Experimental

Melting points and boiling points are uncorrected. Infrared spectra were recorded on Beckman-20 I.R. spectrophotometer. N.M.R spectra were recorded on varian A-60 and HA-100 spectrometers using $CDCl_3$ containing tetramethyl silane as reference. Thin layer chromatography was done on chromatoplate of silicagel G (E.Marck) and the spots were developed in an iodine chamber. Solvents were dried by standard procedures.

2-picoline-1-oxide (LV):

A mixture containing 9.5 gm (0.1 mole) of 2-picoline, 60 ml of glacial acetic acid and 10 ml of 30% hydrogen peroxide solution was heated at 70°-80° for three hours. An additional 7 ml of hydrogen peroxide solution was then added and the resulting mixture was heated at 70°-80° for a further period of nine hours. The mixture was then concentrated to 20 ml in a vacuum, 20 ml water added and the volume reduced to a volume 20 ml. The residue was taken up in 50 ml of chloroform and shaken with sodium carbonate, until no further carbondioxide was evolved. The chloroform layer was then removed, dried and concentrated under reduced pressure. The residual oil was distilled to give colourless hygroscopic oil, yield 7.5 gm (80%) b.p. 120°-25°/15 mm [Literature, 123-24/15 mm].

Phenyl propiolic acid (LXVII)

Ethyl 2.3 dibromo-3-phenyl propionate (LXVI)

88 gm (84 ml) of ethyl cinnamate were placed in 50 ml of carbon tetrachloride in a 500 ml two necked round bottomed flask. 80 gm (25.5 ml) of bromine were added with cooling and frequent shaking. The halogen disappeared rapidly at first, but more slowly towards the end of the reaction. After addition of bromine mixture was allowed to stand for one hour.

The solution was poured into a large evaporating dish, bromine and carbon tetrachloride were evaporated in a fume cupboard. The crude ethyl 2,3 Dibromo-3-Phenylpropionate which was obtained as a solid cake was dried by pressing between large filter papers. Yield 140 gm. M.P. 66°-71° Dibromo ester was recrystallised from light petrolium b.p (60°-80°) m.p. 75° (Lit. 75°) 85 gm of potassium hydroxide were dissolved in 400 ml of rectified spirit by heating in a 1500 ml round bottomed flask, provided with a reflux condenser on a water bath. The solution was cooled to 40-50° and 112 gm. of the crystallised dibromo ester was added. When the initial exothermic reaction subsided, the mixture was heated on a water bath for 5-6 hours. The contents of the flask were poured into a large beaker, cooled and concentrated hydrochloric acid was added until neutral to litmus. The precipitated solid was filtered at the pump and was washed with little alcohol. The filtrate was transfered to the original flask and the liquid was distilled from a wire gauze until the temperature of the vapour reached 95°. The residue in flask, precipitated solid was combined and dissolved in 270 ml of water and 300 gm. crushed ice was added. 20 percent Sulphuric acid was added slowly with stirring until the solution was strongly acid to congo red. After 20 minutes, the dark-coloured crude phenylpropiolic acid was filtered at the pump and washed with three 15 ml portions of 2 percent sulphuric acid. The solids were dissolved in 300 ml of 5% sodium carbonate solution, 6 gm of decolourising carbon was added, heated on a water-bath for 30 minutes with occasional shaking. The solution was filtered, filtrate was cooled in ice. The solution was stirred mechanically and 20% Sulphuric acid was added slowly until acid to congo-red.

After 20 minutes, the precipitated acid was filtered by suction, and was washed with 15 ml of 2% Sulphuric acid and then with water. Acid was dried in the air. The yield of pure phenyl propiolic acid was 20 gm. (m.p. 134-35°, Lit. m.p. 134-35°).

Methyl phenyl propiolate (LXVIII) from Phenyl propiolic acid(LXVII)

60 ml of 50% aqueous potassium hydroxide solution and 200 ml of pure ether was placed in a 500 ml round bottomed flask. This mixture was cooled to 5° and 20 gm. nitrosomethyl urea was added with shaking. In another flask 14.6 gm of phenyl propiolic acid was dissolved in 50 ml of anhydrous ether and was cooled in ice. To this an etheral solution of diazomethane was added in small portion until no more gas evolution was there and the solution

acquired a pale yellow colour. Excess of diazomethane was removed by few drops of glacial acetic acid. Ether layer was washed with 10% sodium bicarbonate solution and then water until neutral. Dried over Na_2So_4. Solvent was removed and Methyl phenyl propiolate was distilled from an oil bath under vacuum, b.p. 133-35°/16 mm. Lit. 133-35°/16 mm.

