added and the temperature maintained for 16 hr. Evaporation to 10 ml., addition of 20 ml. of water and evaporation again to 10 ml. gave a yellow oil which was saturated with sodium carbonate and extracted with five 20-ml. portions of chloroform. The chloroform extracts were dried with calcium sulfate and evaporated in vacuum to leave a viscous oil. Distillation of this gave 2.3 g. of crude product, b.p. 100–102° (1 mm.), which partially solidified to white crystals in the receiver. Careful drying on a clay plate in a desiccator gave crystals, m.p. 67–72°. The product was very hygroscopic and formed a solid complex with mercuric chloride. One recrystallization of this complex from water gave crystals, m.p. 143.5–145°.

5-Methylpyrimidine N-Oxide.—Seven and five one-hundredth grams (0.075 mole) of 5-methylpyrimidine was heated at 70° for 6 hr. in 30 ml. of glacial acetic acid containing 8 ml. of hydrogen peroxide solution (30%). Eight additional ml. of peroxide was added and the heating continued for 20 hr. The resulting solution was treated as before. The crude solid from the chloroform extracts was recrystallized from carbon tetrachloride to yield white, hygroscopic crystals, m.p. 113–116°. A mercuric chloride complex, m.p. 170–170.5°, was obtained.

The infrared spectra were obtained with a Baird double beam recording spectrophotometer equipped with sodium chloride optics using 0.1-mm. sodium chloride cells. All measurements were calibrated against the 3.419 band of polystyrene. The ultraviolet spectra were obtained using a Beckman DU spectrophotometer in 1-cm. quartz cells.

LOUISVILLE 8, KENTUCKY

[CONTRIBUTION FROM THE NOYES CHEMICAL LABORATORY, UNIVERSITY OF ILLINOIS]

The Reaction of 2-Bromopyridine N-Oxides with Active Methylene Compounds

BY ROGER ADAMS AND WALTER REIFSCHNEIDER

RECEIVED NOVEMBER 10, 1956

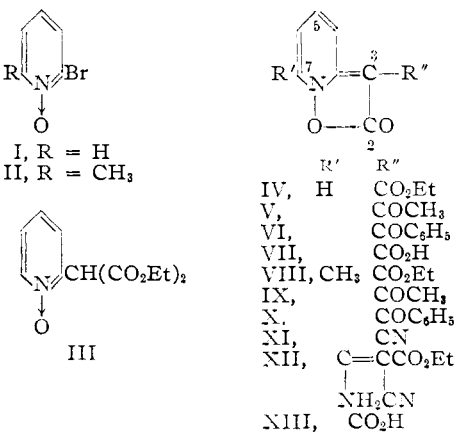
2-Bromopyridine N-oxides condense with active methylene compounds holding a carboalkoxy group to give derivatives of 2-isoxazolono[2,3-a]pyridines. These products react with aqueous alkali; the isoxazolone ring is opened and carbon dioxide is lost with formation of the 2-substituted pyridine N-oxides. 2-Carbethoxy-2-isoxazolono[2,3-a]pyridine is hydrogenated with platinum oxide catalyst to 3-carbethoxy-2-isoxazolono[2,3-a]piperidine.

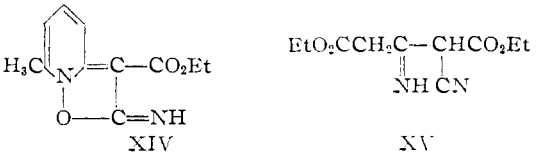
The electron-attracting power of the ring nitrogen accounts for the facile attack of halogen in the 2- and 4-halopyridines by nucleophilic reagents. In spite of this reactivity, the bromine atom in 2-bromopyridine fails to respond to treatment with diethyl sodiomalonate.[1] The introduction of the malonic ester group in the 2-position of pyridine was achieved[2] by using 5-nitro-2-chloropyridine in which the halogen is further activated by the electron-withdrawing nature of the nitro group.

