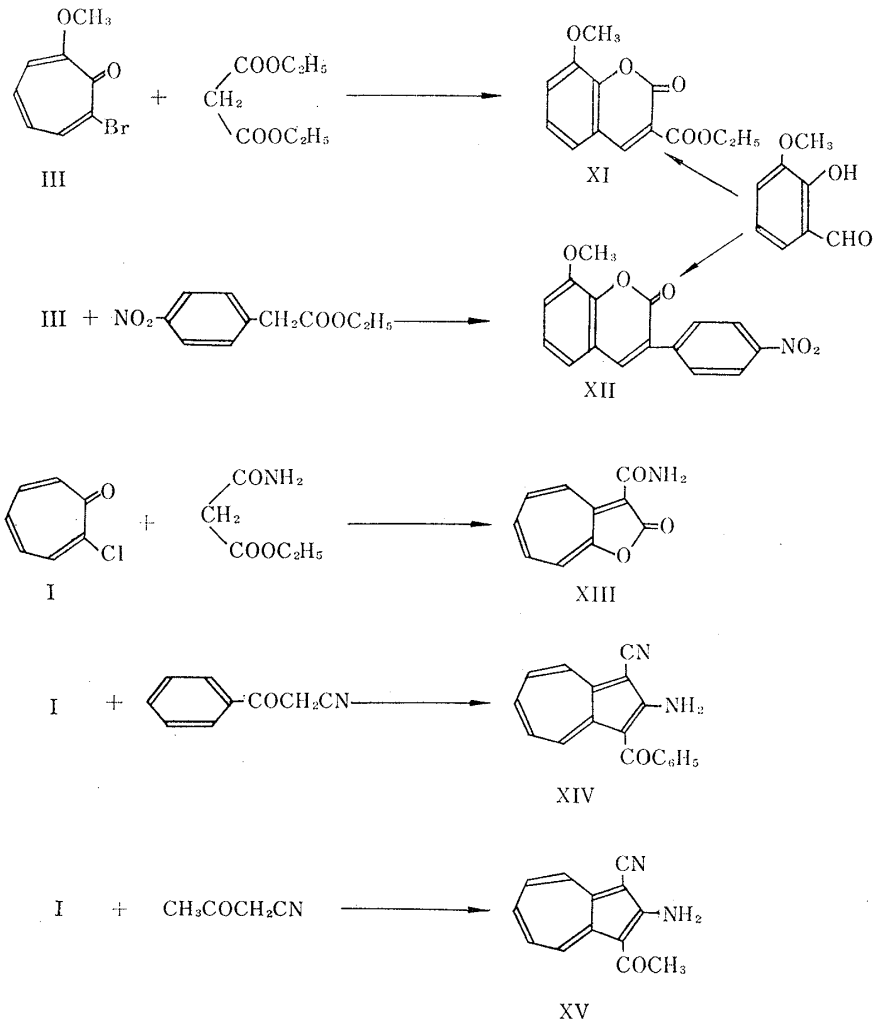

Chart 2.

ultraviolet absorption spectra. Compounds E and F were considered to be 1-benzoyl-2-amino-3-azulenecarbonitrile (XIV) and 1-acetyl-2-amino-3-azulenecarbonitrile (XV), respectively, since their ultraviolet absorption spectra were similar to that of 2-amino-1,3-azulenedicarbonitrile as shown in Fig. 2.

Finally, malononitrile reacted with Ⅲ affording orange-red crystals (G), m.p. above 280°, which were soluble in water but not in organic solvents. The aqueous solution indicated strong basicity. The ultraviolet absorption spectrum of G was similar to that of the sodium salt (XVI) of 1-hydroxy-8,8-heptafulvenedicarbonitrile obtained from 2-methoxytropone (Ⅱ) and malononitrile by Nozoe, *et al.*[8] From the elementary analysis and spectral property, G was confirmed to be the sodium salt (XVII) of 1-hydroxy-2-bromo-8,8-heptafulvenedicarbonitrile. Neutralization of G with hydrochloric acid afforded brown crystals (H), m.p. 120° (decomp.) whose analytical values agreed with $C_{10}H_5ON_2Br$. The infrared absorption spectrum of H exhibited bands at 3400 cm^{-1} for an imino group and 2200 cm^{-1} for cyano group. From these results, H seemed to be 2-imino-8-bromo-2*H*-cyclohepta[*b*]furan-3-carbonitrile (XVIII). Treatment of H with hot dilute hydrobromic acid furnished yellow crystals (J), m.p. 266° (decomp.), whose analytical values agreed with $C_{10}H_6O_3NBr$. The infrared absorption spectrum of J showed the presence of lactone and amide groups. On the basis of these data, J is assumed to be 2-oxo-8-bromo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XIX). Catalytic reduction of J afforded yellow crystals, m.p. 274° (decomp.), which was identified as 2-oxo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XIII) by comparison of infrared absorption spectrum. These experimental results confirmed that the structures of G, H and J are XVII, XVIII, and XIX, respectively. When 7-methoxy-2,4-dibromotropone (XX) instead of Ⅲ was reacted with malononitrile, a similar reaction occurred. Hydrolysis of the reaction product with hydrobromic acid produced 2-oxo-6,8-dibromo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XXI).