Reaction between 2-picoline-1-oxide (LV) and Phenyl Methyl propiolate (LVIII) in dimethyl formamide:

Formation of Compound (LXVIII)

(i) The 2-picoline-1-oxide 0.2592 gm (2.4 m mole) and methyl phenyl propiolate 0.3531 gm (2.2 m mole) in 5 ml Dimethyl formamide were heated at 80°C for 60 hours under nitrogen atmosphere. The reaction mixture was protected from moisture with calcium chloride guard tube. The reaction mixture was taken in 20 ml of ether and washed with water (5 ml x 4), organic layer washed with 10% aqueous hydrochloric acid (5 ml x 4). Then aqueous acid extract was neutralised with saturated sodium bicarbonate solution and was extracted with ether (25 ml). Ether extract was washed with water until neutral (5 ml x 4), dried and concentrated. The gummy residue on scratching gave a yellow solid m.p. 90°-92°.

Yield 0.060 gm (10%) (Rf 0.38)

This compound was recrystallised from pet ether (60°-80°) and benzene gave deep yellow solid m.p. 93°-94°C.

From the ether extract after removal of the basic parts was isolated 0.2883 gm of unreacted acetylene.

(ii) The reaction was repeated with 2-picoline-1-oxide 0.6286 gm (5.8 m mole) and methyl phenyl propiolate 0.4013 gm (2.5 m mole) using dimethyl formamide and gave the product (LXVIII) 0.1381 gm (20%).

I.R. $\nu_{max}^{CHCl_3}$ 1745 cm^{-1} ($-\overset{O}{\overset{\|}{C}}-OCH_3$),

1680 ($-\overset{O}{\overset{\|}{C}}-C_6H_5$)

(Fig. 1)

N.M.R (60 MHz) δ 2.54 (singlet, 3H), $-CH_3$;

δ 3.70 (singlet, 3H), $-OCH_3$;

δ 5.45 (singlet, 1H), $-CH\begin{smallmatrix} COC_6H_5 \\ COOCH_3 \end{smallmatrix}$;

δ 6.8-8.35 (8H, aromatic)

(Fig. 2)

The above experiment was repeated in different solvents using different molar proportion of the reactants. The results obtained are tabulated below (Table 6):

Table 6

Amount of 2-picoline-1-oxide	Amount of phenyl methyl propiolate	Solvent	Temperature	Time	Yield	Percentage
0.3472 gm (3.19 m mole)	0.407 gm (2.63 m mole)	Benzene	Reflux	60 hours	0.1201 gm	17%
0.4417 gm (4.05 m mole)	0.3598 gm (2.8 m mole)	Benzene	Reflux	60 hours	0.1329 gm	30%
0.3060 gm (2.8 m mole)	0.4505 gm (2.8 m mole)	Toluene	Reflux	13 hours	0.1945 gm	27%
0.6644 gm (6.08 m mole)	0.4518 gm (2.8 m mole)	Toluene	Reflux	13 hours	0.3137 gm	44.7%
0.3299 gm (3.05 m mole)	0.5149 gm (3.22 m mole)	Xylene	Reflux	1 hour 45 min	0.2154 gm	26%
0.3234 gm (2.96 m mole)	0.2016 gm (1.24 m mole)	Xylene	Reflux	1 hour 45 min	0.1668 gm	50%
0.3095 gm (2.9 m mole)	0.3469 gm (2.17 m mole)	Diglyme	80°C	60 hours	0.063 gm	10%
0.5183 gm (4.8 m mole)	0.3522 gm (2.2 m mole)	Diglyme	80°C	60 hours	0.122 gm	20%

Transformation of the compound (LXVIII) to compound (LXIX) by column hydrolysis:

Compound (LXVIII) 0.080 gm was dispersed over a column of alumina containing 15% water (30 gm alumina, length of the column six inches) in benzene and left unmoved for 50 hours, then eluted with benzene. Benzene removed from a steam bath and the last trace of benzene in vacuum (1 mm). Nearly complete transformation was observed in the TLC (Rf 0.26).

Product was colourless mobile liquid b.p. 120°-25° (bath)/ 1 mm Yield 0.044 gm (90%).