The introduction of an N-oxide into the pyridine system also is known to increase the reactivity of the 2-, 4- and 6-positions of the ring. A reaction between 2-bromopyridine 1-oxide (I) and diethyl sodiomalonate might therefore be expected. A reaction does take place between these reagents under relatively mild conditions, but diethyl 2-pyridylmalonate 1-oxide (III) is not isolated. Instead, a compound of the formula $C_{10}H_9NO_4$ results. The reaction apparently does not stop after the initial condensation but loss of ethanol occurs to form 3-carbethoxy-2-isoxazolono[2,3-a]pyridine (IV).

To demonstrate the generality of this reaction, 2-bromopyridine 1-oxide (I) and 2-bromo-6-methylpyridine 1-oxide (II) were subjected to the action of various active methylene compounds. 2-Bromo-6-methylpyridine 1-oxide (II) is a stable compound in comparison with 2-bromopyridine 1-oxide (I) and therefore was more often used in this study. Upon addition of ethyl sodioacetoacetate and ethyl sodiobenzoylacetate to 2-bromopyridine 1-oxide (I) and 2-bromo-6-methylpyridine 1-oxide (II) the expected cyclized products V, VI, IX and X were obtained.

When ethyl sodiocyanoacetate was treated with 2-bromo-6-methylpyridine 1-oxide (II) and benzene was used as the solvent, three compounds were isolated, (1) 2-imino-3-carbethoxy-7-methylisoxazolo[2,3-a]pyridine (XIV), (2) 3-cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI) and (3) ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]pyridyl-3)]-acrylate (XII).





The structure of the first compound XIV, a yellow product, was established by analysis ($C_{11}H_{12}N_2O_3$) and the presence in the infrared spectrum of an N–H band at 3285 cm.$^{-1}$ and a conjugated ester band at 1688 cm.$^{-1}$.

The second compound XI was a colorless product with the empirical formula $C_9H_6N_2O_2$ and showed bands in its infrared spectrum for CN at

(1) C. S. Kuhn and G. H. Richter, THIS JOURNAL, **57**, 1927 (1935).

(2) W. Gruber and K. Schloegl, *Monatsh.*, **80**, 499 (1949); **81**, 473 (1950); W. Gruber, *Can. J. Chem.*, **31**, 1181 (1953); see also Aust. Patent 127,795 (*Chem. Zentr.*, **103**, II, 123 (1932)).

2220 cm.$^{-1}$ and for an isoxazolone-CO at 1766 cm.$^{-1}$.

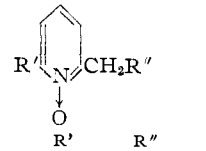
The third product XII, $C_{14}H_{13}N_3O_4$, was colorless but turned yellow upon exposure to light. The infrared spectrum showed bands for NH_2 at 3225 and 3375 cm.$^{-1}$, for CN at 2205 cm.$^{-1}$, for an isoxazolone-CO at 1745 cm.$^{-1}$ and for a conjugated ester at 1672 cm.$^{-1}$. The structure assigned assumes initial formation of a dimer of the ethyl cyanoacetate which then reacted with 2-bromo-6-methylpyridine 1-oxide. This was confirmed by dimerizing ethyl cyanoacetate[3] and condensing it with the 2-bromo-6-methylpyridine 1-oxide to give the same product.

If the condensation of ethyl sodiocyanoacetate with 2-bromo-6-methylpyridine 1-oxide (II) was carried out in dioxane, only compounds XI and XII could be isolated.

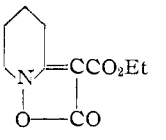
Attempts to achieve reaction between 2-bromo-6-methylpyridine 1-oxide (II) and the sodium salts of acetylacetone, benzoylacetone or dibenzoylmethane failed.