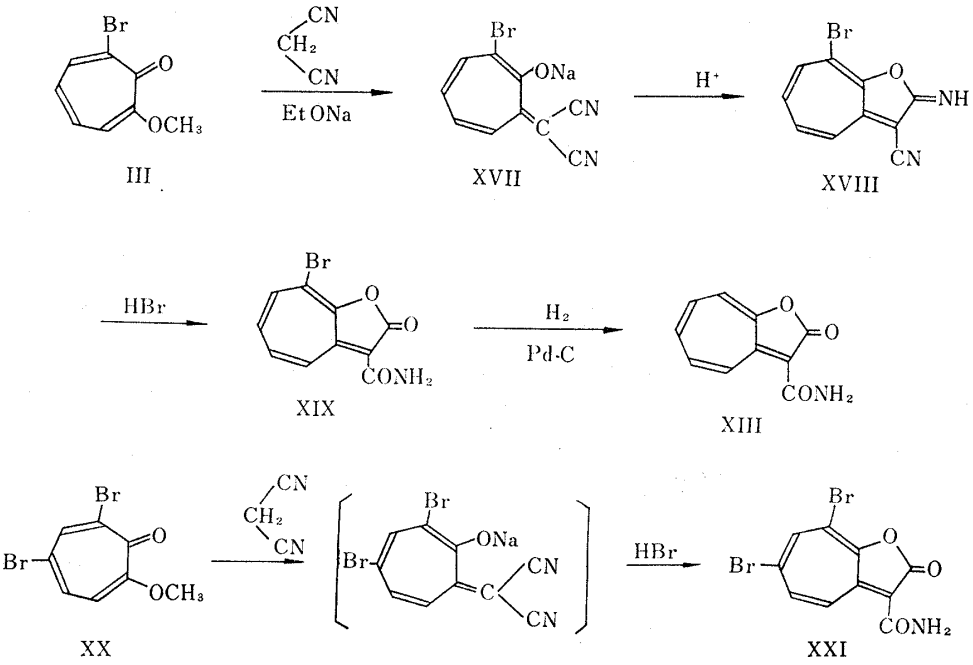

Chart 3.

8) T. Nozoe, T. Mukai, T. Suzuki : Bull. Chem. Soc. Japan, **36**, 38 (1963).

Experimental

Sodium Salt (VII) of 2-Cyano-3-(2-hydroxy-3-methoxyphenyl)acrylamide——a) To a solution of Na (230 mg.) and cyanoacetamide (840 mg.) in EtOH (50 ml.) was added a solution of 2-bromo-7-methoxytropone (1.1 g.) in EtOH (10 ml.). The mixture was then allowed to stand at room temperature for 2 hr., the separated solid was collected by filtration and washed with EtOH. After drying, 0.9 g. of orange-red crystals, m.p. above 280° was obtained. *Anal.* Calcd. for $C_{11}H_9O_3N_2Na$: N, 11.67. Found : N, 11.37. UV $\lambda_{max}^{0.1N\ NaOH}$ mμ (log ε) : 235 (4.28), 280 (3.81), 390 (3.80). UV $\lambda_{max}^{0.1N\ HCl}$ mμ (log ε) : 256 (3.81), 3.16 (4.06). IR ν_{max}^{Nujol} cm^{-1} : 3500, 2200, 1670.

b) To a solution of Na (230 mg.) and 2-cyanoacetamide (840 mg.) in EtOH (50 ml.) was added 1.52 g. of *o*-vanilin. The mixture was then refluxed for 30 min., the separated solid was collected by filtration and washed with EtOH. After drying, 2.0 g. of orange-red crystals, m.p. above 280° was obtained. This compound was identified with one obtained by the method a) by comparison of the IR spectra.