After distilation of the hydrolysis product very small residue was left in the bulb which distilled as a yellow viscous liquid b.p. 176°-78° (bath)/1.2 mm (LXX).

I.R ν_{max}^{NaCl} 1740 cm^{-1} $(-\overset{O}{\overset{\|}{C}}-OCH_3)$

(Fig. 3)

N.M.R. (60 Mz) δ 2.47 (singlet, 3H), $-CH_3$; δ 3.47 (singlet, 2H), $-CH_2$, δ 3.61 (singlet, 3H), $-OCH_3$; δ 6.98 (doublet, J = 8Hz, 1H); δ 8.27 (doublet J = 2Hz, 1H) and δ 7.43 (quartet, J = 8Hz, 2Hz, 1H).

(Fig. 4)

Mass spectrum: Peaks at m/e 59, 77, 106, 119, 134 165 (M^+)

(Fig. 6)

Found C, 65.32; H, 6.32; N, 8.54 %

Analysis calculated for $C_9H_{11}O_2N$ (LXIX) C, 65.44; H, 6.71; N, 8.48 %

I.R $\nu_{max}^{CHCl_3}$ 1680 cm^{-1} $(-\overset{O}{\overset{\|}{C}}-C_6H_5)$

(Fig. 5)

2.6 Lutidine-1-oxide (LVI)

2,6-lutidine-1-oxide was prepared by same method as 2-picoline-1-oxide using hydrogen peroxide and glacial acetic acid described above.

2,6-lutidine 10.78 gm (0.1 m mole) gave 7.5 gm (70%) Colourless oil b.p. 125°-28°/15 mm (literature b.p. 125°-127°/15 mm)

Reaction between 2,6-lutidine-1-oxide and phenyl methyl propiolate in dimethyl formamide: Formation of the compound (LXXI).

(1) 2,6-lutidine-1-oxide 0.2706 gm (2.2 m mole) and phenyl methyl propiolate 0.3595 gm (2.24 m mole) in 5 ml dry dimethyl formamide was heated at 80°-82° for 60 hours in nitrogen atmosphere. Working up as in (LXVIII) gave the product (LXXI) light pink gum.

Basic fraction 0.0197 gm (3.1%)

b.p. 160° (bath)/0.6 mm.

(ii) The reaction was repeated with 2,6-lutidine-1-oxide 0.5489 gm (4.4 m mole) and phenyl methyl propiolate 0.3218 gm (2.01 m mole) using dimethyl formamide gave the product (LXXI) 0.0790 gm (6.8%).

I.R. ν_{max}^{NaCl} 1740 cm^{-1} ($-\overset{O}{\overset{\|}{C}}-OCH_3$), 1680 cm^{-1}($-\overset{O}{\overset{\|}{C}}-C_6H_5$)

(Fig. 7)

N.M.R (100 MHz) δ 2.47 (singlet, 3H), $-CH_3$; δ 2.61 (singlet, 3H), $-CH_3$; δ 3.75 (singlet, 3H), $-OCH_3$;
δ 5.74 (singlet, 1H), $H-C\begin{matrix}-C=O\\ COOCH_3\end{matrix}$;
δ 6.85-79 (multiplet, 7H, aromatic)

(Fig. 8)

The above experiment was repeated in different solvents using different molar proportion of the reactants. The results obtained are tabulated below (Table 7):

Table 7

Amount of 2,6 lutidine-1-oxide	Amount of phenyl methyl propiolate	Solvent	Temperature	Time	Yield	Percentage
0.6706 gm (5.4 m mole)	0.7780 gm (4.8 m mole)	Benzene	Reflux	60 hours	0.028 gm	4.4%
0.6607 gm (5.4 m mole)	0.3891 gm (2.43 m mole)	Benzene	Reflux	60 hours	0.0562	9%
0.5479 gm (4.4 m mole)	0.6440 gm (4.02 m mole)	Toluene	Reflux	13 hours	0.0396 gm	3.4%
0.6359 gm (5.17 m mole)	0.3657 gm (2.29 m mole)	Toluene	Reflux	13 hours	0.0493 gm	7.6%
0.5423 gm (4.4 m mole)	0.7191 gm (4.4 m mole)	Xylene	Reflux	1 hour 45 min	0.0394	6%
0.5128 gm (4.16 m mole)	0.280 gm (1.74 m mole)	Xylene	Reflux	1 hour 45 min	0.0590 gm	12%