The derivatives of 2-isoxazolono[2,3-a]pyridine were all subjected to hydrolysis with 5% aqueous sodium hydroxide. In both 3-acetyl-7-methyl-2-isoxazolono[2,3-a]pyridine (IX) and 3-benzoyl-7-methyl-2-isoxazolono[2,3-a]pyridine (X) opening of the isoxazolone ring and decarboxylation occurred leading to formation of 6-methyl-2-acetonylpyridine 1-oxide (XVIII) and 6-methyl-2-benzoylmethylpyridine 1-oxide (XIX), respectively. Upon hydrolysis of 3-cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI), 6-methyl-2-pyridylacetic acid 1-oxide (XVII) was obtained; besides ring opening and decarboxylation the nitrile group underwent hydrolysis. 6-Methyl-2-pyridylacetic acid 1-oxide (XVII) also resulted from hydrolysis of ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]-pyridyl-3-)]-acrylate (XII). Hydrolysis of both 3-carbethoxy-2-isoxazolono[2,3-a]pyridine (IV) and its 7-methyl derivative VIII resulted in a mixture of two compounds. 3-Carboxy-2-isoxazolono-[2,3-a]pyridine (VII) and 2-pyridylacetic acid 1-oxide (XVI) were obtained from IV, while the corresponding methyl analogs (XIII and XVII) were formed from VIII. The ratio of the two products in each case is dependent on the duration of the hydrolysis.

2-Pyridylacetic acid 1-oxide (XVI) and 6-methyl-2-pyridylacetic acid 1-oxide (XVII) are much more stable than 2-pyridylacetic acid and 6-methyl-2-pyridylacetic acid. The former do not decompose with loss of carbon dioxide to form 2-picoline 1-oxide and 2,6-dimethylpyridine 1-oxide until their melting points are reached.



	R'	R''
XVI	H	CO_2H
XVII	CH_3	CO_2H
XVIII		$COCH_3$
XIX		COC_6H_5



XX

(3) S. R. Best and J. F. Thorpe, *J. Chem. Soc.*, **95**, 1518 (1909).

3-Carbethoxy-2-isoxazolono[2,3-a]pyridine (IV) was hydrogenated using a platinum oxide catalyst. Two moles of hydrogen were absorbed and 3-carbethoxy-2-isoxazolono[2,3-a]piperidine (XX) was formed.

Experimental Part

2-Bromo-6-methylpyridine 1-Oxide (II).—To a solution of 172 g. of 2-bromo-6-methylpyridine[4] in 150 ml. of glacial acetic acid was added 310 ml. of 40% peracetic acid. The temperature rose and was kept below 50° by external cooling. After the initial reaction subsided the solution was heated for 5 hours at 50° and then overnight at 70°. After concentration of the solution *in vacuo* on the water-bath to about 200 ml., it was poured onto ice and made strongly alkaline by adding 40% aqueous potassium hydroxide. An oil separated. The solution was extracted thrice with chloroform. The combined chloroform solutions were dried over potassium carbonate, filtered and the chloroform was removed under reduced pressure on the water-bath. Addition of ether to the oily residue and cooling yielded crystalline 2-bromo-6-methylpyridine 1-oxide. It was recrystallized from ethanol–ether, m.p. 70°. The yield was 181.0 g. (96.3%).

Anal. Calcd. for C_6H_6BrNO: C, 38.32; H, 3.22. Found: C, 38.44; H, 3.17.

Hydrochloride, m.p. 196–197° (lit.[5] m.p. 185–186°).

Anal. Calcd. for $C_6H_7BrClNO$: C, 32.10; H, 3.14. Found: C, 31.98; H, 3.09.

2-Bromopyridine 1-Oxide (I).—The procedure described for making 2-bromo-6-methylpyridine 1-oxide (II) was used. The product was obtained in 72.4% yield. It was recrystallized from ethanol–ether, m.p. 64°; hydrochloride, m.p. 132–135° (lit.[5] m.p. 130–135°).

Anal. Calcd. for C_5H_4BrNO: C, 34.51; H, 2.32. Found: C, 34.55; H, 2.40.

2-Bromopyridine 1-oxide is unstable at room temperature. A sample detonated without apparent cause on standing at room temperature for several days.