2-Imino-8-methoxy-2-*H*-1-benzopyran-3-carboxamide (IV)——Neutralization of a solution of VII (1 g.) in H_2O (20 ml.) with 10% HCl gave colorless crystals, which were recrystallized from EtOH to give colorless needles (0.5 g.), m.p. 195°. *Anal.* Calcd. for $C_{11}H_{10}O_3N_2$: C, 60.54; H, 4.62; N, 12.84. Found : C, 60.75; H, 4.74; N, 12.91. UV λ_{max}^{EtOH} mμ (log ε) : 310 (4.13). IR ν_{max}^{Nujol} cm^{-1} : 3320, 3140, 1700, 1630, 1590.

8-Methoxy-3-coumarincarboxamide (VIII)——A mixture of IV (300 mg.) and 10% HCl (10 ml.) was heated on a steam bath for 1 hr. After cooling, the precipitate was collected and recrystallized from EtOH to give 200 mg. of pale yellow needles, m.p. 247°. *Anal.* Calcd. for $C_{11}H_9O_4N$: C, 60.27; H, 4.14; N, 6.39. Found : C, 59.99; H, 3.99; N, 6.17. UV λ_{max}^{EtOH} mμ (log ε) : 251 (4.03), 310 (4.24).

8-Hydroxy-3-coumarincarboxylic Acid (VI)——a) A mixture of 8-methoxy-3-coumarincarboxylic acid (500 mg.) and conc. HBr (10 ml.) was refluxed for 5 hr. After cooling, the separated solid was collected, washed with H_2O, and recrystallized from EtOH to give 300 mg. of pale yellow needles, m.p. 305° (decomp.). *Anal.* Calcd. for $C_{10}H_6O_5$: C, 58.52; H, 2.93. Found : C, 58.18; H, 3.02. UV λ_{max}^{EtOH} mμ (log ε) : 252 (3.92), 306 (4.18).

b) VI was prepared from IV (300 mg.) by the same procedure described above.

c) VI was also obtained from VIII (300 mg.) in the same manner described above.

N-Methyl-8-methoxy-3-coumarincarboxamide (IX)——a) To a solution of Na (460 mg.) and N-methyl-2-cyanoacetamide (2 g.) in EtOH (25 ml.) was added a solution of 2-bromo-7-methoxytropone (4.3 g.) in EtOH (30 ml.). After the mixture was allowed to stand at room temperature for 2 hr., the separated solid was collected and dissolved in 20 ml. of H_2O. Neutralization of the solution with 10% HCl gave colorless crystals, which were recrystallized from EtOH to give 200 mg. of colorless needles, m.p. 184°. *Anal.* Calcd. for $C_{12}H_{11}O_4N$: C, 61.80; H, 4.75; N, 6.01. Found : C, 61.86; H, 4.68; N, 6.12. UV λ_{max}^{Nujol} mμ (log ε) : 254 (4.18), 310 (4.42).

b) To 200 mg. of 8-methoxy-3-coumarin carboxylic acid chloride was added 0.5 ml. of 30% aqueous methylamine under cooling. The reaction product was collected, washed with H_2O and recrystallized from EtOH to give 100 mg. of colorless needles, m.p. 184°. *Anal.* Calcd. for $C_{12}H_{11}O_4N$: C, 61.80; H, 4.75; N, 6.01. Found : C, 61.88; H, 4.76; N, 5.97.

8-Methoxy-3-coumarincarbonyl Chloride (X)——A mixture of V (500 mg.), PCl_5 (600 mg.) and benzene (15 ml.) was refluxed for 2 hr. After cooling, the separated solid was collected, washed with benzene and recrystallized from benzene to give yellow prisms (400 mg.), m.p. 171°. *Anal.* Calcd. for $C_{11}H_7O_4Cl$: C, 55.36; H, 2.96. Found : C, 55.30; H, 2.99.