Transformation of the compound (LXXI) to compound (LXXII) by column hydrolysis:

Compound (LXXI) 0.07 gm was dispersed over a column of alumina containing 15% water (30 gm alumina, length of the column six inches) in benzene and left unmoved for 72 hours then eluted with benzene. Benzene removed from a water bath and then in high vacuum pump. The product is yellow oil

b.p. 140°-48° (bath)/1.0 gm mm

yield 0.037 gm (84%)

I.R ν_{max}^{NaCl} 1730 cm^{-1} $(-\overset{O}{\overset{\|}{C}}-OCH_3)$

(Fig. 9)

Found	C, 66.96;	H, 7.23;	N, 7.74
Analysis calculated for $C_{10}H_{13}O_2N$ (LXXII)	C, 67.02;	H, 7.31;	N, 7.82

After distillation of the hydrolysis product very small residue was left in the bulb which distilled as a yellow viscous liquid b.p 180°-81° (bath)/1 mm (LXXIII)

I.R. ν_{max}^{NaCl} 1690 cm^{-1} $(-\overset{O}{\overset{\|}{C}}-C_6H_5)$

(Fig. 10)

2,4,6 Collidine-1-oxide (LVII)

2,4,6-Collidine-1-oxide was prepared by same method as 2-picoline-1-oxide using hydrogen peroxide and glacial acetic acid described above. 2,4,6-Collidine 12 gm (0.1 mole) gave 4.9 gm (40%) 2,4,6-Collidine-1-oxide, b.p. 145°-46°/15 mm (lit. 145°-146°/15 mm).

Reaction between 2,4,6-Collidine-1-oxide (LVII) and phenyl methyl propiolate (LVIII) in Dimethyl formamide:

Formation of compound (LXXIV)

(i) 2,4,6-Collidine-1-oxide 0.773 gm (5.7 m mole) and phenyl methyl propiolate 0.6796 g (4.2 m mole) in 5 ml dry dimethyl formamide was heated at 80°-82° for 60 hours in nitrogen atmosphere. Working up as in (LXVIII) gave the product (LXXIV) deep yellow viscous liquid.

Basic fraction 0.0486 gm (3.8%)
b.p. 178°-79° (bath)/0.6 mm.

(ii) The reaction was repeated with 2,4,6-Collidine-1-oxide 0.7361 gm (5.7 m mole) and phenyl methyl propiolate 0.3430 gm (2.1 m mole) using dimethyl formamide gave the product (LXXIV) 0.512 gm (8%).

I.R ν_{max}^{NaCl} 2800-3100 cm^{-1} (enolic -OH), 1685 cm^{-1} $(-\overset{O}{\overset{\|}{C}}-C_6H_5)$

(Fig. 11)

N.M.R (60 MHz) δ 1.9 (singlet, 3H), $-CH_3$; δ 2.18 (singlet, 3H), $-CH_3$; δ 2.38 (singlet, 3H), $-CH_3$; δ 3.7 (singlet, 3H), $-OCH_3$; δ 6.66 (singlet, -O-H); δ 7.16 (aromatic H)

(Fig. 12)

The above experiment was repeated in different solvents using different molar proportion of the reatants. The results obtained are tabulated below (Table 8):

Table 8

Amount of 2,4,6-Collidine-1-oxide	Amount of phenyl methyl propiolate	Solvents	Temperature	Time	Yield	Percentage
0.2955 gm (2.1 m mole)	0.3477 gm (2.17 m mole)	Benzene	Reflux	60 hours	0.0403 gm	6.5%
0.6110 gm (4.3 m mole)	0.3378 gm (2.17 m mole)	Benzene	Reflux	60 hours	0.064 gm	13%
0.3472 gm (2.5 m mole)	0.3757 gm (2.35 m mole)	Toluene	Reflux	13 hours	0.0597 gm	3.5%
0.6804 gm (5 m mole)	0.3596 gm (2.25 m mole)	Toluene	Reflux	13 hours	0.1132 gm	17%
0.2960 gm (2.1 m mole)	0.3468 gm (2.17 m mole)	Xylene	Reflux	1 hour 45 min	0.0835 gm	13%
0.2836 gm (2.15 m mole)	0.1275 gm (0.79 m mole)	Xylene	Reflux	1 hour 45 min	0.0643 gm	27.4%