Reaction of Active Methylene Compounds with 2-Bromo-6-methylpyridine 1-Oxide and 2-Bromopyridine 1-Oxide. General Procedure.—The sodium salt of an active methylene compound was prepared by adding 0.1 mole of the active methylene compound to 2.4 g. (0.1 mole) of sodium hydride kept under 100 ml. of dioxane, benzene or ether. To this was added 0.1 mole of 2-bromo-6-methylpyridine 1-oxide (II) or 2-bromopyridine 1-oxide (I), and the mixture was heated under reflux for 24 hours. After cooling, the solid part of the reaction mixture was collected by filtration, and the filtrate was evaporated to dryness under reduced pressure on the water-bath. The combined residues were triturated with about 100 ml. of water. The insoluble portion was collected by filtration, washed with water and recrystallized from ethanol.

To recover any unreacted N-oxide, the filtrate was extracted with three 80-ml. portions of chloroform and the combined chloroform extracts were extracted with three 50-ml. portions of 20% hydrochloric acid. The hydrochloric acid solution was concentrated *in vacuo* on the steam-bath until the N-oxide hydrochloride began to crystallize. After cooling, the N-oxide hydrochloride was collected by filtration and was recrystallized from ether.

See Table I for constants of the products.

Hydrolysis of 3-Acetyl-7-methyl-2-isoxazolono[2,3-a]-pyridine (IX): 2-Acetonyl-6-methylpyridine 1-Oxide (XVIII).—A mixture of 2.0 g. of 3-acetyl-7-methyl-2-isoxazolono-[2,3-a]pyridine (IX) and 10 ml. of 5% aqueous sodium hydroxide was boiled under reflux until a clear solution was obtained (about 70 min.). After cooling, the solution was extracted with three 10-ml. portions of chloroform. The combined chloroform extracts were dried over potassium carbonate, and the chloroform then removed under reduced pressure. The residual oil was dissolved in warm ether which on cooling yielded 1.6 g. (92.5%) of colorless needles. The substance was recrystallized from ether, m.p. 67–68°.

Anal. Calcd. for $C_9H_{11}NO_2$: C, 65.44; H, 6.71; N, 8.48. Found: C, 65.71; H, 6.95; N, 8.49.

(4) R. Adams and S. Miyano, THIS JOURNAL, **76**, 3168 (1954).

(5) E. Shaw, J. Bernstein, K. Losee and W. A. Lott, *ibid.*, **72**, 4362 (1950).

TABLE I

CONDENSATION PRODUCTS OF 2-BROMOPYRIDINE 1-OXIDES AND ACTIVE METHYLENE COMPOUNDS

Active methylene compound	Solvent	Reaction product	Yield, %	Recovd. starting material, %	Yield based on N-oxide used in the reacn., %	M.p., °C.	Analyses, % Calcd.	Found
		2-Bromopyridine 1-oxide (I)						
Diethyl malonate	Ether	3-Carbethoxy-2-isoxazolono[2,3-a]-pyridine (IV)	40.2	39.5	66.4	181	C, 57.97 H, 4.38 N, 6.76	57.98 4.41 6.92
Ethyl acetoacetate	Benzene	3-Acetyl-2-isoxazolono[2,3-a]pyridine (V)	24.8	50.2	48.8	188–190	C, 61.02 H, 3.98 N, 7.91	60.72 4.11 7.66
Ethyl benzoylacetate	Benzene	3-Benzoyl-2-isoxazolono[2,3-a]pyridine (VI)	20.1	36.2	31.5	193–194	C, 70.29 H, 3.79 N, 5.86	70.71 3.92 5.90
		2-Bromo-6-methyl pyridine 1-oxide (II)						
Diethyl malonate	Benzene or dioxane	3-Carbethoxy-7-methyl-2-isoxazolono-[2,3-a]pyridine (VIII)	44.7	17.6	54.3	175–176	C, 59.72 H, 5.01 N, 6.34	59.87 5.21 6.49
Ethyl acetoacetate	Benzene or dioxane	3-Acetyl-7-methyl-2-isoxazolono[2,3-a]pyridine (IX)	24.3	50.8	49.5	200	C, 62.82 H, 4.74 N, 7.33	62.97 4.51 7.37
Ethyl benzoylacetate	Dioxane	3-Benzoyl-7-methyl-2-isoxazolono[2,3-a]pyridine (X)	22.1	50.1	44.2	208–209	C, 71.14 H, 4.38 N, 5.35	71.04 4.27 5.46
Ethyl cyanoacetate	Benzene[a,b]	2-Imino-3-carbethoxy-7-methyl-isoxazolono[2,3-a]pyridine (XIV)	10.8	18.2	13.3	128 d.	C, 59.99 H, 5.49 N, 12.72	60.15 5.46 13.16
		3-Cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI)	5.75		7.0	217–219 (dec.)	C, 62.07 H, 3.47 N, 16.09	62.13 3.31 15.85
		Ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]pyridyl-3-)] acrylate (XII)	4.2		5.1	209–212 (dec.)	C, 58.53 H, 4.56 N, 14.63	58.57 4.65 14.64
	Dioxane[b]	3-Cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI)	16.7	20.5	21.0	217–219 (dec.)		
		Ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]pyridyl-3-)]-acrylate (XII)	9.1		11.4	209–212 (dec.)		
Diethyl β-imino-α-cyanoglutarate (XV)	Dioxane	Ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]pyridyl-3-)]-acrylate (XII)	46.2	18.4	56.5	209–212 (dec.)	C, 58.53 H, 4.56	58.64 4.52