Ethyl 8-methoxy-3-coumarincarboxylate (XI)——a) To a suspension of diethyl sodium malonate, prepared from powdered sodium (110 mg.) and diethyl malonate (750 mg.) in ether (50 ml.) was added 500 mg. of 2-bromo-7-methoxytropone. The mixture was stirred at room temperature for 3 hr. and then allowed to stand overnight. The reaction mixture was filtered to remove a small amount of insoluble substance and the filtrate was concentrated. The residue was purified by chromatography over Al_2O_3 using $CHCl_3$. 200 mg. of yellowish crystals were obtained from a part of $CHCl_3$ eluates, and recrystallized from benzene–cyclohexane to pale yellow crystals melting at 88°. *Anal.* Calcd. for $C_{13}H_{12}O_5$: C, 62.90; H, 4.87. Found : C, 62.81; H, 5.03. UV λ_{max}^{EtOH} mμ (log ε) : 252 (3.90), 306 (4.22).

b) A mixture of *o*-vaniline (1.5 g.), diethyl malonate (1.6 g.) and piperidine (2 drops) was allowed to stand overnight at room temperature. After 50 ml. of abs. EtOH was added to the reaction mixture, the reaction mixture was refluxed for 3 hr. After cooling, 10 ml. of H_2O was added to the mixture and separated crystals were collected and recrystallized from benzene–cyclohexane to give colorless needles, m.p. 85°, which were identical with those from a).

3-(*p*-Nitrophenyl)-8-methoxycoumarin (XII)——a) A mixture of *o*-vaniline (1.5 g.), ethyl *p*-nitrophenylacetate (2.1 g.), piperidine (3 drops), AcOH (1 drop) and EtOH (5 ml.) was refluxed for 30 min. After cooling, separated crystals were collected and recrystallized from AcOH to give pale yellew needles, m.p. above 280°. *Anal.* Calcd. for $C_{10}H_{11}O_5N$: C, 64.64; H, 3.73; N, 4.71. Found : C, 64.80; H, 3.75; N, 5.29. UV λ_{max}^{EtOH} mμ (log ε) : 255 (4.00), 328 (4.36).

b) To a solution of Na (215 mg.) and ethyl *p*-nitrophenylacetate (2 g.) in EtOH was added a solution of 2-bormo-7-methoxytropone (2 g.) in EtOH (20 ml.). The mixture was allowed to stand overnight at room temperature, then the separated solid was collected and recrystallized from AcOH to give pale yellow needles, which were identical with the ones obtained above.

1-Benzoyl-2-amino-3-azulenecarbonitrile (XIV)——To a solution of Na (114 mg.) and 2-cyanoacetophenone (720 mg.) in EtOH (20 ml.) was added a solution of 2-chlorotropone (350 mg.) in EtOH (5 mg.). The mixture was allowed to stand overnight at room temperature, then the separated crystals were collected, washed with H_2O and recrystallized from EtOH to give red-violet needles (150 mg.), m.p. 269°. *Anal.* Calcd. for $C_{18}H_{12}ON_2$: C, 79.39; H, 4.44; N, 10.29. Found: C, 79.39; H, 4.41; N, 10.30. UV λ_{max}^{EtOH} mμ (log ε): 230 (4.34), 270 (4.28), 319 (4.72).

1-Acetyl-2-amino-3-azulenecarbonitrile (XV)——This compound was prepared from Na (70 mg.), cyanoacetone (250 mg.) and 2-chlorotropone (210 mg.) by the same procedure described above. Red-violed needles, m.p. 271°(decomp.). *Anal.* Calcd. for $C_{13}H_{10}ON_2$: C, 74.27; H, 4.79; N, 13.33. Found: C, 73.78; H, 4.54; N, 13.64. UV λ_{max}^{EtOH} mμ (log ε): 233 (4.52), 260 (4.14), 291 (4.67), 303 (4.74).

Sodium Salt (XVII) of 1-Hydroxy-7-bromo-8,8-heptafulvenedicarbonitrile——To a solution of Na (230 mg.) and malononitrile (660 mg.) in EtOH (35 ml.) was added a solution of 2-bromo-7-methoxytropone (1.1 g.) in EtOH (10 ml.). After the mixture was allowed to stand at room temperature for 2 hr., the separated solid was collected and washed with EtOH to give 0.9 g. of orange-red crystals, m.p. above 280°. *Anal.* Calcd. for $C_{10}H_4ON_2BrNa$: C, 44.31; H, 1.49; N, 10.44. Found: C, 44.41; H, 1.62; N, 10.37.