[a] Compound XIV was isolated from the solid part of the reaction mixture. It was recrystallized from water. Compounds XI and XII were isolated from the residue after removing the benzene under reduced pressure. [b] Compounds XI and XII were separated by fractional crystallization from chloroform.

Hydrolysis of 3-Benzoyl-7-methyl-2-isoxazolono[2,3-a]-pyridine (X): 2-Benzoylmethyl-6-methylpyridine 1-Oxide (XIX).—A suspension of 0.7 g. of 3-benzoyl-7-methyl-2-isoxazolono[2,3-a]pyridine (X) in 8 ml. of 5% aqueous sodium hydroxide was boiled under reflux for 1.5 hours. The clear solution was treated in the same manner as described for 6-methyl-2-acetonylpyridine 1-oxide to yield 0.61 g. (97.1%) of white crystals. The substance was recrystallized from ethanol–ether, m.p. 143–145°.

Anal. Calcd. for $C_{14}H_{13}NO_2$: C, 73.99; H, 5.76; N, 6.17. Found: C, 74.11; H, 5.74; N, 6.21.

Hydrolysis of 3-Cyano-7-methyl-2-isoxazolono[2,3-a]-pyridine (XI): 6-Methyl-2-pyridylacetic Acid 1-Oxide (XVII).—A mixture of 1.15 g. of 3-cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI) and 15 ml. of 5% aqueous sodium hydroxide was boiled under reflux until a clear solution was obtained (1 hr.). After cooling, the solution was acidified with 2 *N* sulfuric acid and then exhaustively extracted with chloroform. The chloroform extracts were dried over magnesium sulfate and the chloroform was removed under reduced pressure. A crystalline residue was obtained and was recrystallized from ethanol, m.p. 147–148° dec. The yield was 1.05 g. (95%).

Anal. Calcd. for $C_8H_9NO_3$: C, 57.48; H, 5.43; N, 8.38. Found: C, 57.81; H, 5.66; N, 8.66.

Hydrolysis of Ethyl [α-Cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]pyridyl-3-)]-acrylate (XII): 6-Methyl-2-pyridylacetic Acid 1-Oxide (XVII).—A mixture of 2.4 g. of ethyl [α-cyano-β-amino-β-(7-methyl-2-isoxazolono[2,3-a]-pyridyl-3-)]-acrylate (XII) and 50 ml. of 5% aqueous sodium hydroxide was treated as described for the hydrolysis of 3-cyano-7-methyl-2-isoxazolono[2,3-a]pyridine (XI) to yield 1.28 g. (91.4%) of 6-methyl-2-pyridylacetic acid 1-oxide (XVII), m.p. 147–148° dec.

Anal. Calcd. for $C_8H_9NO_3$: C, 57.48; H, 5.43. Found: C, 57.53; H, 5.35.

Hydrolysis of 3-Carbethoxy-7-methyl-2-isoxazolono[2,3-a]pyridine (VIII): 3-Carboxy-7-methyl-2-isoxazolono[2,3-a]pyridine (XIII) and 6-Methyl-2-pyridylacetic Acid 1-oxide (XVII).—A suspension of 3.3 g. of 3-carbethoxy-7-methyl-2-isoxazolono[2,3-a]pyridine (VIII) in 40 ml. of

5% aqueous sodium hydroxide was boiled under reflux for one hour. The clear solution was cooled and then acidified with 2 *N* sulfuric acid. The white substance which precipitated was collected by filtration and washed with water. The material was recrystallized from ethanol, m.p. 211–212° dec. The yield was 1.5 g. (52.1%).

Anal. Calcd. for $C_9H_7NO_4$: C, 55.96; H, 3.65; N, 7.25. Found: C, 55.67; H, 3.74; N, 7.54.

The filtrate, after removal of 3-carboxy-7-methyl-2-isoxazolono[2,3-a]pyridine, was exhaustively extracted with chloroform. The chloroform extracts were dried over magnesium sulfate and the chloroform removed under reduced pressure. The crystalline residue was recrystallized from ethanol. The yield was 1.1 g. (44.2%) of 6-methyl-2-pyridylacetic acid 1-oxide (XVII), m.p. 146–147° dec.

Anal. Calcd. for $C_8H_9NO_3$: C, 57.48; H, 5.43. Found: C, 57.86; H, 5.37.

Hydrolysis of 3-Carbethoxy-2-isoxazolono[2,3-a]pyridine (IV): 3-Carboxy-2-isoxazolono[2,3-a]pyridine (VII) and 2-Pyridylacetic Acid 1-Oxide (XVI).—A mixture of 3.0 g. of 3-carbethoxy-2-isoxazolono[2,3-a]pyridine (IV) and 30 ml. of 5% aqueous sodium hydroxide was treated as described for its 7-methyl derivative. A yield of 0.8 g. (30.9%) of 3-carboxy-2-isoxazolono[2,3-a]pyridine (VII), m.p. 204–205° dec., resulted from acidification of the alkaline solution.

Anal. Calcd. for $C_8H_5NO_4$: C, 53.64; H, 2.81; N, 7.82. Found: C, 53.67; H, 2.78; N, 7.73.

From the filtrate 0.4 g. (18.0%) of 2-pyridylacetic acid 1-oxide (XVI), m.p. 140° dec., was obtained.

Anal. Calcd. for $C_7H_7NO_3$: C, 54.90; H, 4.61; N, 9.14. Found: C, 54.60; H, 4.54; N, 8.82.

Hydrogenation of 3-Carbethoxy-2-isoxazolono[2,3-a]pyridine (IV): 3-Carbethoxy-2-isoxazolono[2,3-a]piperidine (XX).—A suspension of 0.4 g. of 3-carbethoxy-2-isoxazolono[2,3-a]pyridine (IV) in 100 ml. of ethanol was hydrogenated in the presence of platinum oxide catalyst. An uptake of 92 ml. of hydrogen at 24° and 745 mm. was observed (theoretical for 2 moles at 24° and 745 mm. is 96.0 ml.) The catalyst was removed by filtration and the filtrate was concentrated until the substance started to crystallize. Ether was added and after cooling the compound was collected by filtration. It was recrystallized from ethanol–ether, m.p. 157–158°.

Anal. Calcd. for $C_{10}H_{13}NO_4$: C, 56.86; H, 6.20; N, 6.64. Found: C, 56.71; H, 6.23; N, 6.37.