2-Imino-8-bromo-2*H*-cyclohepta[*b*]furan-3-carbonitrile (XVIII)——A solution of XVII (0.9 g.) in 20 ml. of H_2O was treated with charcoal, then neutralization of this solution with 10% HCl gave brown crystals (0.6 g.), m.p. 120°(decomp.), which is unstable to heat. *Anal.* Calcd. for $C_{10}H_5ON_2Br$: C, 48.22; H, 2.02; N, 11.25; Br, 32.09. Found: C, 48.52; H, 1.90; N, 11.19; Br, 32.04. UV λ_{max}^{EtOH} mμ (log ε): 242 (4.24), 279 (4.23), 287 (4.17), 405 (4.25), 422 (4.22), 490 (3.71).

2-Oxo-8-bromo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XIX)——A mixture of XVIII (1.5 g.) and 8% HBr (30 ml.) was heated on a steam bath for 5 hr. After cooling, separated crystals were collected, washed with H_2O and recrystallized from EtOH to give brown needles (0.5 g.), m.p. 270°. *Anal.* Calcd. for $C_{10}H_6O_3NBr$: C, 44.80; H, 2.26; N, 5.23. Found: C, 44.77; H, 2.30; N, 5.33. UV λ_{max}^{EtOH} mμ (log ε): 233 (4.30), 280 (4.37), 407 (4.37).

2-Oxo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XIII)——a) A mixture of 2-imino-2*H*-cyclohepta[*b*]-furan-3-carbonitrile (200 mg.) and 1% HCl (5 ml.) was heated on a steam bath for 8 hr. After cooling, separated crystals were collected, washed with H_2O and recrystallized from EtOH to give 150 mg. of yellow needles, m.p. 274°(decomp.). UV λ_{max}^{EtOH} mμ (log ε): 224 (4.26), 258 (4.37), 403 (4.33).

b) A solution of XIX (200 mg.) in AcOH (60 ml.) was shaken in hydrogen atmosphere over 100 mg. of 5% Pd-C. When no more hydrogen was absorbed, the catalyst was filtered off and the filtrate was concentrated to dryness under reduced pressure. The residue was recrystallized from EtOH to give yellow needles, m.p. 274°(decomp.).

c) To a suspension of sodium salt of ethyl carbamoylacetate, prepared from powdered sodium (176 mg.) and ethyl carbamoylacetate (1 g.) in 50 m. of ether was added 540 mg. of 2-chlorotropone. After the mixture was stirred at room temperature for 3 hr. and allowed to stand overnight, the product was collected, washed with ether and added to 20 ml. of 5% HCl. The resulting solid was collected, washed with H_2O and recrystallized from EtOH to give 0.6 g. of yellow needles, m.p. 274°(decomp.). *Anal.* Calcd. for $C_{10}H_7O_3N$: C, 63.49; H, 3.73; N, 7.41. Found: C, 63.53; H, 3.82; N, 7.24. The compounds obtained by the methods b) and c) were proved identical with the compound obtained by the method a) by comparison of their UV and IR spectra.

2-Oxo-6,8-dibromo-2*H*-cyclohepta[*b*]furan-3-carboxamide (XXI)——To a solution of Na (46 mg.) and malononitrile (132 mg.) in EtOH (30 ml.) was added a solution of 2-methoxy-5,7-dibromotropone (294 mg.) in EtOH 15 ml. The mixture was allowed to stand at room temperature for 4 hr. The separated solid was collected and heated with 10% HBr (10 ml.) on a steam bath for 1.5 hr. After cooling, the separated crystals were collected, washed with H_2O and recrystallized from EtOH to give yellow crystals (100 mg.), m.p. 224°(decomp.). *Anal.* Calcd. for $C_{10}H_5O_3NBr$: C, 34.61; H, 1.45; N, 4.04. Found: C, 34.47; H, 1.91; N, 3.98. UV λ_{max}^{EtOH} mμ (log ε): 252 (4.39), 277 (4.37), 289 (4.35), 413 (4.36).

The authors wish to express their deep gratitude to Prof. S. Uyeo of Kyoto University, Prof. T. Nozoe of Tohoku University and Mr. M. Matsui, Director of this Laboratory, for guidance and encouragement, throughout the course of this work. The measurement of infrared and ultraviolet spectra were carried out by Messrs. H. Higuchi and T. Fujimura and Miss N. Sawamoto, and microanalyses were performed by Messrs. K. Ono and H. Nagashima and Misses Y. Saito and N. Gonda.