URBANA, ILLINOIS

[CONTRIBUTION FROM THE LABORATORY OF CHEMISTRY OF NATURAL PRODUCTS, NATIONAL HEART INSTITUTE, NATIONAL INSTITUTES OF HEALTH]

Alkaloids of *Lunasia amara* Blanco. 4-Methoxy-2-phenylquinoline

BY SIDNEY GOODWIN, A. F. SMITH AND E. C. HORNING

RECEIVED SEPTEMBER 16, 1956

From the leaves of *Lunasia amara* Blanco there was isolated an alkaloid which did not correspond to any of the previously reported *Lunasia* alkaloids. It was identified as 4-methoxy-2-phenylquinoline. This substance has not hitherto been reported to occur in nature.

Alkaloids of the genus *Lunasia* (fam. *Rutaceae*) have been investigated on several occasions since their discovery by Lewin[1] and by Boorsma.[1] Several alkaloids of unknown structure were described by Steldt and Chen,[2] who found that, contrary to previous reports, the alkaloids did not possess a digitalis-like action. Pertinent early references are given by Steldt and Chen.

In the present work, a number of alkaloids were isolated from leaves of *Lunasia amara* Blanco obtained from the Philippine Islands.[3] Of the total of seven compounds isolated by chromatography on alumina, only the one eluted first will be discussed in this paper. This material, with an empirical formula $C_{16}H_{13}ON$, crystallized from pentane in colorless, optically inactive needles melting at 66–67°. It was identified through its reactions and by synthesis as 4-methoxy-2-phenylquinoline (I). This substance has not heretofore been reported as a naturally occurring compound, and it was not observed in earlier *Lunasia* work.

An interesting property of this compound, which provided one of the first keys to its structure, was observed through the melting point behavior of the hydrochloride. The salt melted with effervescence to a colorless liquid which resolidified and thereafter melted above 240°. These effects suggested a thermal demethylation to yield a 2- or 4-quinolone. Salts of cusparine (a 4-methoxyquinoline) were reported to yield a 4-quinolone on heating to decomposition temperature,[4] and a preparative pyrolysis of the *Lunasia* alkaloid hydrochloride

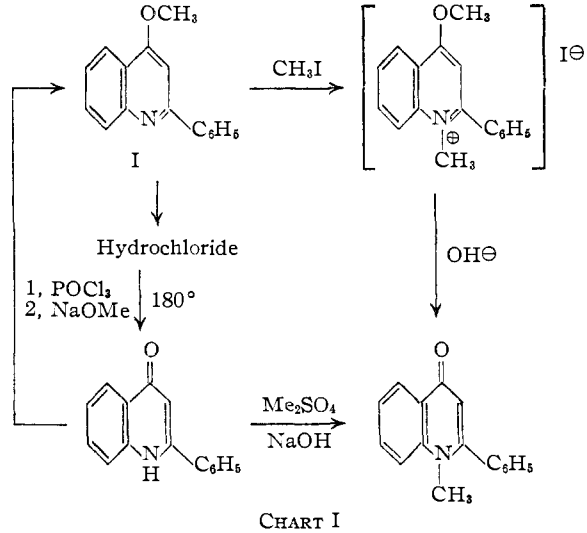


CHART I

was therefore carried out. The high-melting (256–258°) product, later recognized as 2-phenyl-

(1) L. Lewin, "Lehrbuch der Toxikologie," 2nd Ed., Urban and Schwarzenberg, Vienna and Leipzig, 1897, p. 271; W. G. Boorsma, *Bull. Inst. Bot. Buitenzorg.* **6**, 15 (1900).

(2) F. A. Steldt and K. K. Chen, *J. Am. Pharm. Assoc., Sci. Ed.*, **32**, 107 (1943).

(3) S. H. Kooders and T. Valeton (*Meededeel. uit's Lands Plant.*, **17**, 226 (1896)) suggest that the species found in the Malayan and Philippine archipelagoes and described by Miquel are actually varieties of *L. amara*. Steldt and Chen used *L. amara* bark from the Philippines.

(4) J. Troger and W. Beck, *Arch. Pharm.*, **251**, 246 (113); J. Troger and W. Muller, *ibid.*, **252**, 459 (1914).