Summary

Reaction of 2-bromo-7-methoxytropone (III) with active methylene compounds was

carried out. Ⅲ reacted with malononitrile to afford heptafulvene derivative, whereas Ⅲ reacted with cyanoacetamid, diethyl malonate and ethyl *p*-nitrophenylacetate to yield rearrangement products, coumarin derivatives. Ⅲ didn't react with ethyl carbamoylacetate, 2-cyanoacetophenone and cyanoacetone, which easily reacted with 2-chlorotropone.

(Received September 2, 1964)

[Chem. Pharm. Bull. 13(4) 450~457 (1965)]

UDC 547.517.07

59. Genshun Sunagawa and Hideo Nakao: Studies on Seven-membered Ring Compounds. XIV.*1 Reactions of 2-Methoxytropone and 2-Halotropone with Hydrazides.

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Nozoe, *et al.*[1] reported that the reaction of 2-methoxytropone (I) or 2-chlorotropone (Ⅱ) with 2-cyanoacetamide afforded 3-cyanocyclohepta[*b*]pyrrol-2(1*H*)-one (Ⅲ). In order to examine the generality of this reaction some hydrazides were presently tested with I, Ⅱ and their analogues.

First, reaction of hydrazides with 2-methoxytropone (I) was attempted. Reaction of cyanoacetohydrazide with I, in the presence of sodium ethoxide, afforded pale yellow crystals, m.p. 201°, whose analytical values agreed with formula $C_{10}H_9O_2N_3$. The ultraviolet absorption spectrum was similar to that of 2-hydrazinotropone (Ⅳ) (Fig. 1) and the infrared spectrum exhibited absorption bands at 3340, 3160 cm^{-1} for either an amino or two imino groups, at 2260 cm^{-1} for a cyano group and 1725 cm^{-1} for carbonyl group. Thus, this compound was assumed to be 2-(2-cyanoacetylhydrazino)tropone (Ⅴ), and this was proved by comparison with Ⅴ prepared from Ⅳ and cyanoacetylchloride. Interestingly cyanoacetohydrazide didn't react with I to yield a cyclized compound in spite

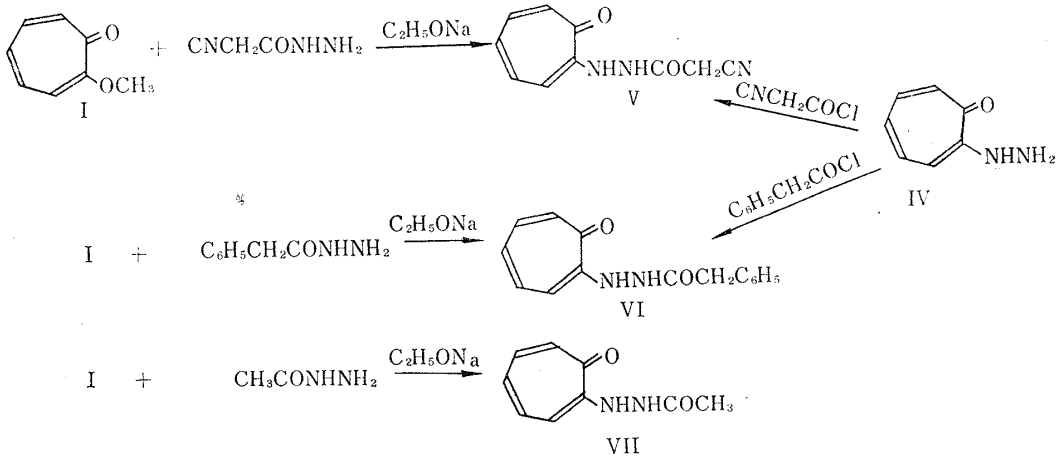

Chart 1.

*1 Part XIII. G. Sunagawa, H. Nakao: This Bulletin, **13**, 443 (1965).
*2 1-2-58 Hiromachi, Shinagawa-ku, Tokyo (砂川玄俊, 中尾英雄).
1) T. Nozoe, S. Seto, S. Nozoe: Proc. Japan Acad., **32**, 472 (1956).